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(54) **COMPOSITIONS AND METHODS FOR DETECTING KLEBSIELLA PNEUMONIAE**

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(58) **Field of Classification Search** None
See application file for complete search history.

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Four highly conserved genes, encoding translation elongation factor Tu, translation elongation factor G, the catalytic subunit of proton-translocating ATPase and the RecA recombinase, are used to generate species-specific, genus-specific, family-specific, group-specific and universal nucleic acid probes and amplification primers to rapidly detect and identify algal, archaeal, bacterial, fungal and parasitical pathogens from clinical specimens for diagnosis. The detection of associated antimicrobial agents resistance and toxin genes are also under the scope of the present invention.

9 Claims, 17 Drawing Sheets

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Figure 1: *atpD* sequences databases and main subsets.

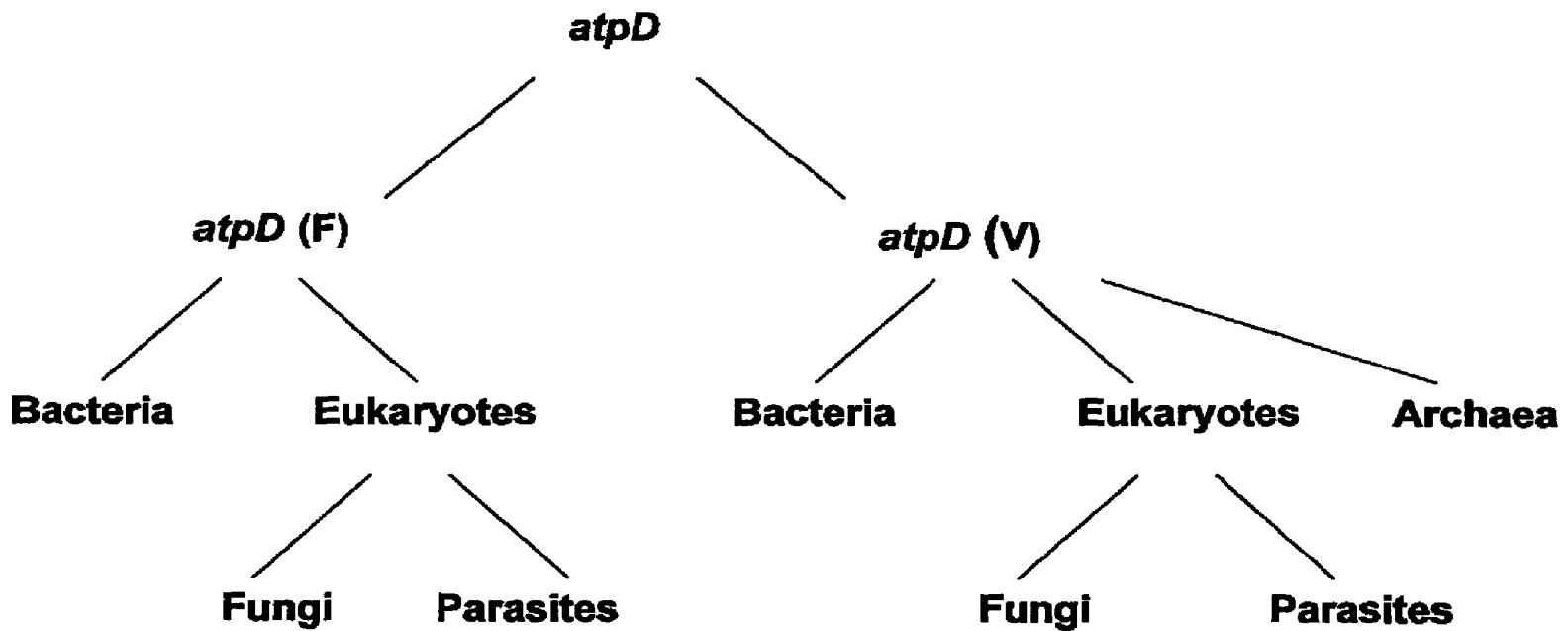


Figure 2: *tuf* sequences databases and main subsets.

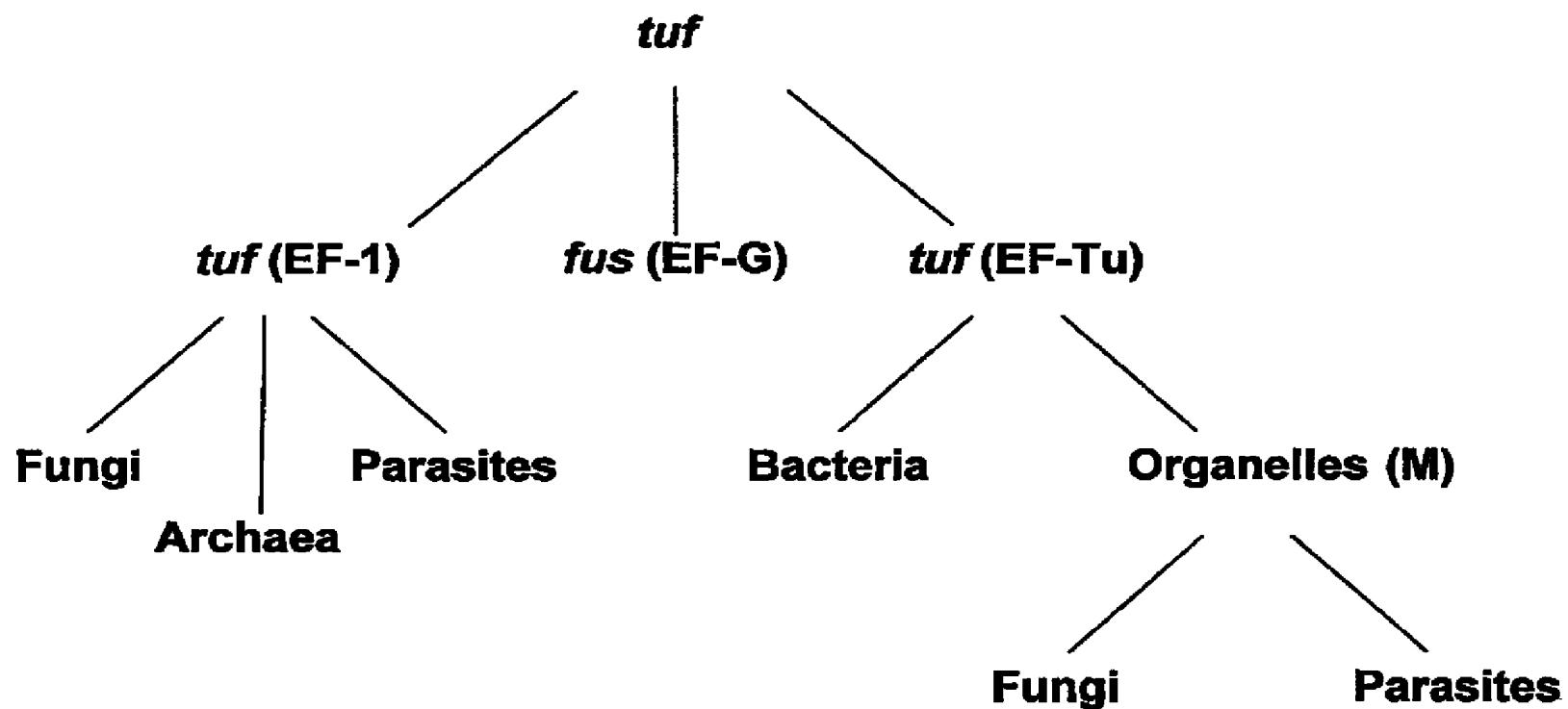
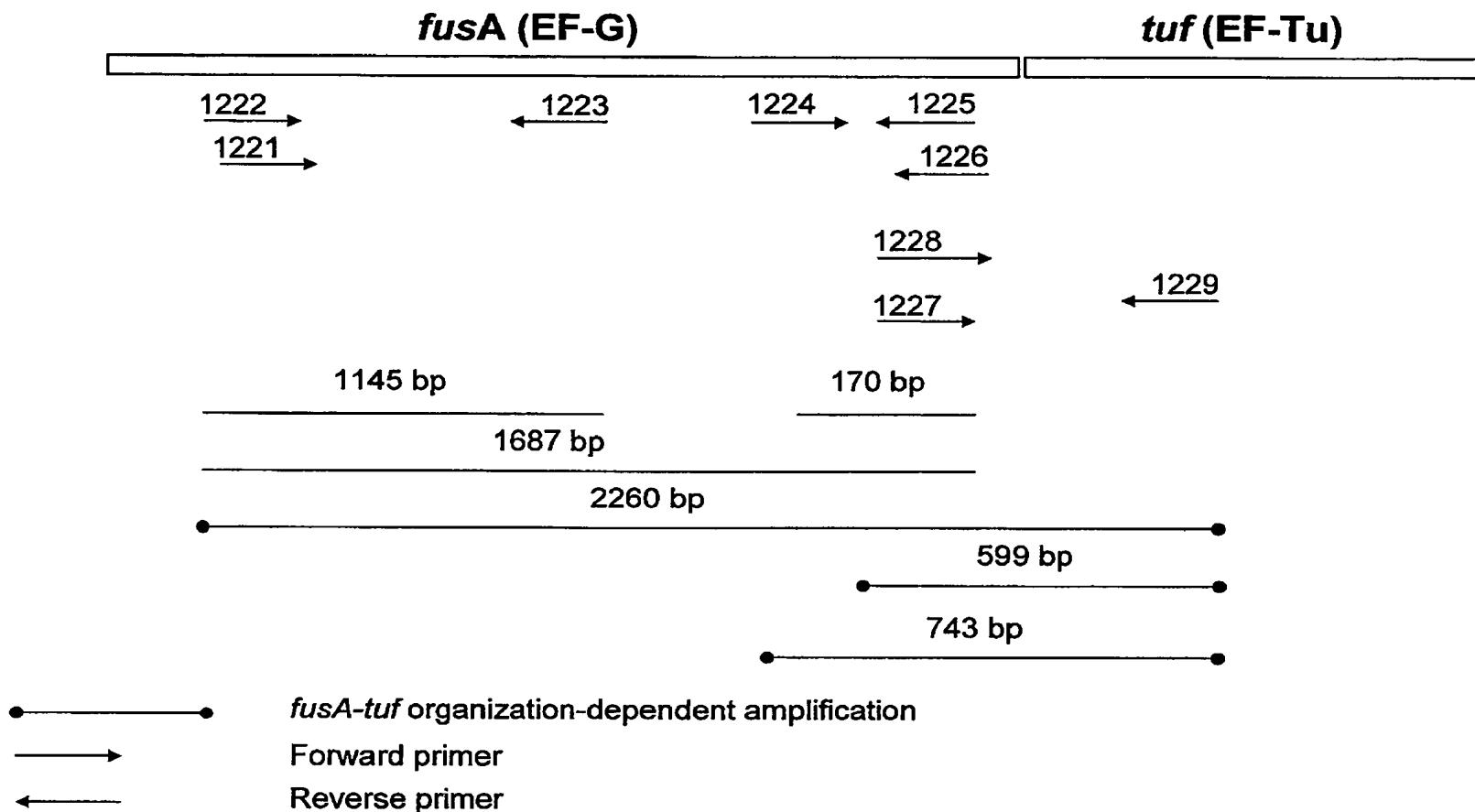
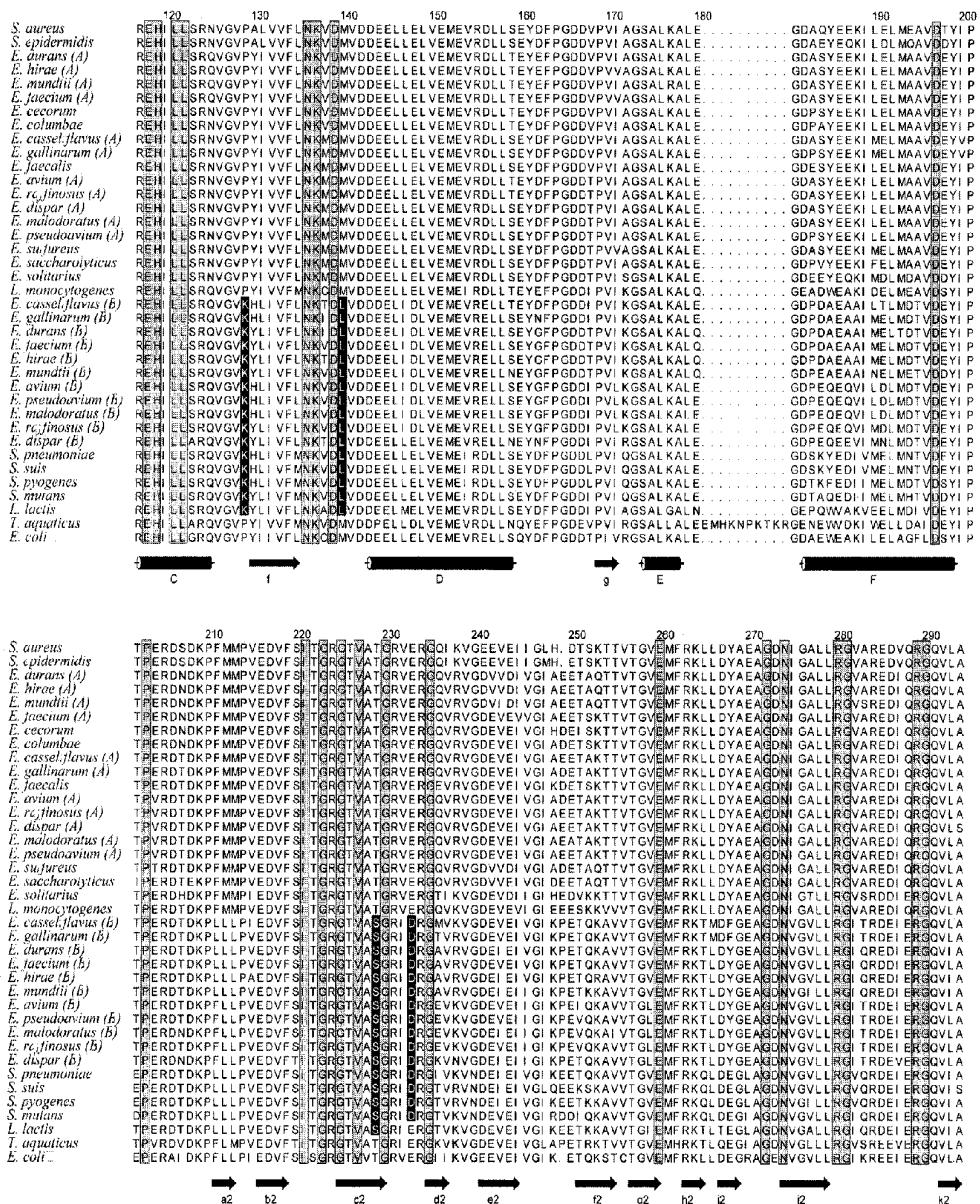


Figure 3.



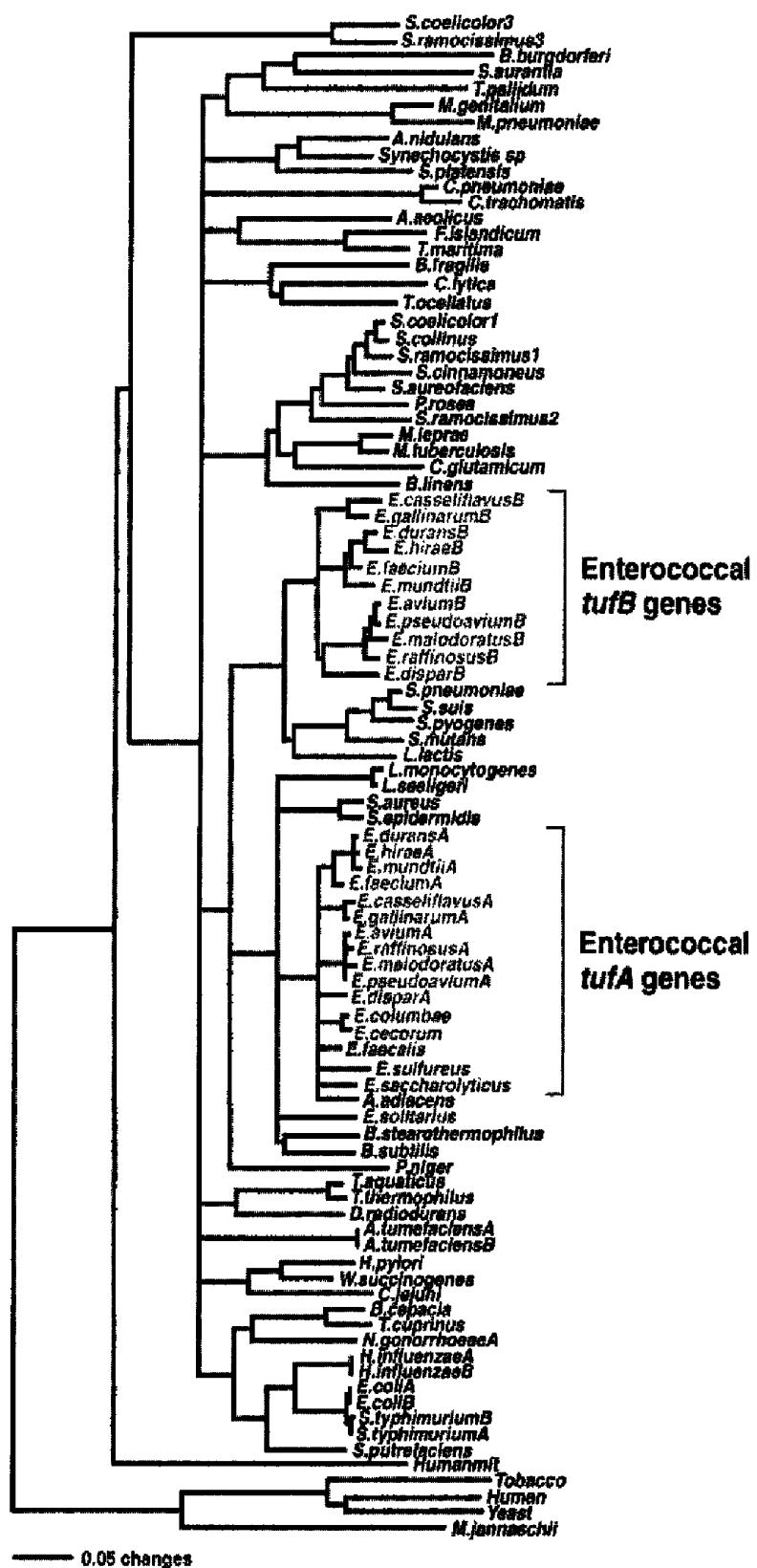


FIGURE 5.

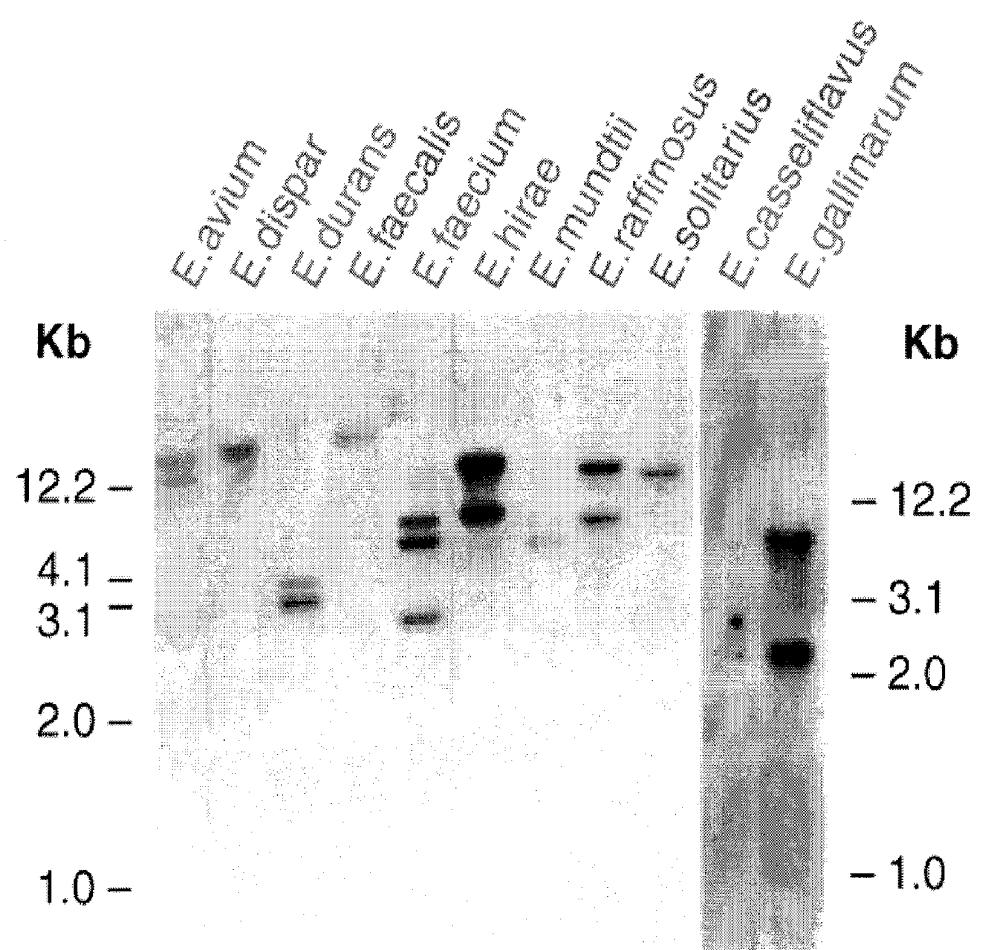
**FIGURE 6.**

FIGURE 7

	301	311	321	331	SEQ ID NO :
<i>E. coli</i>	GAGATCGGTG	AAGAAGAGCG	TTGGG.....	CGATTCAACCG	(2620)
<i>E. agglomerans</i>	GACATCGGTG	AAGAAGAGCG	TTGGG.....	CGATCCACCG	(2621)
<i>P. agglomerans</i>	GAGCTGAAAG	AAGAAGATGG	CAGCGCAGTA	GAGATCGCCT	CTATTCAACCG (2622)
<i>P. dispersa</i>	GACCTGAAAC	AACAAGACGG	CAGCGCTGTA	GAGGTTTCCT	CTATTCATCG (2623)
<i>T. ptyseos</i>	GACCTGAAGA	ACGAAGATGG	TAGCAATGTT	GAGGTGAAC	CTATTCAACCG (2624)
<i>E. coli</i>	-I~~G~~E~~	E~~E~~R~~W	~A~~.....	I~~H~~R~~	(2625)
<i>E. agglomerans</i>	-I~~G~~E~~	E~~E~~R~~W	~A~~.....	I~~H~~R~~	(2626)
<i>P. agglomerans</i>	-L~~K~~E~~	E~~D~~G~~S	~~A~~V~~E~	-I~~A~~S~~	I~~H~~R~~ (2627)
<i>P. dispersa</i>	-L~~K~~E~~	E~~D~~G~~S	~~A~~V~~E~	-V~~S~~S~~	I~~H~~R~~ (2628)
<i>T. ptyseos</i>	-L~~K~~N~~	E~~D~~G~~S	~~N~~V~~E~	-V~~N~~S~~	I~~H~~R~~ (2629)

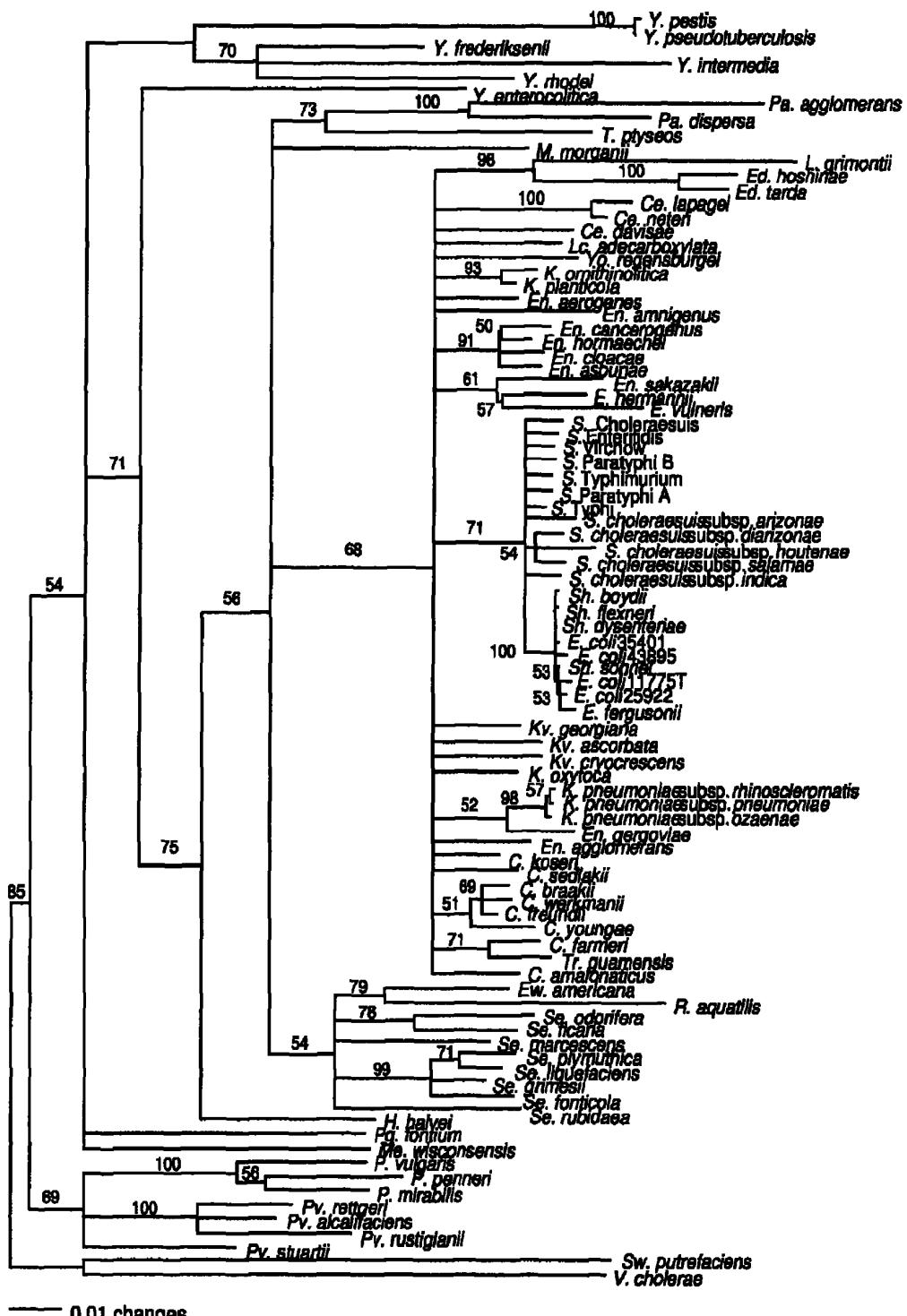


FIGURE 8 (1/2)



FIGURE 8 (2/2)

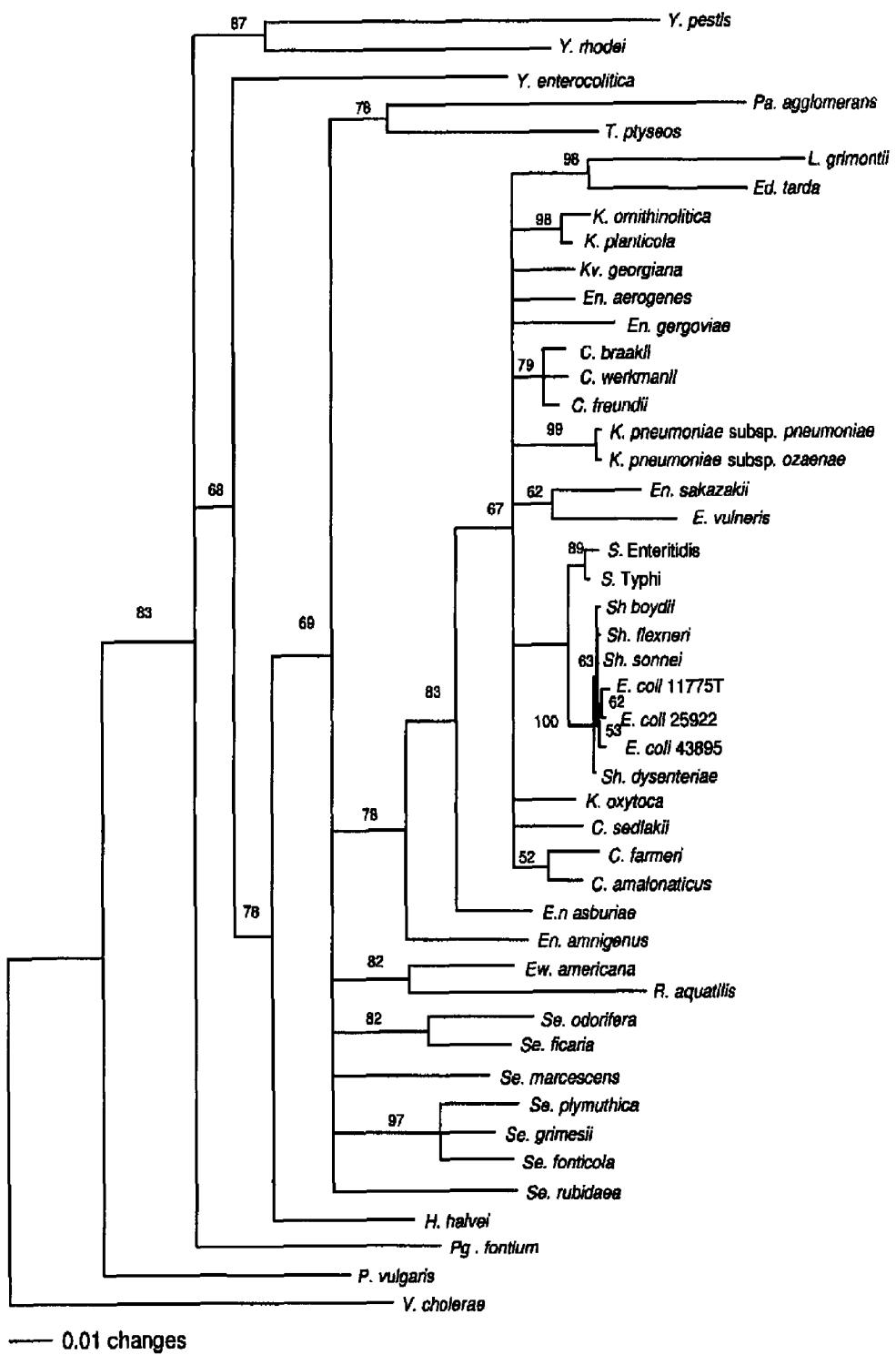


FIGURE 9 a)

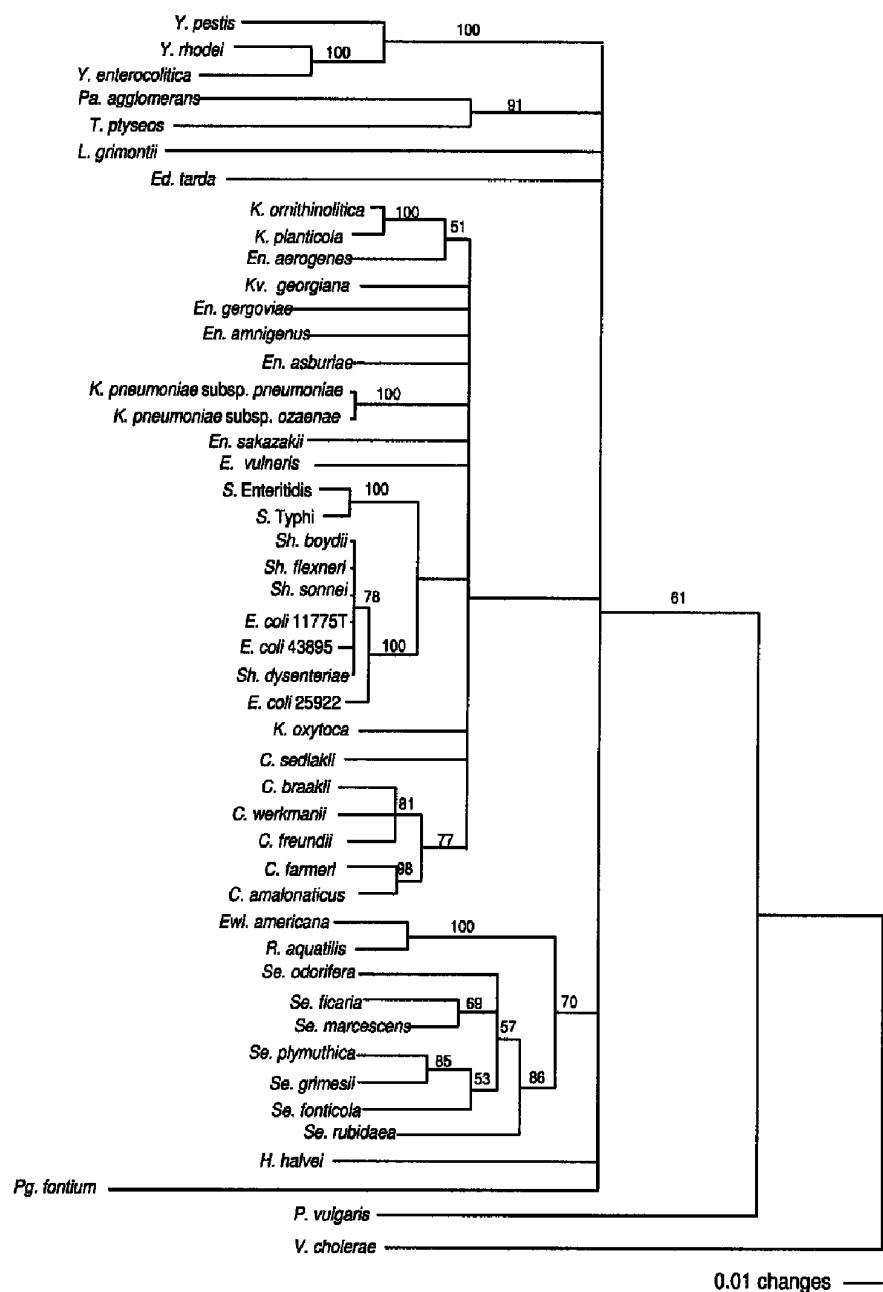


FIGURE 9 b)

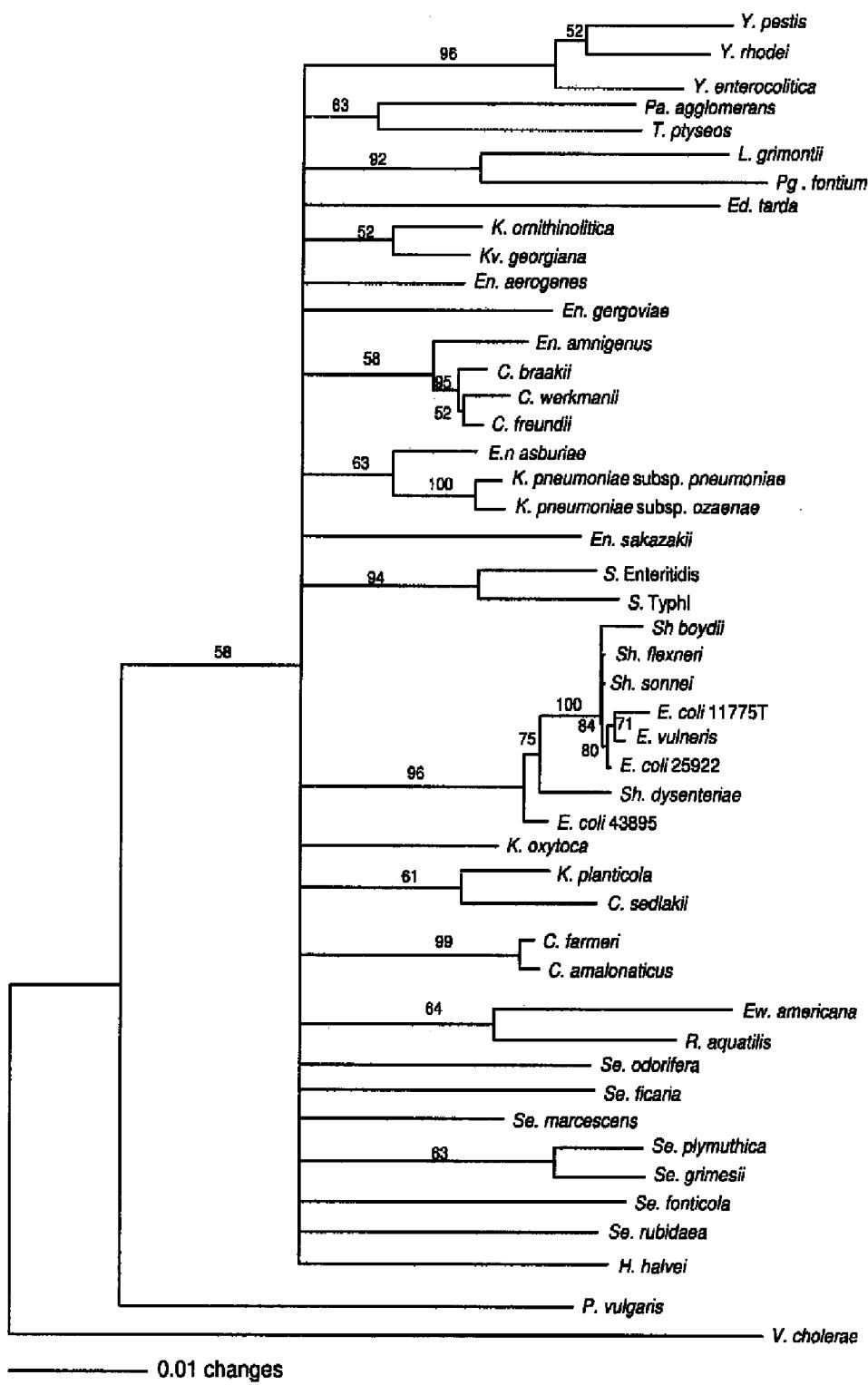


Figure 9 c)

FIGURE 10 a)

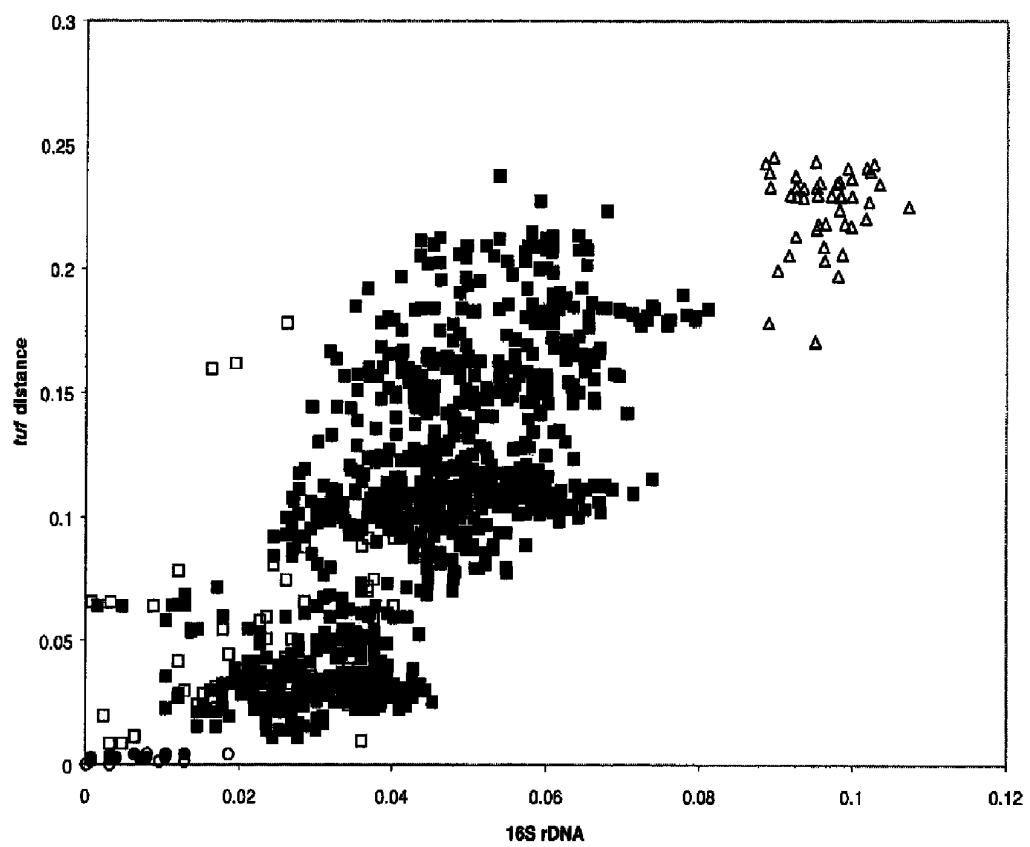


FIGURE 10 b)

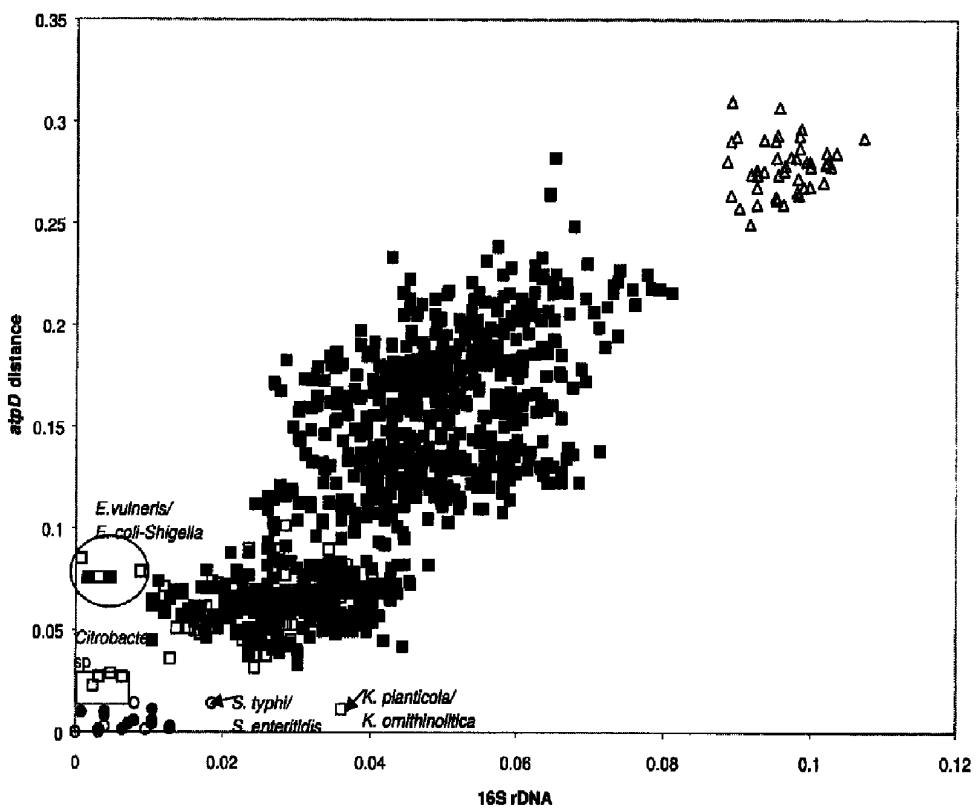


FIGURE 10 c)

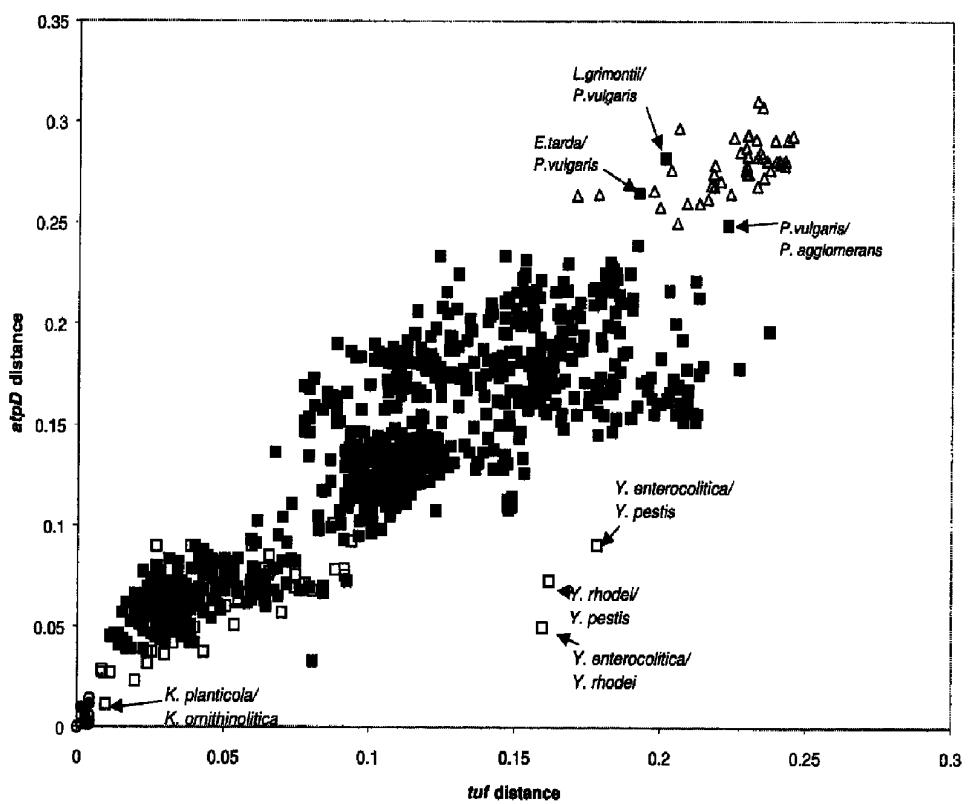
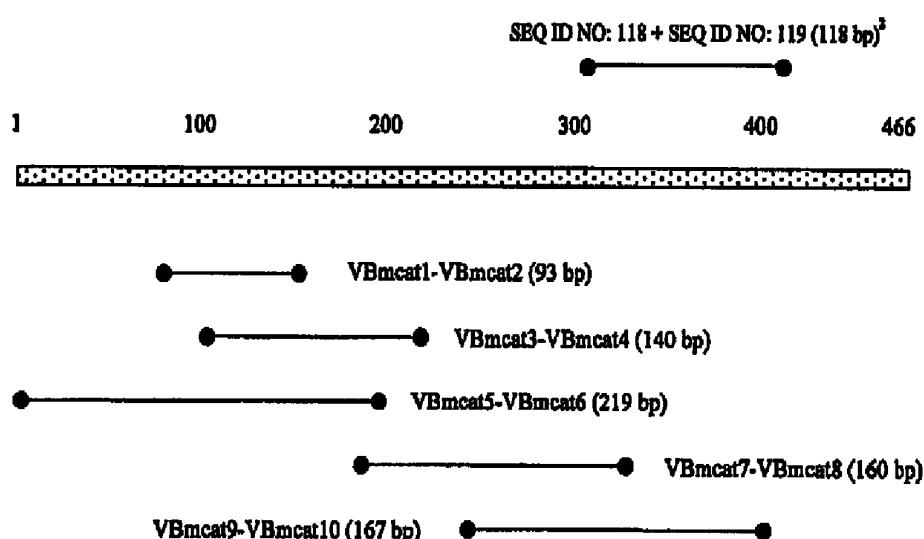


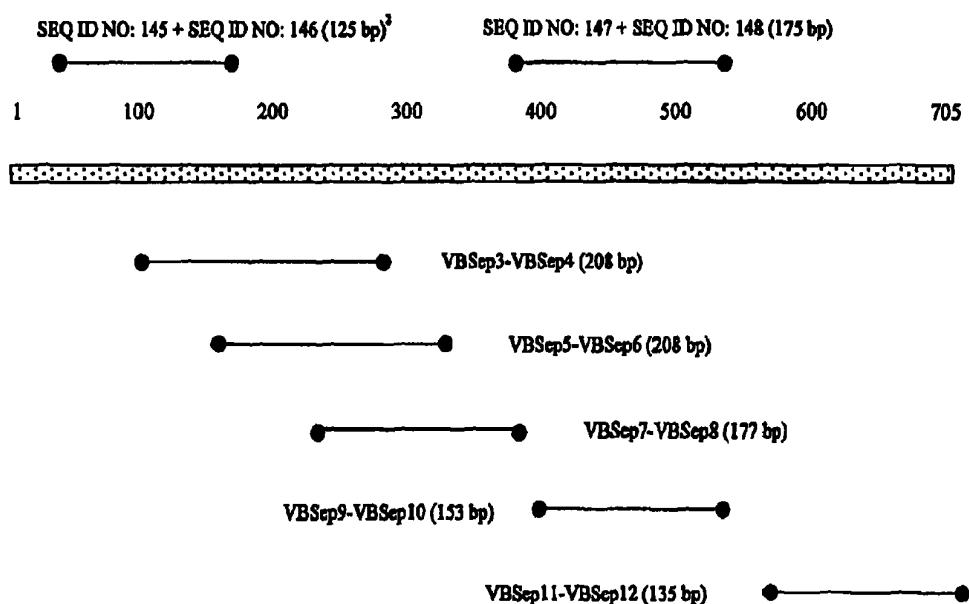
FIGURE 11: Position of the 5 new primer pairs selected from the *M. catarrhalis*-specific 466-bp DNA fragment (SEQ ID NO: 29)¹.



¹ All SEQ ID NOs. in this Figure are from US patent 6,001,564.

² Amplicon size is given in parenthesis.

FIGURE 12: Position of the 5 new primer pairs selected from the *S. epidermidis*-specific 705-bp DNA fragment (SEQ ID NO: 36)¹.



¹ All SEQ ID NOs. in this Figure are from US patent 6,001,564.

² Amplicon size is given in parenthesis.

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**COMPOSITIONS AND METHODS FOR
DETECTING *KLEBSIELLA PNEUMONIAE***

**CROSS-REFERENCE TO RELATED
APPLICATIONS**

This application is a continuation of application Ser. No. 11/236,785, filed Sep. 27, 2005, which is a continuation of application Ser. No. 10/089,177, filed Mar. 27, 2002, which is the U.S. national phase under 35 U.S.C. §371 of prior PCT International Application No. PCT/CA00/01150, filed Sep. 28, 2000, which claims the benefit of Canadian Application No. 2,307,010 filed May 19, 2000, and Canadian Application No. 2283458, filed Sep. 28, 1999.

SEQUENCE LISTING

The present application is being filed along with a Sequence Listing in electronic format. The Sequence Listing is provided as a file entitled GENOM.048NPCC2.TXT, created May 24, 2010, which is 1.99 MB in size. The information in the electronic format of the Sequence Listing is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

Classical Methods for the Identification of Microorganisms

Microorganisms are classically identified by their ability to utilize different substrates as a source of carbon and nitrogen through the use of biochemical tests such as the API20E™ system (bioMérieux). For susceptibility testing, clinical microbiology laboratories use methods including disk diffusion, agar dilution and broth microdilution. Although identifications based on biochemical tests and antibacterial susceptibility tests are cost-effective, generally two days are required to obtain preliminary results due to the necessity of two successive overnight incubations to identify the bacteria from clinical specimens as well as to determine their susceptibility to antimicrobial agents. There are some commercially available automated systems (i.e. the MicroScan™ system from Dade Behring and the Vitek™ system from bioMérieux) which use sophisticated and expensive apparatus for faster microbial identification and susceptibility testing (Stager and Davis, 1992, Clin. Microbiol. Rev. 5:302-327). These systems require shorter incubation periods, thereby allowing most bacterial identifications and susceptibility testing to be performed in less than 6 hours. Nevertheless, these faster systems always require the primary isolation of the bacteria or fungi as a pure culture, a process which takes at least 18 hours for a pure culture or 2 days for a mixed culture. So, the shortest time from sample reception to identification of the pathogen is around 24 hours. Moreover, fungi other than yeasts are often difficult or very slow to grow from clinical specimens. Identification must rely on labor-intensive techniques such as direct microscopic examination of the specimens and by direct and/or indirect immunological assays. Cultivation of most parasites is impractical in the clinical laboratory. Hence, microscopic examination of the specimen, a few immunological tests and clinical symptoms are often the only methods used for an identification that frequently remains presumptive.

The fastest bacterial identification system, the autoSCAN-Walk-Away™ system (Dade Behring) identifies both gram-negative and gram-positive bacterial species from standardized inoculum in as little as 2 hours and gives susceptibility patterns to most antibiotics in 5 to 6 hours. However, this system has a particularly high percentage (i.e. 3.3 to 40.5%)

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of non-conclusive identifications with bacterial species other than Enterobacteriaceae (Croizé J., 1995, Lett. Infectiol. 10:109-113; York et al., 1992, J. Clin. Microbiol. 30:2903-2910). For Enterobacteriaceae, the percentage of non-conclusive identifications was 2.7 to 11.4%. The list of microorganisms identified by commercial systems based on classical identification methods is given in Table 15.

A wide variety of bacteria and fungi are routinely isolated and identified from clinical specimens in microbiology laboratories. Tables 1 and 2 give the incidence for the most commonly isolated bacterial and fungal pathogens from various types of clinical specimens. These pathogens are the main organisms associated with nosocomial and community-acquired human infections and are therefore considered the most clinically important.

Clinical Specimens Tested in Clinical Microbiology Laboratories

Most clinical specimens received in clinical microbiology laboratories are urine and blood samples. At the microbiology laboratory of the Centre Hospitalier de l'Université Laval (CHUL), urine and blood account for approximately 55% and 30% of the specimens received, respectively (Table 3). The remaining 15% of clinical specimens comprise various biological fluids including sputum, pus, cerebrospinal fluid, synovial fluid, and others (Table 3). Infections of the urinary tract, the respiratory tract and the bloodstream are usually of bacterial etiology and require antimicrobial therapy. In fact, all clinical samples received in the clinical microbiology laboratory are tested routinely for the identification of bacteria and antibiotic susceptibility.

Conventional Pathogen Identification from Clinical Specimens

Urine Specimens

The search for pathogens in urine specimens is so preponderant in the routine microbiology laboratory that a myriad of tests have been developed. However, the gold standard remains the classical semi-quantitative plate culture method in which 1 µL of urine is streaked on agar plates and incubated for 18-24 hours. Colonies are then counted to determine the total number of colony forming units (CFU) per liter of urine. A bacterial urinary tract infection (UTI) is normally associated with a bacterial count of 10^7 CFU/L or more in urine. However, infections with less than 10^7 CFU/L in urine are possible, particularly in patients with a high incidence of diseases or those catheterized (Stark and Maki, 1984, N. Engl. J. Med. 311:560-564). Importantly, approximately 80% of urine specimens tested in clinical microbiology laboratories are considered negative (i.e. bacterial count of less than 10^7 CFU/L; Table 3). Urine specimens found positive by culture are further characterized using standard biochemical tests to identify the bacterial pathogen and are also tested for susceptibility to antibiotics. The biochemical and susceptibility testing normally require 18-24 hours of incubation.

Accurate and rapid urine screening methods for bacterial pathogens would allow a faster identification of negative specimens and a more efficient treatment and care management of patients. Several rapid identification methods (Uriscreen™, UTIscreen™, Flash Track™ DNA probes and others) have been compared to slower standard biochemical methods, which are based on culture of the bacterial pathogens. Although much faster, these rapid tests showed low sensitivities and poor specificities as well as a high number of false negative and false positive results (Koenig et al., 1992, J. Clin. Microbiol. 30:342-345; Pezzlo et al., 1992, J. Clin. Microbiol. 30:640-684).

Blood Specimens

The Blood Specimens Received In The Microbiology Laboratory Are Always Submitted For Culture. Blood Culture Systems May Be Manual, Semi-Automated Or Completely Automated. The BACTECTTM System (From Becton Dickinson) And The BactalertTM System (From Organon Teknika Corporation) Are The Two Most Widely Used Automated Blood Culture Systems. These Systems Incubate Blood Culture Bottles Under Optimal Conditions For Growth Of Most Bacteria. Bacterial Growth Is Monitored Continuously To Detect Early Positives By Using Highly Sensitive Bacterial Growth Detectors. Once Growth Is Detected, A Gram Stain Is Performed Directly From The Blood Culture And Then Used To Inoculate Nutrient Agar Plates. Subsequently, Bacterial Identification And Susceptibility Testing Are Carried Out From Isolated Bacterial Colonies With Automated Systems As Described Previously. Blood Culture Bottles Are Normally Reported As Negative If No Growth Is Detected After An Incubation Of 6 To 7 Days. Normally, The Vast Majority Of Blood Cultures Are Reported Negative. For Example, The Percentage Of Negative Blood Cultures At The Microbiology Laboratory Of The CHUL For The Period February 1994-January 1995 Was 93.1% (Table 3).

Other Clinical Samples

Upon receipt by the clinical microbiology laboratory, all body fluids other than blood and urine that are from normally sterile sites (i.e. cerebrospinal, synovial, pleural, pericardial and others) are processed for direct microscopic examination and subsequent culture. Again, most clinical samples are negative for culture (Table 3). In all these normally sterile sites, tests for the universal detection of algae, archaea, bacteria, fungi and parasites would be very useful.

Regarding clinical specimens which are not from sterile sites such as sputum or stool specimens, the laboratory diagnosis by culture is more problematic because of the contamination by the normal flora. The bacterial or fungal pathogens potentially associated with the infection are grown and separated from the colonizing microbes using selective methods and then identified as described previously. Of course, the DNA-based universal detection of bacteria would not be useful for the diagnosis of bacterial infections at these non-sterile sites. On the other hand, DNA-based assays for species or genus or family or group detection and identification as well as for the detection of antimicrobial agents resistance genes from these specimens would be very useful and would offer several advantages over classical identification and susceptibility testing methods.

DNA-Based Assays with Any Specimen

There is an obvious need for rapid and accurate diagnostic tests for the detection and identification of algae, archaea, bacteria, fungi and parasites directly from clinical specimens. DNA-based technologies are rapid and accurate and offer a great potential to improve the diagnosis of infectious diseases (Persing et al., 1993, Diagnostic Molecular Microbiology: Principles and Applications, American Society for Microbiology, Washington, D.C.; Bergeron and Ouellette, 1995, Infection 23:69-72; Bergeron and Ouellette, 1998, J Clin Microbiol. 36:2169-72). The DNA probes and amplification primers which are objects of the present invention are applicable for the detection and identification of algae, archaea, bacteria, fungi, and parasites directly from any clinical specimen such as blood, urine, sputum, cerebrospinal fluid, pus, genital and gastro-intestinal tracts, skin or any other type of specimens (Table 3). These assays are also applicable to detection from microbial cultures (e.g. blood cultures, bacterial or fungal colonies on nutrient agar, or liquid cell cultures in nutrient broth). The DNA-based tests proposed in this

invention are superior in terms of both rapidity and accuracy to standard biochemical methods currently used for routine diagnosis from any clinical specimens in microbiology laboratories. Since these tests can be performed in one hour or less, they provide the clinician with new diagnostic tools which should contribute to a better management of patients with infectious diseases. Specimens from sources other than humans (e.g. other primates, birds, plants, mammals, farm animals, livestock, food products, environment such as water or soil, and others) may also be tested with these assays.

A High Percentage of Culture-Negative Specimens

Among all the clinical specimens received for routine diagnosis, approximately 80% of urine specimens and even more (around 95%) for other types of normally sterile clinical specimens are negative for the presence of bacterial pathogens (Table 3). It would also be desirable, in addition to identify bacteria at the species or genus or family or group level in a given specimen, to screen out the high proportion of negative clinical specimens with a DNA-based test detecting the presence of any bacterium (i.e. universal bacterial detection). As disclosed in the present invention, such a screening test may be based on DNA amplification by PCR of a highly conserved genetic target found in all bacteria. Specimens negative for bacteria would not be amplified by this assay. On the other hand, those that are positive for any bacterium would give a positive amplification signal. Similarly, highly conserved genes of fungi and parasites could serve not only to identify particular species or genus or family or group but also to detect the presence of any fungi or parasite in the specimen.

Towards the Development of Rapid DNA-Based Diagnostic Tests

A rapid diagnostic test should have a significant impact on the management of infections. DNA probe and DNA amplification technologies offer several advantages over conventional methods for the identification of pathogens and antimicrobial agents resistance genes from clinical samples (Persing et al., 1993, Diagnostic Molecular Microbiology: Principles and Applications, American Society for Microbiology, Washington, D.C.; Ehrlich and Greenberg, 1994, PCR-based Diagnostics in Infectious Disease, Blackwell Scientific Publications, Boston, Mass.). There is no need for culture of the pathogens, hence the organisms can be detected directly from clinical samples, thereby reducing the time associated with the isolation and identification of pathogens. Furthermore, DNA-based assays are more accurate for microbial identification than currently used phenotypic identification systems which are based on biochemical tests and/or microscopic examination. Commercially available DNA-based technologies are currently used in clinical microbiology laboratories, mainly for the detection and identification of fastidious bacterial pathogens such as *Mycobacterium tuberculosis*, *Chlamydia trachomatis*, *Neisseria gonorrhoeae* as well as for the detection of a variety of viruses (Tang Y. and Persing D. H., Molecular detection and identification of microorganisms, In: P. Murray et al., 1999, Manual of Clinical Microbiology, ASM press, 7th edition, Washington D.C.). There are also other commercially available DNA-based assays which are used for culture confirmation assays.

Others have developed DNA-based tests for the detection and identification of bacterial pathogens which are objects of the present invention, for example: *Staphylococcus* sp. (U.S. Pat. No. 5,437,978), *Neisseria* sp. (U.S. Pat. No. 5,162,199 and European patent serial no. 0,337,896,131) and *Listeria monocytogenes* (U.S. Pat. Nos. 5,389,513 and 5,089,386). However, the diagnostic tests described in these patents are based either on rRNA genes or on genetic targets different from those described in the present invention. To our knowl-

edge there are only four patents published by others mentioning the use of any of the four highly conserved gene targets described in the present invention for diagnostic purposes (PCT international publication number WO92/03455 and WO00/14274, European patent publication number 0 133 671 B1, and European patent publication number 0 133 288 A2). WO92/03455 is focused on the inhibition of *Candida* species for therapeutic purposes. It describes antisense oligonucleotide probes hybridizing to *Candida* messenger RNA. Two of the numerous mRNA proposed as targets are coding for translation elongation factor 1 (tef1) and the beta subunit of ATPase. DNA amplification or hybridization are not under the scope of their invention and although diagnostic use is briefly mentioned in the body of the application, no specific claim is made regarding diagnostics. WO00/14274 describes the use of bacterial recA gene for identification and speciation of bacteria of the *Burkholderia cepacia* complex. Specific claims are made on a method for obtaining nucleotide sequence information for the recA gene from the target bacteria and a following comparison with a standard library of nucleotide sequence information (claim 1), and on the use of PCR for amplification of the recA gene in a sample of interest (claims 4 to 7, and 13). However, the use of a discriminatory restriction enzyme in a RFLP procedure is essential to fulfill the speciation and WO00/14274 did not mention that multiple recA probes could be used simultaneously. Patent EP 0 133 288 A2 describes and claims the use of bacterial tuf (and fus) sequence for diagnostics based on hybridization of a tuf (or fus) probe with bacterial DNA. DNA amplification is not under the scope of EP 0 133 288 A2. Nowhere it is mentioned that multiple tuf (or fus) probes could be used simultaneously. No mention is made regarding speciation using tuf (or fus) DNA nucleic acids and/or sequences. The sensitivities of the tuf hybridizations reported are 1×10^6 bacteria or 1-100 ng of DNA. This is much less sensitive than what is achieved by our assays using nucleic acid amplification technologies.

Although there are phenotypic identification methods which have been used for more than 125 years in clinical microbiology laboratories, these methods do not provide information fast enough to be useful in the initial management of patients. There is a need to increase the speed of the diagnosis of commonly encountered bacterial, fungal and parasitical infections. Besides being much faster, DNA-based diagnostic tests are more accurate than standard biochemical tests presently used for diagnosis because the microbial genotype (e.g. DNA level) is more stable than the phenotype (e.g. physiologic level).

Bacteria, fungi and parasites encompass numerous well-known microbial pathogens. Other microorganisms could also be pathogens or associated with human diseases. For example, achlorophylous algae of the *Prototheca* genus can infect humans. Archaea, especially methanogens, are present in the gut flora of humans (Reeve, J. H., 1999, J. Bacteriol. 181:3613-3617). However, methanogens have been associated to pathologic manifestations in the colon, vagina, and mouth (Belay et al., 1988, Appl. Environ. Microbiol. 54:600-603; Belay et al., 1990, J. Clin. Microbiol. 28:1666-1668; Weaver et al., 1986, Gut 27:698-704).

In addition to the identification of the infectious agent, it is often desirable to identify harmful toxins and/or to monitor the sensitivity of the microorganism to antimicrobial agents. As revealed in this invention, genetic identification of the microorganism could be performed simultaneously with toxin and antimicrobial agents resistance genes.

Knowledge of the genomic sequences of algal, archaeal, bacterial, fungal and parasitical species continuously increases as testified by the number of sequences available

from public databases such as GenBank. From the sequences readily available from those public databases, there is no indication therefrom as to their potential for diagnostic purposes. For determining good candidates for diagnostic purposes, one could select sequences for DNA-based assays for (i) the species-specific detection and identification of commonly encountered bacterial, fungal and parasitical pathogens, (ii) the genus-specific detection and identification of commonly encountered bacterial, fungal or parasitical pathogens, (iii) the family-specific detection and identification of commonly encountered bacterial, fungal or parasitical pathogens, (iv) the group-specific detection and identification of commonly encountered bacterial, fungal or parasitical pathogens, (v) the universal detection of algal, archaeal, bacterial, fungal or parasitical pathogens, and/or (vi) the specific detection and identification of antimicrobial agents resistance genes, and/or (vii) the specific detection and identification of bacterial toxin genes. All of the above types of DNA-based assays may be performed directly from any type of clinical specimens or from a microbial culture.

In our assigned U.S. Pat. No. 6,001,564 and our WO98/20157 patent publication, we described DNA sequences suitable for (i) the species-specific detection and identification of clinically important bacterial pathogens, (ii) the universal detection of bacteria, and (iii) the detection of antimicrobial agents resistance genes.

The WO98/20157 patent publication describes proprietary tuf DNA sequences as well as tuf sequences selected from public databases (in both cases, fragments of at least 100 base pairs), as well as oligonucleotide probes and amplification primers derived from these sequences. All the nucleic acid sequences described in that patent publication can enter in the composition of diagnostic kits or products and methods capable of a) detecting the presence of bacteria and fungi b) detecting specifically at the species, genus, family or group levels, the presence of bacteria and fungi and antimicrobial agents resistance genes associated with these pathogens. However, these methods and kits need to be improved, since the ideal kit and method should be capable of diagnosing close to 100% of microbial pathogens and associated antimicrobial agents resistance genes and toxins genes. For example, infections caused by *Enterococcus faecium* have become a clinical problem because of its resistance to many antibiotics. Both the detection of these bacteria and the evaluation of their resistance profiles are desirable. Besides that, novel DNA sequences (probes and primers) capable of recognizing the same and other microbial pathogens or the same and additional antimicrobial agents resistance genes are also desirable to aim at detecting more target genes and complement our earlier patent applications.

The present invention improves the assigned application by disclosing new proprietary tuf nucleic acids and/or sequences as well as describing new ways to obtain tuf nucleic acids and/or sequences. In addition we disclose new proprietary atpD and recA nucleic acids and/or sequences. In addition, new uses of tuf, atpD and recA DNA nucleic acids and/or sequences selected from public databases (Table 11) are disclosed.

Highly Conserved Genes for Identification and Diagnostics

Highly conserved genes are useful for identification of microorganisms. For bacteria, the most studied genes for identification of microorganisms are the universally conserved ribosomal RNA genes (rRNA). Among those, the principal targets used for identification purposes are the small subunit (SSU) ribosomal 16S rRNA genes (in prokaryotes) and 18S rRNA genes (in eukaryotes) (Relman and Persing, Genotyping Methods for Microbial Identification, In: D. H.

Persing, 1996, PCR Protocols for Emerging Infectious Diseases, ASM Press, Washington D.C.). The rRNA genes are also the most commonly used targets for universal detection of bacteria (Chen et al., 1988, FEMS Microbiol. Lett. 57:19-24; McCabe et al., 1999, Mol. Genet. Metabol. 66:205-211) and fungi (Van Burik et al., 1998, J. Clin. Microbiol. 36:1169-1175).

However, it may be difficult to discriminate between closely related species when using primers derived from the 16S rRNA. In some instances, 16S rRNA sequence identity may not be sufficient to guarantee species identity (Fox et al., 1992, Int. J. Syst. Bacteriol. 42:166-170) and it has been shown that inter-operon sequence variation as well as strain to strain variation could undermine the application of 16S rRNA for identification purposes (Clayton et al., 1995, Int. J. Syst. Bacteriol. 45:595-599). The heat shock proteins (HSP) are another family of very conserved proteins. These ubiquitous proteins in bacteria and eukaryotes are expressed in answer to external stress agents. One of the most described of these HSP is HSP 60. This protein is very conserved at the amino acid level, hence it has been useful for phylogenetic studies. Similar to 16S rRNA, it would be difficult to discriminate between species using the HSP 60 nucleotide sequences as a diagnostic tool. However, Goh et al. identified a highly conserved region flanking a variable region in HSP 60, which led to the design of universal primers amplifying this variable region (Goh et al., U.S. Pat. No. 5,708,160). The sequence variations in the resulting amplicons were found useful for the design of species-specific assays.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a specific, ubiquitous and sensitive method using probes and/or amplification primers for determining the presence and/or amount of nucleic acids:

from any algal, archaeal, bacterial, fungal or parasitical species in any sample suspected of containing said nucleic acids, and optionally,
from specific microbial species or genera selected from the group consisting of the species or genera listed in Table 4, and optionally,
from an antimicrobial agents resistance gene selected from the group consisting of the genes listed in Table 5, and optionally,
from a toxin gene selected from the group consisting of the genes listed in Table 6,
wherein each of said nucleic acids or a variant or part thereof comprises a selected target region hybridizable with said probes or primers;
said method comprising the steps of contacting said sample with said probes or primers and detecting the presence and/or amount of hybridized probes or amplified products as an indication of the presence and/or amount of said any microbial species, specific microbial species or genus or family or group and antimicrobial agents resistance gene and/or toxin gene.

In a specific embodiment, a similar method directed to each specific microbial species or genus or family or group detection and identification, antimicrobial agents resistance genes detection, toxin genes detection, and universal bacterial detection, separately, is provided.

In a more specific embodiment, the method makes use of DNA fragments from conserved genes (proprietary sequences and sequences obtained from public databases), selected for their capacity to sensitively, specifically and

ubiquitously detect the targeted algal, archaeal, bacterial, fungal or parasitical nucleic acids.

In a particularly preferred embodiment, oligonucleotides of at least 12 nucleotides in length have been derived from the longer DNA fragments, and are used in the present method as probes or amplification primers. To be a good diagnostic candidate, an oligonucleotide of at least 12 nucleotides should be capable of hybridizing with nucleic acids from given microorganism(s), and with substantially all strains and representatives of said microorganism(s); said oligonucleotide being species-, or genus-, or family-, or group-specific or universal.

In another particularly preferred embodiment, oligonucleotides primers and probes of at least 12 nucleotides in length are designed for their specificity and ubiquity based upon analysis of our databases of tuf, atpD and recA sequences. These databases are generated using both proprietary and public sequence information. Altogether, these databases form a sequence repertory useful for the design of primers and probes for the detection and identification of algal, archaeal, bacterial, fungal and parasitical microorganisms. The repertory can also be subdivided into subrepertoires for sequence analysis leading to the design of various primers and probes.

The tuf, atpD and recA sequences databases as a product to assist the design of oligonucleotides primers and probes for the detection and identification of algal, archaeal, bacterial, fungal and parasitical microorganisms are also covered.

The proprietary oligonucleotides (probes and primers) are also another object of this invention.

Diagnostic kits comprising probes or amplification primers such as those for the detection of a microbial species or genus or family or phylum or group selected from the following list consisting of *Abiotrophia adiacens*, *Acinetobacter baumanii*, *Actinomycetae*, *Bacteroides*, *Cytophaga* and *Flexibacter* phylum, *Bacteroides fragilis*, *Bordetella pertussis*, *Bordetella* sp., *Campylobacter jejuni* and *C. coli*, *Candida albicans*, *Candida dubliniensis*, *Candida glabrata*, *Candida guilliermondii*, *Candida krusei*, *Candida lusitaniae*, *Candida parapsilosis*, *Candida tropicalis*, *Candida zeylanoides*, *Candida* sp., *Chlamydia pneumoniae*, *Chlamydia trachomatis*, *Clostridium* sp., *Corynebacterium* sp., *Cryptococcus neoformans*, *Cryptococcus* sp., *Cryptosporidium parvum*, *Entamoeba* sp., Enterobacteriaceae group, *Enterococcus casseliflavus-flavescens-gallinarum* group, *Enterococcus faecalis*, *Enterococcus faecium*, *Enterococcus gallinarum*, *Enterococcus* sp., *Escherichia coli* and *Shigella* sp. group, *Gemella* sp., *Giardia* sp., *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Legionella pneumophila*, *Legionella* sp., *Leishmania* sp., Mycobacteriaceae family, *Mycoplasma pneumoniae*, *Neisseria gonorrhoeae*, platelets contaminants group (see Table 14), *Pseudomonas aeruginosa*, *Pseudomonads* group, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Staphylococcus haemolyticus*, *Staphylococcus hominis*, *Staphylococcus saprophyticus*, *Staphylococcus* sp., *Streptococcus agalactiae*, *Streptococcus pneumoniae*, *Streptococcus pyogenes*, *Streptococcus* sp., *Trypanosoma brucei*, *Trypanosoma cruzi*, *Trypanosoma* sp., Trypanosomatidae family, are also objects of the present invention.

Diagnostic kits further comprising probes or amplification primers for the detection of an antimicrobial agents resistance gene selected from the group listed in Table 5 are also objects of this invention.

Diagnostic kits further comprising probes or amplification primers for the detection of a toxin gene selected from the group listed in Table 6 are also objects of this invention.

Diagnostic kits further comprising probes or amplification primers for the detection of any other algal, archaeal, bacte-

rial, fungal or parasitical species than those specifically listed herein, comprising or not comprising those for the detection of the specific microbial species or genus or family or group listed above, and further comprising or not comprising probes and primers for the antimicrobial agents resistance genes listed in Table 5, and further comprising or not comprising probes and primers for the toxin genes listed in Table 6 are also objects of this invention.

In a preferred embodiment, such a kit allows for the separate or the simultaneous detection and identification of the above-listed microbial species or genus or family or group; or universal detection of algae, archaea, bacteria, fungi or parasites; or antimicrobial agents resistance genes; or toxin genes; or for the detection of any microorganism (algae, archaea, bacteria, fungi or parasites).

In the above methods and kits, probes and primers are not limited to nucleic acids and may include, but are not restricted to analogs of nucleotides such as: inosine, 3-nitropyrrrole nucleosides (Nichols et al., 1994, *Nature* 369:492-493), Linked Nucleic Acids (LNA) (Koskinen et al., 1998, *Tetrahedron* 54:3607-3630), and Peptide Nucleic Acids (PNA) (Egholm et al., 1993, *Nature* 365:566-568).

In the above methods and kits, amplification reactions may include but are not restricted to: a) polymerase chain reaction (PCR), b) ligase chain reaction (LCR), c) nucleic acid sequence-based amplification (NASBA), d) self-sustained sequence replication (3SR), e) strand displacement amplification (SDA), f) branched DNA signal amplification (bDNA), g) transcription-mediated amplification (TMA), h) cycling probe technology (CPT), i) nested PCR, j) multiplex PCR, k) solid phase amplification (SPA), l) nuclease dependent signal amplification (NDSA), m) rolling circle amplification technology (RCA), n) Anchored strand displacement amplification, o) Solid-phase (immobilized) rolling circle amplification.

In the above methods and kits, detection of the nucleic acids of target genes may include real-time or post-amplification technologies. These detection technologies can include, but are not limited to, fluorescence resonance energy transfer (FRET)-based methods such as adjacent hybridization to FRET probes (including probe-probe and probe-primer methods), TaqMan, Molecular Beacons, scorpions, nanoparticle probes and Sunrise (Amplifluor). Other detection methods include target genes nucleic acids detection via immunological methods, solid phase hybridization methods on filters, chips or any other solid support, whether the hybridization is monitored by fluorescence, chemiluminescence, potentiometry, mass spectrometry, plasmon resonance, polarimetry, colorimetry, or scanometry. Sequencing, including sequencing by dideoxy termination or sequencing by hybridization, e.g. sequencing using a DNA chip, is another possible method to detect and identify the nucleic acids of target genes.

In a preferred embodiment, a PCR protocol is used for nucleic acid amplification, in diagnostic method as well as in method of construction of a repertory of nucleic acids and deduced sequences.

In a particularly preferred embodiment, a PCR protocol is provided, comprising, an initial denaturation step of 1-3 minutes at 95° C., followed by an amplification cycle including a denaturation step of one second at 95° C. and an annealing step of 30 seconds at 45-65° C., without any time allowed specifically for the elongation step. This PCR protocol has been standardized to be suitable for PCR reactions with most selected primer pairs, which greatly facilitates the testing because each clinical sample can be tested with universal, species-specific, genus-specific, antimicrobial agents resis-

tance gene and toxin gene PCR primers under uniform cycling conditions. Furthermore, various combinations of primer pairs may be used in multiplex PCR assays.

It is also an object of the present invention that tuf, atpD and recA sequences could serve as drug targets and these sequences and means to obtain them revealed in the present invention can assist the screening, design and modeling of these drugs.

It is also an object of the present invention that tuf, atpD and recA sequences could serve for vaccine purposes and these sequences and means to obtain them revealed in the present invention can assist the screening, design and modeling of these vaccines.

We aim at developing a universal DNA-based test or kit to screen out rapidly samples which are free of algal, archaeal, bacterial, fungal or parasitical cells. This test could be used alone or combined with more specific identification tests to detect and identify the above algal and/or archaeal and/or bacterial and/or fungal and/or parasitical species and/or genera and/or family and/or group and to determine rapidly the bacterial resistance to antibiotics and/or presence of bacterial toxins. Although the sequences from the selected antimicrobial agents resistance genes are available from public databases and have been used to develop DNA-based tests for their detection, our approach is unique because it represents a major improvement over current diagnostic methods based on bacterial cultures. Using an amplification method for the simultaneous or independent or sequential microbial detection-identification and antimicrobial resistance genes detection, there is no need for culturing the clinical sample prior to testing. Moreover, a modified PCR protocol has been developed to detect all target DNA sequences in approximately one hour under uniform amplification conditions. This procedure should save lives by optimizing treatment, should diminish antimicrobial agents resistance because less antibiotics will be prescribed, should reduce the use of broad spectrum antibiotics which are expensive, decrease overall health care costs by preventing or shortening hospitalizations, and side effects of drugs, and decrease the time and costs associated with clinical laboratory testing.

In another embodiment, sequence repertoires and ways to obtain them for other gene targets are also an object of this invention, such is the case for the hexA nucleic acids and/or sequences of Streptococci.

In yet another embodiment, for the detection of mutations associated with antibiotic resistance genes, we built repertoires to distinguish between point mutations reflecting only gene diversity and point mutations involved in resistance. Such repertoires and ways to obtain them for pbp1a, pbp2b and pbp2x genes of sensitive and penicillin-resistant *Streptococcus pneumoniae* and also for gyrA and parC gene fragments from various bacterial species are also an object of the present invention.

The diagnostic kits, primers and probes mentioned above can be used to identify algae, archaea, bacteria, fungi, parasites, antimicrobial agents resistance genes and toxin genes on any type of sample, whether said diagnostic kits, primers and probes are used for in vitro or in situ applications. The said samples may include but are not limited to: any clinical sample, any environment sample, any microbial culture, any microbial colony, any tissue, and any cell line.

It is also an object of the present invention that said diagnostic kits, primers and probes can be used alone or in conjunction with any other assay suitable to identify microorganisms, including but not limited to: any immunoassay, any enzymatic assay, any biochemical assay, any lysotypic assay, any serological assay, any differential culture medium, any

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enrichment culture medium, any selective culture medium, any specific assay medium, any identification culture medium, any enumeration culture medium, any cellular stain, any culture on specific cell lines, and any infectivity assay on animals.

In the methods and kits described herein below, the oligonucleotide probes and amplification primers have been derived from larger sequences (i.e. DNA fragments of at least 100 base pairs). All DNA fragments have been obtained either from proprietary fragments or from public databases. DNA fragments selected from public databases are newly used in a method of detection according to the present invention, since they have been selected for their diagnostic potential.

In another embodiment, the amino acid sequences translated from the repertory of tuf, atpD and recA nucleic acids and/or sequences are also an object of the present invention.

It is clear to the individual skilled in the art that other oligonucleotide sequences appropriate for (i) the universal detection of algae, archaea, bacteria, fungi or parasites, (ii) the detection and identification of the above microbial species or genus or family or group, and (iii) the detection of antimicrobial agents resistance genes, and (iv) the detection of toxin genes, other than those listed in Tables 39-41, 59-60, 70-76, 77-79, and 81-92 may also be derived from the proprietary fragments or selected public database sequences. For example, the oligonucleotide primers or probes may be shorter or longer than the ones chosen; they may also be selected anywhere else in the proprietary DNA fragments or in the sequences selected from public databases; they may be also variants of the same oligonucleotide. If the target DNA or a variant thereof hybridizes to a given oligonucleotide, or if the target DNA or a variant thereof can be amplified by a given oligonucleotide PCR primer pair, the converse is also true; a given target DNA may hybridize to a variant oligonucleotide probe or be amplified by a variant oligonucleotide PCR primer. Alternatively, the oligonucleotides may be designed from any DNA fragment sequences for use in amplification methods other than PCR. Consequently, the core of this invention is the identification of universal, species-specific, genus-specific, family-specific, group-specific, resistance gene-specific, toxin gene-specific genomic or non-genomic DNA fragments which are used as a source of specific and ubiquitous oligonucleotide probes and/or amplification primers. Although the selection and evaluation of oligonucleotides suitable for diagnostic purposes requires much effort, it is quite possible for the individual skilled in the art to derive, from the selected DNA fragments, oligonucleotides other than the ones listed in Tables 39-41, 59-60, 70-76, 77-79, and 81-92 which are suitable for diagnostic purposes. When a proprietary fragment or a public databases sequence is selected for its specificity and ubiquity, it increases the probability that subsets thereof will also be specific and ubiquitous.

Since a high percentage of clinical specimens are negative for bacteria (Table 3), DNA fragments having a high potential for the selection of universal oligonucleotide probes or primers were selected from proprietary and public database sequences. The amplification primers were selected from genes highly conserved in algae, archaea, bacteria, fungi and parasites, and are used to detect the presence of any algal, archaeal, bacterial, fungal or parasitical pathogen in clinical specimens in order to determine rapidly whether it is positive or negative for algae, archaea, bacteria, fungi or parasites. The selected genes, designated tuf, fus, atpD and recA, encode respectively 2 proteins (elongation factors Tu and G) involved in the translational process during protein synthesis, a protein (beta subunit) responsible for the catalytic activity of proton

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pump ATPase and a protein responsible for the homologous recombination of genetic material. The alignments of tuf, atpD and recA sequences used to derive the universal primers include both proprietary and public database sequences. The universal primer strategy allows the rapid screening of the numerous negative clinical specimens (around 80% of the specimens received, see Table 3) submitted for microbiological testing.

Table 4 provides a list of the archaeal, bacterial, fungal and parasitical species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are revealed in the present invention. Tables 5 and 6 provide a list of antimicrobial agents resistance genes and toxin genes selected for diagnostic purposes. Table 7 provides the origin of tuf, atpD and recA nucleic acids and/or sequences listed in the sequence listing. Tables 8-10 and 12-14 provide lists of species used to test the specificity, ubiquity and sensitivity of some assays described in the examples. Table 11 provides a list of microbial species for which tuf and/or atpD and/or recA sequences are available in public databases. Table 15 lists the microorganisms identified by commercial systems. Tables 16-18 are part of Example 42, whereas Tables 19-20 are part of Example 43. Tables 21-22 illustrate Example 44, whereas Tables 23-25 illustrate Example 45.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 illustrate the principal subdivisions of the tuf and atpD sequences repertoires, respectively. For the design of primers and probes, depending on the needs, one may want to use the complete data set illustrated on the top of the pyramid or use only a subset illustrated by the different branching points. Smaller subdivisions, representing groups, families, genus and species, could even be made to extend to the bottom of the pyramid. Because the tuf and atpD sequences are highly conserved and evolved with each species, the design of primers and probes does not need to include all the sequences within the database or its subdivisions. As illustrated in Tables 42 to 58, 61 to 69, 76 and 80, depending on the use, sequences from a limited number of species can be carefully selected to represent: i) only the main phylogenetic branches from which the intended probes and primers need to be differentiating, and ii) only the species for which they need to be matching. However, for ubiquity purposes, and especially for primers and probes identifying large groups of species (genus, family, group or universal, or sequencing primers), the more data is included into the sequence analysis, the better the probes and primers will be suitable for each particular intended use. Similarly, for specificity purposes, a larger data set (or repertory) ensures optimal primers and probes design by reducing the chance of employing nonspecific oligonucleotides.

FIG. 3 illustrates the approach used to design specific amplification primers from fusA as well as from the region between the end of fusA and the beginning of tuf in the streptomycin (str) operon (referred to as the fusA-tuf intergenic spacer in Table 7). Shown is a schematic organization of universal amplification primers (SEQ ID NOS. 1221-1229) in the str operon. Amplicon sizes are given in bases pairs. Drawing not to scale, as the fusA-tuf intergenic spacer size varies depending on the bacterial species. Indicated amplicon lengths are for *E. coli*.

FIGS. 4 to 6 are illustrations to Example 42, whereas FIGS. 7 to 10 illustrate Example 43.

FIG. 4. Abridged multiple amino acid sequence alignment of the partial tuf gene products from selected species illustrated using the program Alscript. Residues highly conserved

in bacteria are boxed in grey and gaps are represented with dots. Residues in reverse print are unique to the enterococcal tufB as well as to streptococcal and lactococcal tuf gene products. Numbering is based on *E. coli* EF-Tu and secondary structure elements of *E. coli* EF-Tu are represented by cylinders (α -helices) and arrows (β -strands). The sequences shown correspond to SEQ ID NO's: 2630 to 2667.

FIG. 5. Distance matrix tree of bacterial EF-Tu based on amino acid sequence homology. The tree was constructed by the neighbor-joining method. The tree was rooted using archeal and eukaryotic EF-1 α genes as the outgroup. The scale bar represents 5% changes in amino acid sequence, as determined by taking the sum of all of the horizontal lines connecting two species.

FIG. 6. Southern hybridization of BglII/XbaI digested genomic DNAs of some enterococci (except for *E. casseliflavus* and *E. gallinarum* whose genomic DNA was digested with BamHI/PvuII) using the tufA gene fragment of *E. faecium* as probes. The sizes of hybridizing fragments are shown in kilobases. Strains tested are listed in Table 16.

FIG. 7. *Pantoea* and *Tatumella* species specific signature indel in atpD genes. The nucleotide positions given are for *E. coli* atpD sequence (GenBank accession no. V00267). Numbering starts from the first base of the initiation codon.

FIG. 8: Trees based on sequence data from tuf (left side) and atpD (right side). The phylogenetic analysis was performed using the Neighbor-Joining method calculated using the Kimura two-parameter method. The value on each branch indicates the occurrence (%) of the branching order in 750 bootstrapped trees.

FIG. 9: Phylogenetic tree of members of the family Enterobacteriaceae based on tuf (a), atpD (b), and 16S rDNA (c) genes. Trees were generated by neighbor-joining method calculated using the Kimura two-parameter method. The value on each branch is the percentage of bootstrap replications supporting the branch. 750 bootstrap replications were calculated.

FIG. 10: Plot of tuf distances versus 16S rDNA distances (a), atpD distances versus 16S rDNA distances (b), and atpD distances versus tuf distances (c). Symbols: ○, distances between pairs of strains belonging to the same species; ●, distances between *E. coli* strains and *Shigella* strains; □, distances between pairs belonging to the same genus; ■, distances between pairs belonging to different genera; Δ, distances between pairs belonging to different families.

FIGS. 11 and 12 are illustrations to Example 44.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present inventors reasoned that comparing the published *Haemophilus influenzae* and *Mycoplasma genitalium* genomes and searching for conserved genes could provide targets to develop useful diagnostic primers and probes. This sequence comparison is highly informative as these two bacteria are distantly related and most genes present in the minimal genome of *M. genitalium* are likely to be present in every bacterium. Therefore genes conserved between these two bacteria are likely to be conserved in all other bacteria.

Following the genomic comparison, it was found that several protein-coding genes were conserved in evolution. Highly conserved proteins included the translation elongation factors G (EF-G) and Tu (EF-Tu) and the β subunit of F_0F_1 type ATP-synthase, and to a lesser extent, the RecA recombinase. These four proteins coding genes were selected amongst the 20 most conserved genes on the basis that they all possess at least two highly conserved regions suitable for the

design of universal amplification and sequencing primers. Moreover, within the fragment amplified by these primers, highly conserved and more variable regions are also present hence suggesting it might be possible to rapidly obtain sequence information from various microbial species to design universal as well as species-, genus-, family-, or group-specific primers and probes of potential use for the detection and identification and/or quantification of microorganisms.

10 Translation elongation factors are members of a family of GTP-binding proteins which intervene in the interactions of tRNA molecules with the ribosome machinery during essential steps of protein synthesis. The role of elongation factor Tu is to facilitate the binding of aminoacylated tRNA molecules to the A site of the ribosome. The eukaryotic, archaeal (archaeabacterial) and algal homolog of EF-Tu is called elongation factor 1 alpha (EF-1 α). All protein synthesis factors originated from a common ancestor via gene duplications and fusions (Cousineau et al., 1997, J. Mol. Evol. 45:661-670). In particular, elongation factor G (EF-G), although having a functional role in promoting the translocation of aminoacyl-tRNA molecules from the A site to the P site of the ribosome, shares sequence homologies with EF-Tu and is thought to have arisen from the duplication and fusion of an ancestor of the EF-Tu gene.

In addition, EF-Tu is known to be the target for antibiotics belonging to the elfamycin's group as well as to other structural classes (Anborgh and Parmeggiani, 1991, EMBO J. 10:779-784; Luiten et al., 1992, European patent application serial No. EP 0 466 251 A1). EF-G for its part, is the target of the antibiotic fusidic acid. In addition to its crucial activities in translation, EF-Tu has chaperone-like functions in protein folding, protection against heat denaturation of proteins and interactions with unfolded proteins (Caldas et al., 1998, J. Biol. Chem. 273:11478-11482). Interestingly, a form of the EF-Tu protein has been identified as a dominant component of the periplasm of *Neisseria gonorrhoeae* (Porcella et al., 1996, Microbiology 142:2481-2489), hence suggesting that at least in some bacterial species, EF-Tu might be an antigen with vaccine potential.

40 F_0F_1 type ATP-synthase belongs to a superfamily of proton-translocating ATPases divided in three major families: P, V and F (Nelson and Taiz, 1989, TIBS 14:113-116). P-ATPases (or E_1-E_2 type) operate via a phosphorylated intermediate and are not evolutionarily related to the other two families. V-ATPases (or V_0V_1 type) are present on the vacuolar and other endomembranes of eukaryotes, on the plasma membrane of archaea (archaeabacteria) and algae, and also on the plasma membrane of some eubacteria especially species belonging to the order Spirochaetales as well as to the Chlamydiaceae and Deinococcaceae families. F-ATPases (or F_0F_1 type) are found on the plasma membrane of most eubacteria, on the inner membrane of mitochondria and on the thylakoid membrane of chloroplasts. They function mainly in ATP synthesis. They are large multimeric enzymes sharing numerous structural and functional features with the V-ATPases. F and V-type ATPases have diverged from a common ancestor in an event preceding the appearance of eukaryotes. The β subunit of the F-ATPases is the catalytic subunit and it possesses low but significant sequence homologies with the catalytic A subunit of V-ATPases.

45 The translation elongation factors EF-Tu, EF-G and EF-1 α and the catalytic subunit of F or V-types ATP-synthase, are highly conserved proteins sometimes used for phylogenetic analysis and their genes are also known to be highly conserved (Iwabe et al., 1989, Proc. Natl. Acad. Sci. USA 86:9355-9359, Gogarten et al., 1989, Proc. Natl. Acad. Sci.

USA 86:6661-6665, Ludwig et al., 1993, Antonie van Leeuwenhoek 64:285-305). A recent BLAST (Altschul et al., 1997, J. Mol. Biol. 215:403-410) search performed by the present inventors on the GenBank, European Molecular Biology Laboratory (EMBL), DNA Database of Japan (DDBJ) and specific genome project databases indicated that throughout bacteria, the EF-Tu and the β subunit of F_0F_1 type ATP-synthase genes may be more conserved than other genes that are well conserved between *H. influenzae* and *M. genitalium*.

The RecA recombinase is a multifunctional protein encoded by the recA gene. It plays a central role in homologous recombination, it is critical for the repair of DNA damage and it is involved in the regulation of the SOS system by promoting the proteolytic digestion of the LexA repressor. It is highly conserved in bacteria and could serve as a useful genetic marker to reconstruct bacterial phylogeny (Miller and Kokjohn, 1990, Annu. Rev. Microbiol. 44:365-394). Although RecA possesses some highly conserved sequence segments that we used to design universal primers aimed at sequencing the recA fragments, it is clearly not as well conserved EF-G, EF-Tu and β subunit of F_0F_1 type ATP-synthase. Hence, RecA may not be optimal for universal detection of bacteria with high sensitivity but it was chosen because preliminary data indicated that EF-G, EF-Tu and β subunit of F_0F_1 type ATP-synthase may sometimes be too closely related to find specific primer pairs that could discriminate between certain very closely related species and genera. While RecA, EF-G, EF-Tu and β subunit of F_0F_1 type ATP-synthase genes, possesses highly conserved regions suitable for the design of universal sequencing primers, the less conserved region between primers should be divergent enough to allow species-specific and genus-specific primers in those cases.

Thus, as targets to design primers and probes for the genetic detection of microorganisms, the present inventors have focused on the genes encoding these four proteins: tuf, the gene for elongation factor Tu (EF-Tu); fus, the gene for the elongation factor G (EF-G); atpD, the gene for β subunit of F_0F_1 type ATP-synthase; and recA, the gene encoding the RecA recombinase. In several bacterial genomes tuf is often found in two highly similar duplicated copies named tufA and tufB (Filer and Furano, 1981, J. Bacteriol. 148:1006-1011, Sela et al., 1989, J. Bacteriol. 171:581-584). In some particular cases, more divergent copies of the tuf genes can exist in some bacterial species such as some actinomycetes (Luiten et al. European patent application publication No. EP 0 446 251 A1; Vijgenboom et al., 1994, Microbiology 140:983-998) and, as revealed as part of this invention, in several enterococcal species. In several bacterial species, tuf is organized in an operon with its homolog gene for the elongation factor G (EF-G) encoded by the fusA gene (FIG. 3). This operon is often named the str operon. The tuf, fus, atpD and recA genes were chosen as they are well conserved in evolution and have highly conserved stretches as well as more variable segments. Moreover, these four genes have eukaryotic orthologs which are described in the present invention as targets to identify fungi and parasites. The eukaryotic homolog of elongation factor Tu is called elongation factor 1-alpha (EF-1 α) (gene name: tef, teff, eft, ef-1 or EF-1). In fungi, the gene for EF-1 α occurs sometimes in two or more highly similar duplicated copies (often named tef1, tef2, tef3 . . .). In addition, eukaryotes have a copy of elongation factor Tu which is originating from their organelle genome ancestry (gene name: tufL, tufM or tufA). For the purpose of the current invention, the genes for these four functionally and evolutionarily linked elongation factors (bacterial EF-Tu and EF-G, eukaryotic EF-1 α , and organellar EF-Tu) will hereafter be designated as <>tuf

nucleic acids and/or sequences>>. The eukaryotic (mitochondrial) F_0F_1 type ATP-synthase beta subunit gene is named atp2 in yeast. For the purpose of the current invention, the genes of catalytic sub-unit of either F or V-type ATP-synthase will hereafter be designated as <>atpD nucleic acids and/or sequences>>. The eukaryotic homologs of RecA are distributed in two families, typified by the Rad51 and Dmc1 proteins. Archaeal homologs of RecA are called RadA. For the purpose of the current invention, the genes corresponding to the latter proteins will hereafter be designated as <>recA nucleic acids and/or sequences>>.

In the description of this invention, the terms <>nucleic acids>> and <>sequences>> might be used interchangeably. However, <>nucleic acids>> are chemical entities while <>sequences>> are the pieces of information derived from (inherent to) these <>nucleic acids>>. Both nucleic acids and sequences are equivalently valuable sources of information for the matter pertaining to this invention.

Analysis of multiple sequence alignments of tuf and atpD sequences permitted the design of oligonucleotide primers (and probes) capable of amplifying (or hybridizing to) segments of tuf (and/or fus) and atpD genes from a wide variety of bacterial species (see Examples 1 to 4, 24 and 26, and Table 7). Sequencing and amplification primer pairs for tuf nucleic acids and/or sequences are listed in Annex I and hybridization probes are listed in Tables 41 and 85. Sequencing and amplification primer pairs for atpD nucleic acids and/or sequences are listed in Table 40. Analysis of the main subdivisions of tuf and atpD sequences (see FIGS. 1 and 2) permitted to design sequencing primers amplifying specifically each of these subdivisions. It should be noted that these sequencing primers could also be used as universal primers. However, since some of these sequencing primers include several variable sequence (degenerated) positions, their sensitivity could be lower than that of universal primers developed for diagnostic purposes. Further subdivisions could be done on the basis of the various phyla where these genes are encountered.

Similarly, analysis of multiple sequence alignments of recA sequences present in the public databases permitted the design of oligonucleotide primers capable of amplifying segments of recA genes from a wide variety of bacterial species. Sequencing and amplification primer pairs for recA sequences are listed in Table 59. The main subdivisions of recA nucleic acids and/or sequences comprise recA, radA, rad51 and dmc1. Further subdivisions could be done on the basis of the various phyla where these genes are encountered.

The present inventor's strategy is to get as much sequence data information from the four conserved genes (tuf, fus, atpD and recA). This ensemble of sequence data forming a repertory (with subrepertoires corresponding to each target gene and their main sequence subdivisions) and then using the sequence information of the sequence repertory (or subrepertoires) to design primer pairs that could permit either universal detection of algae or archaea or bacteria or fungi or parasites, detection of a family or group of microorganism (e.g. Enterobacteriaceae), detection of a genus (e.g. *Streptococcus*) or finally a specific species (e.g. *Staphylococcus aureus*). It should be noted that for the purpose of the present invention a group of microorganisms is defined depending on the needs of the particular diagnostic test. It does not need to respect a particular taxonomical grouping or phylum. See Example 12 where primers were designed to amplify a group of bacteria consisting of the 17 major bacterial species encountered as contaminants of platelet concentrates. Also remark that in that Example, the primers are not only able to sensitively and rapidly detect at least the 17 important bacterial species, but could also detect other species as well, as shown

in Table 14. In these circumstances the primers shown in Example 12 are considered universal for platelet-contaminating bacteria. To develop an assay specific for the latter, one or more primers or probes specific to each species could be designed. Another example of primers and/or probes for group detection is given by the Pseudomonad group primers. These primers were designed based upon alignment of tuf sequences from real *Pseudomonas* species as well as from former *Pseudomonas* species such as *Stenotrophomonas maltophilia*. The resulting primers are able to amplify all *Pseudomonas* species tested as well as several species belonging to different genera, hence as being specific for a group including *Pseudomonas* and other species, we defined that group as Pseudomonads, as several members were former *Pseudomonas*.

For certain applications, it may be possible to develop a universal, group, family or genus-specific reaction and to proceed to species identification using sequence information within the amplicon to design species-specific internal probes or primers, or alternatively, to proceed directly by sequencing the amplicon. The various strategies will be discussed further below.

The ensembles formed by public and proprietary tuf, atpD and recA nucleic acids and/or sequences are used in a novel fashion so they constitute three databases containing useful information for the identification of microorganisms.

Sequence repertoires of other gene targets were also built to solve some specific identification problems especially for microbial species genetically very similar to each other such as *E. coli* and *Shigella* (see Example 23). Based on tuf, atpD and recA sequences, *Streptococcus pneumoniae* is very difficult to differentiate from the closely related species *S. oralis* and *S. mitis*. Therefore, we elected to built a sequence repertoire from hexA sequences (Example 19), a gene much more variable than our highly conserved tuf, atpD and recA nucleic acids and/or sequences.

For the detection of mutations associated with antibiotic resistance genes, we also built repertoires to distinguish between point mutations reflecting only gene diversity and point mutations involved in resistance. This was done for pbp1a, pbp2b and pbp2x genes of penicillin-resistant and sensitive *Streptococcus pneumoniae* (Example 18) and also for gyrA and parC gene fragments of various bacterial species for which quinolone resistance is important to monitor.

Oligonucleotide Primers and Probes Design and Synthesis

The tuf, fus, atpD and recA DNA fragments sequenced by us and/or selected from public databases (GenBank and EMBL) were used to design oligonucleotides primers and probes for diagnostic purposes. Multiple sequence alignments were made using subsets of the tuf or atpD or recA sequences repertoire. Subsets were chosen to encompass as much as possible of the targetted microorganism(s) DNA sequence data and also include sequence data from phylogenetically related microorganisms from which the targetted microorganism(s) should be distinguished. Regions suitable for primers and probes should be conserved for the targetted microorganism(s) and divergent for the microorganisms from which the targetted microorganism(s) should be distinguished. The large amount of tuf or atpD or recA sequences data in our repertoire permits to reduce trial and errors in obtaining specific and ubiquitous primers and probes. We also relied on the corresponding peptide sequences of tuf, fus, atpD and recA nucleic acids and/or sequences to facilitate the identification of regions suitable for primers and probes design. As part of the design rules, all oligonucleotides (probes for hybridization and primers for DNA amplification by PCR) were evaluated for their suitability for hybridization

or PCR amplification by computer analysis using standard programs (i.e. the Genetics Computer Group (GCG) programs and the primer analysis software Oligo™ 5.0). The potential suitability of the PCR primer pairs was also evaluated prior to the synthesis by verifying the absence of unwanted features such as long stretches of one nucleotide and a high proportion of G or C residues at the 3' end (Persing et al., 1993, Diagnostic Molecular Microbiology: Principles and Applications, American Society for Microbiology, Washington, D.C.). Oligonucleotide probes and amplification primers were synthesized using an automated DNA synthesizer (Perkin-Elmer Corp., Applied Bio systems Division).

The oligonucleotide sequence of primers or probes may be derived from either strand of the duplex DNA. The primers or probes may consist of the bases A, G, C, or T or analogs and they may be degenerated at one or more chosen nucleotide position(s). The primers or probes may be of any suitable length and may be selected anywhere within the DNA sequences from proprietary fragments or from selected data-base sequences which are suitable for (i) the universal detection of algae or archaea or bacteria or fungi or parasites, (ii) the species-specific detection and identification of any micro-organism, including but not limited to: *Abiotrophia adiacens*, *Bacteroides fragilis*, *Bordetella pertussis*, *Candida albicans*, *Candida dubliniensis*, *Candida glabrata*, *Candida guilliermondii*, *Candida krusei*, *Candida lusitaniae*, *Candida parapsilosis*, *Candida tropicalis*, *Candida zeylanoides*, *Campylobacter jejuni* and *C. coli*, *Chlamydia pneumoniae*, *Chlamydia trachomatis*, *Cryptococcus neoformans*, *Cryptosporidium parvum*, *Enterococcus faecalis*, *Enterococcus faecium*, *Enterococcus gallinarum*, *Escherichia coli*, *Haemophilus influenzae*, *Legionella pneumophila*, *Mycoplasma pneumoniae*, *Neisseria gonorrhoeae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Staphylococcus haemolyticus*, *Staphylococcus hominis*, *Staphylococcus saprophyticus*, *Streptococcus agalactiae*, *Streptococcus pneumoniae*, *Trypanosoma brucei*, *Trypanosoma cruzi*, (iii) the genus-specific detection of *Bordetella* species, *Candida* species, *Clostridium* species, *Corynebacterium* species, *Cryptococcus* species, *Entamoeba* species, *Enterococcus* species, *Gemella* species, *Giardia* species, *Legionella* species, *Leishmania* species, *Staphylococcus* species, *Streptococcus* species, *Trypanosoma* species, (iv) the family-specific detection of Enterobacteriaceae family members, *Mycobacteriaceae* family members, Trypanosomatidae family members, (v) the detection of *Enterococcus casseliflavus-flavescens-gallinarum* group, *Enterococcus*, *Gemella* and *Abiotrophia adiacens* group, Pseudomonads extended group, Platelet-contaminating bacteria group, (vi) the detection of clinically important antimicrobial agents resistance genes listed in Table 5, (vii) the detection of clinically important toxin genes listed in Table 6.

Variants for a given target microbial gene are naturally occurring and are attributable to sequence variation within that gene during evolution (Watson et al., 1987, Molecular Biology of the Gene, 4th ed., The Benjamin/Cummings Publishing Company, Menlo Park, Calif.; Lewin, 1989, Genes IV, John Wiley & Sons, New York, N.Y.). For example, different strains of the same microbial species may have a single or more nucleotide variation(s) at the oligonucleotide hybridization site. The person skilled in the art is well aware of the existence of variant algal, archaeal, bacterial, fungal or parasitical DNA nucleic acids and/or sequences for a specific gene and that the frequency of sequence variations depends on the selective pressure during evolution on a given gene product. The detection of a variant sequence for a region between two PCR primers may be demonstrated by sequencing the ampli-

fication product. In order to show the presence of sequence variants at the primer hybridization site, one has to amplify a larger DNA target with PCR primers outside that hybridization site. Sequencing of this larger fragment will allow the detection of sequence variation at this site. A similar strategy may be applied to show variants at the hybridization site of a probe. Insofar as the divergence of the target nucleic acids and/or sequences or a part thereof does not affect the specificity and ubiquity of the amplification primers or probes, variant microbial DNA is under the scope of this invention. Variants of the selected primers or probes may also be used to amplify or hybridize to a variant DNA.

Sequencing of tuf Nucleic Acids and/or Sequences from a Variety of Archaeal, Bacterial, Fungal and Parasitical Species

The nucleotide sequence of a portion of tuf nucleic acids and/or sequences was determined for a variety of archaeal, bacterial, fungal and parasitical species. The amplification primers (SEQ ID NOs. 664 and 697), which amplify a tuf gene portion of approximately 890 bp, were used along with newly designed sequencing primer pairs (See Annex I for the sequencing primers for tuf nucleic acids and/or sequences). Most primer pairs can amplify different copies of tuf genes (tufA and tufB). This is not surprising since it is known that for several bacterial species these two genes are nearly identical. For example, the entire tufA and tufB genes from *E. coli* differ at only 13 nucleotide positions (Neidhardt et al., 1996, *Escherichia coli* and *Salmonella*: Cellular and Molecular Biology, 2nd ed., American Society for Microbiology Press, Washington, D.C.). Similarly, some fungi are known to have two nearly identical copies of tuf nucleic acids and/or sequences (EF-1 \square). These amplification primers are degenerated at several nucleotide positions and contain inosines in order to allow the amplification of a wide range of tuf nucleic acids and/or sequences. The strategy used to select these amplification primers is similar to that illustrated in Table 39 for the selection of universal primers. The tuf sequencing primers even sometimes amplified highly divergent copies of tuf genes (tufC) as illustrated in the case of some enterococcal species (SEQ ID NOs.: 73, 75, 76, 614 to 618, 621 and 987 to 989). To prove this, we have determined the enterococcal tuf nucleic acids and/or sequences from PCR amplicons cloned into a plasmid vector. Using the sequence data from the cloned amplicons, we designed new sequencing primers specific to the divergent (tufC) copy of enterococci (SEQ ID NOs.: 658-659 and 661) and then sequenced directly the tufC amplicons. The amplification primers (SEQ ID NOs.: 543, 556, 557, 643-645, 660, 664, 694, 696 and 697) could be used to amplify the tuf nucleic acids and/or sequences from any bacterial species. The amplification primers (SEQ ID NOs.: 558, 559, 560, 653, 654, 655, 813, 815, 1974-1984, 1999-2003) could be used to amplify the tuf (EF-1 \square) genes from any fungal and/or parasitical species. The amplification primers SEQ ID NOs. 1221-1228 could be used to amplify bacterial tuf nucleic acids and/or sequences of the EF-G subdivision (fusA) (FIG. 3). The amplification primers SEQ ID NOs. 1224, and 1227-1229 could be used to amplify bacterial tuf nucleic acids and/or sequences comprising the end of EF-G (fusA) and the beginning of EF-Tu (tuf), including the intergenic region, as shown in FIG. 3.

Most tuf fragments to be sequenced were amplified using the following amplification protocol: One μ l of cell suspension (or of purified genomic DNA 0.1-100 ng/ μ l) was transferred directly to 19 μ l of a PCR reaction mixture. Each PCR reaction contained 50 mM KCl, 10 mM Tris-HCl (pH 9.0), 0.1% Triton X-100, 2.5 mM MgCl₂, 1 μ M of each of the 2 primers, 200 μ M of each of the four dNTPs, 0.5 unit of Taq DNA polymerase (Promega Corp., Madison, Wis.). PCR

reactions were subjected to cycling using a PTC-200 thermal cycler (MJ Research Inc., Watertown, Mass.) as follows: 3 min at 94-96°C. followed by 30-45 cycles of 1 min at 95°C. for the denaturation step, 1 min at 50-55°C. for the annealing step and 1 min at 72°C. for the extension step. Subsequently, twenty microliters of the PCR-amplified mixture were resolved by electrophoresis in a 1.5% agarose gel. The amplicons were then visualized by staining with methylene blue (Flores et al., 1992, Biotechniques, 13:203-205). The size of the amplification products was estimated by comparison with a 100-bp molecular weight ladder. The band corresponding to the specific amplification product was excised from the agarose gel and purified using the QIAquick™ gel extraction kit (QIAGEN Inc., Chatsworth, Calif.). The gel-purified DNA fragment was then used directly in the sequencing protocol. Both strands of the tuf genes amplification product were sequenced by the dideoxynucleotide chain termination sequencing method by using an Applied Biosystems automated DNA sequencer (model 377) with their Big Dye™ Terminator Cycle Sequencing Ready Reaction Kit (Applied Biosystems, Foster City, Calif.). The sequencing reactions were performed by using the same amplification primers and 10 ng/100 bp of the gel-purified amplicon per reaction. For the sequencing of long amplicons such as those of eukaryotic tuf (EF-1 \square nucleic acids and/or sequences, we designed internal sequencing primers (SEQ ID NOs.: 654, 655 and 813) to be able to obtain sequence data on both strands for most of the fragment length. In order to ensure that the determined sequence did not contain errors attributable to the sequencing of PCR artefacts, we have sequenced two preparations of the gel-purified tuf amplification product originating from two independent PCR amplifications. For most target microbial species, the sequences determined for both amplicon preparations were identical. In case of discrepancies, amplicons from a third independent PCR amplification were sequenced. Furthermore, the sequences of both strands were 100% complementary thereby confirming the high accuracy of the determined sequence. The tuf nucleic acids and/or sequences determined using the above strategy are described in the Sequence Listing. Table 7 gives the originating microbial species and the source for each tuf sequence in the Sequence Listing.

The alignment of the tuf sequences determined by us or selected from databases revealed clearly that the length of the sequenced portion of the tuf genes is variable. There may be insertions or deletions of several amino acids. In addition, in several fungi introns were observed. Intron nucleic acids and/or sequences are part of tuf nucleic acids and/or sequences and could be useful in the design of species-specific primers and probes. This explains why the size of the sequenced tuf amplification products was variable from one fungal species to another. Consequently, the nucleotide positions indicated on top of each of Tables 42 to 58, 61 to 69, 76 and 80 do not correspond for sequences having insertions or deletions.

It should also be noted that the various tuf nucleic acids and/or sequences determined by us occasionally contain base ambiguities. These degenerated nucleotides correspond to sequence variations between tufA and tufB genes (or copies of the EF-G subdivision of tuf nucleic acids and/or sequences, or copies of EF-10 subdivision of tuf nucleic acids and/or sequences for fungi and parasites) because the amplification primers amplify both tuf genes. These nucleotide variations were not attributable to nucleotide misincorporations by the Taq DNA polymerase because the sequence of both strands was identical and also because the sequences determined with both preparations of the gel-purified tuf amplicons obtained from two independent PCR amplifications were identical.

The Selection of Amplification Primers from tuf Nucleic Acids and/or Sequences

The tuf sequences determined by us or selected from public databases were used to select PCR primers for universal detection of bacteria, as well as for genus-specific, species-specific family-specific or group-specific detection and identification. The strategy used to select these PCR primers was based on the analysis of multiple sequence alignments of various tuf sequences. For more details about the selection of PCR primers from tuf sequences please refer to Examples 5, 7-14, 17, 22, 24, 28, 30-31, 33, 36, and 38-40, and to Tables 44-47, 49-57 and 63.

Sequencing of atpD and recA Nucleic Acids and/or Sequences from a Variety of Archaeal, Bacterial, Fungal and Parasitical Species

The method used to obtain atpD and recA nucleic acids and/or sequences is similar to that described above for tuf nucleic acids and/or sequences.

The Selection of Amplification Primers from atpD or recA Nucleic Acids and/or Sequences

The comparison of the nucleotide sequence for the atpD or recA genes from various archaeal, bacterial, fungal and parasitical species allowed the selection of PCR primers (refer to Examples 6, 13, 29, 34 and 37, and to Tables 42, V43, 48, and 58).

DNA Amplification

For DNA amplification by the widely used PCR (polymerase chain reaction) method, primer pairs were derived from proprietary DNA fragments or from database sequences. Prior to synthesis, the potential primer pairs were analyzed by using the OligoTM 5.0 software to verify that they were good candidates for PCR amplification.

During DNA amplification by PCR, two oligonucleotide primers binding respectively to each strand of the heat-denatured target DNA from the microbial genome are used to amplify exponentially in vitro the target DNA by successive thermal cycles allowing denaturation of the DNA, annealing of the primers and synthesis of new targets at each cycle (Persing et al., 1993, Diagnostic Molecular Microbiology: Principles and Applications, American Society for Microbiology, Washington, D.C.).

Briefly, the PCR protocols were as follows: Treated clinical specimens or standardized bacterial or fungal or parasitical suspensions (see below) or purified genomic DNA from bacteria, fungi or parasites were amplified in a 20 µl PCR reaction mixture. Each PCR reaction contained 50 mM KCl, 10 mM Tris-HCl (pH 9.0), 2.5 mM MgCl₂, 0.4 µM of each primer, 200 µM of each of the four dNTPs and 0.5 unit of Taq DNA polymerase (Promega) combined with the TaqStartTM antibody (Clontech Laboratories Inc., Palo Alto, Calif.). The TaqStartTM antibody, which is a neutralizing monoclonal antibody to Taq DNA polymerase, was added to all PCR reactions to enhance the specificity and the sensitivity of the amplifications (Kellogg et al., 1994, Biotechniques 16:1134-1137). The treatment of the clinical specimens varies with the type of specimen tested, since the composition and the sensitivity level required are different for each specimen type. It consists in a rapid protocol to lyse the microbial cells and eliminate or neutralize PCR inhibitors. For amplification from bacterial or fungal or parasitical cultures or from purified genomic DNA, the samples were added directly to the PCR amplification mixture without any pre-treatment step. An internal control was derived from sequences not found in the target microorganisms or in the human genome. The internal control was integrated into all amplification reactions to verify the efficiency of the PCR assays and to ensure that significant PCR

inhibition was absent. Alternatively, an internal control derived from rRNA was also useful to monitor the efficiency of microbial lysis protocols.

PCR reactions were then subjected to thermal cycling (3 min at 94-96° C. followed by 30 cycles of 1 second at 95° C. for the denaturation step and 30 seconds at 50-65° C. for the annealing-extension step) using a PTC-200 thermal cycler (MJ Research Inc.). The number of cycles performed for the PCR assays varies according to the sensitivity level required.

- 5 For example, the sensitivity level required for microbial detection directly from clinical specimens is higher for blood specimens than for urine specimens because the concentration of microorganisms associated with a septicemia can be much lower than that associated with a urinary tract infection.
- 10 Consequently, more sensitive PCR assays having more thermal cycles are probably required for direct detection from blood specimens. Similarly, PCR assays performed directly from bacterial or fungal or parasitical cultures may be less sensitive than PCR assays performed directly from clinical
- 15 specimens because the number of target organisms is normally much lower in clinical specimens than in microbial cultures.

The person skilled in the art of DNA amplification knows the existence of other rapid amplification procedures such as ligase chain reaction (LCR), transcription-mediated amplification (TMA), self-sustained sequence replication (3SR), nucleic acid sequence-based amplification (NASBA), strand displacement amplification (SDA), branched DNA (bDNA), cycling probe technology (CPT), solid phase amplification (SPA), rolling circle amplification technology (RCA), solid phase RCA, anchored SDA and nuclease dependent signal amplification (NDSA) (Lee et al., 1997, Nucleic Acid Amplification Technologies: Application to Disease Diagnosis, Eaton Publishing, Boston, Mass.; Persing et al., 1993, Diagnostic Molecular Microbiology: Principles and Applications, American Society for Microbiology, Washington, D.C.; Westtin et al., 2000, Nat. Biotechnol. 18:199-204). The scope of this invention is not limited to the use of amplification by PCR, but rather includes the use of any rapid nucleic acid amplification method or any other procedure which may be used to increase the sensitivity and/or the rapidity of nucleic acid-based diagnostic tests. The scope of the present invention also covers the use of any nucleic acids amplification and detection technology including real-time or post-amplification detection technologies, any amplification technology combined with detection, any hybridization nucleic acid chips or arrays technologies, any amplification chips or combination of amplification and hybridization chips technologies. Detection and identification by any sequencing method is also under the scope of the present invention.

Any oligonucleotide suitable for the amplification of nucleic acids by approaches other than PCR or for DNA hybridization which are derived from the species-specific, genus-specific and universal DNA fragments as well as from selected antimicrobial agents resistance or toxin gene sequences included in this document are also under the scope of this invention.

Detection of Amplification Products

Classically, detection of amplification is performed by standard ethidium bromide-stained agarose gel electrophoresis. It is clear that other methods for the detection of specific amplification products, which may be faster and more practical for routine diagnosis, may be used. Such methods may be based on the detection of fluorescence after or during amplification. One simple method for monitoring amplified DNA is to measure its rate of formation by measuring the increase in fluorescence of intercalating agents such as

ethidium bromide or SYBR® Green I (Molecular Probes). If more specific detection is required, fluorescence-based technologies can monitor the appearance of a specific product during the reaction. The use of dual-labeled fluorogenic probes such as in the TaqMan™ system (Applied Biosystems) which utilizes the 5'-3' exonuclease activity of the Taq polymerase is a good example (Livak K. J. et al. 1995, PCR Methods Appl. 4:357-362). TaqMan™ can be performed during amplification and this "real-time" detection can be done in a single closed tube hence eliminating post-PCR sample handling and consequently preventing the risk of amplicon carryover. Several other fluorescence-based detection methods can be performed in real-time. Fluorescence resonance energy transfer (FRET) is the principle behind the use of adjacent hybridization probes (Wittwer, C. T. et al. 1997, BioTechniques 22:130-138), molecular beacons (Tyagi S, and Kramer F. R. 1996, Nature Biotechnology 14:303-308) and scorpions (Whitcomb et al. 1999, Nature Biotechnology 17:804-807). Adjacent hybridization probes are designed to be internal to the amplification primers. The 3' end of one probe is labelled with a donor fluorophore while the 5' end of an adjacent probe is labelled with an acceptor fluorophore. When the two probes are specifically hybridized in closed proximity (spaced by 1 to 5 nucleotides) the donor fluorophore which has been excited by an external light source emits light that is absorbed by a second acceptor that emit more fluorescence and yields a FRET signal. Molecular beacons possess a stem-and-loop structure where the loop is the probe and at the bottom of the stem a fluorescent moiety is at one end while a quenching moiety is at the other end. The beacons undergo a fluorogenic conformational change when they hybridize to their targets hence separating the fluorochrome from its quencher. The FRET principle is also used in an air thermal cycler with a built-in fluorometer (Wittwer, C. T. et al. 1997, BioTechniques 22:130-138). The amplification and detection are extremely rapid as reactions are performed in capillaries: it takes only 18 min to complete 45 cycles. Those techniques are suitable especially in the case where few pathogens are searched for. Boehringer-Roche Inc. sells the LightCycler™, and Cepheid makes the SmartCycler. These two apparatus are capable of rapid cycle PCR combined with fluorescent SYBR® Green I or FRET detection. We recently demonstrated in our laboratory, real-time detection of 10 CFU in less than 40 minutes using adjacent hybridization probes on the LightCycler™. Methods based on the detection of fluorescence are particularly promising for utilization in routine diagnosis as they are very rapid, quantitative and can be automated.

Microbial pathogens detection and identification may also be performed by solid support or liquid hybridization using species-specific internal DNA probes hybridizing to an amplification product. Such probes may be generated from any sequence from our repertory and designed to specifically hybridize to DNA amplification products which are objects of the present invention. Alternatively, the internal probes for species or genus or family or group detection and identification may be derived from the amplicons produced by a universal, family-, group-, genus- or species-specific amplification assay(s). The oligonucleotide probes may be labeled with biotin or with digoxigenin or with any other reporter molecule (for more details see below the section on hybrid capture). Hybridization on a solid support is amendable to miniaturization.

At present the oligonucleotide nucleic acid microarray technology is appealing. Currently, available low to medium density arrays (Heller et al., An integrated microelectronics hybridization system for genomic research and diagnostic

applications. In: Harrison, D. J., and van den Berg, A., 1998, Micro total analysis systems '98, Kluwer Academic Publisher, Dordrecht.) could specifically capture fluorescent-labelled amplicons. Detection methods for hybridization are not limited to fluorescence; potentiometry, colorimetry and plasmon resonance are some examples of alternative detection methods. In addition to detection by hybridization, nucleic acid microarrays could be used to perform rapid sequencing by hybridization. Mass spectrometry could also be applicable for rapid identification of the amplicon or even for sequencing of the amplification products (Chiu and Cantor, 1999, Clinical Chemistry 45:1578; Berkenkamp et al., 1998, Science 281:260).

For the future of our assay format, we also consider the major challenge of molecular diagnostics tools, i.e.: integration of the major steps including sample preparation, genetic amplification, detection, data analysis and presentation (Anderson et al., Advances in integrated genetic analysis. In: Harrison, D. J., and van den Berg, A., 1998, Micro total analysis systems '98, Kluwer Academic Publisher, Dordrecht.).

To ensure PCR efficiency, glycerol, dimethyl sulfoxide (DMSO) or other related solvents can be used to increase the sensitivity of the PCR and to overcome problems associated with the amplification of a target DNA having a high GC content or forming strong secondary structures (Dieffenbach and Dveksler, 1995, PCR Primer: A Laboratory Manual, Cold Spring Harbor Laboratory Press, Plainview, N.Y.). The concentration ranges for glycerol and DMSO are 5-15% (v/v) and 3-10% (v/v), respectively. For the PCR reaction mixture, the concentration ranges for the amplification primers and MgCl₂ are 0.1-1.5 μM and 1.0-10.0 mM, respectively. Modifications of the standard PCR protocol using external and nested primers (i.e. nested PCR) or using more than one primer pair (i.e. multiplex PCR) may also be used (Persing et al., 1993, Diagnostic Molecular Microbiology: Principles and Applications, American Society for Microbiology, Washington, D.C.). For more details about the PCR protocols and amplicon detection methods, see Examples.

40 Hybrid Capture and Chemiluminescence Detection of Amplification Products

Hybridization and detection of amplicons by chemiluminescence were adapted from Nikiforov et al. (1994, PCR Methods and Applications 3:285-291 and 1995, Anal. Biochem. 227:201-209) and from the DIG™ system protocol of Boehringer Mannheim. Briefly, 50 μl of a 25 picomoles solution of capture probe diluted in EDC {1-ethyl-3-(3-dimethylaminopropyl) carbodiimide hydrochloride} are immobilized in each well of 96-wells plates (Microlite™ 2, Dynex) by incubation overnight at room temperature. The next day, the plates are incubated with a solution of 1% BSA diluted into TNTw (10 mM Tris-HCl, pH 7.5; 150 mM NaCl; 0.05% Tween™ 20) for 1 hour at 37° C. The plates are then washed on a Wellwash Ascent™ (Labsystems) with TNTw followed by Washing Buffer (100 mM maleic acid pH7.5; 150 mM NaCl; 0.3% Tween™ 20).

The amplicons were labelled with DIG-11-dUTP during PCR using the PCR DIG Labelling Mix from Boehringer Mannheim according to the manufacturer's instructions. Hybridization of the amplicons to the capture probes is performed in triplicate at stringent temperature (generally, probes are designed to allow hybridization at 55° C., the stringent temperature) for 30 minutes in 1.5 M NaCl; 10 mM EDTA. It is followed by two washes in 2×SSC; 0.1% SDS, then by four washes in 0.1×SSC; 0.1% SDS at the stringent temperature (55° C.). Detection with 1,2 dioxetane chemiluminescent alkaline phosphatase substrates like CSPD®

(Tropix Inc.) is performed according to the manufacturer's instructions but with shorter incubations times and a different antibody concentration. The plates are agitated at each step, the blocking incubation is performed for only 5 minutes, the anti-DIG-AP1 is used at a 1:1000 dilution, the incubation with antibody lasts 15 minutes, the plates are washed twice for only 5 minutes. Finally, after a 2 minutes incubation into the detection buffer, the plates are incubated 5 minutes with CSPD® at room temperature followed by a 10 minutes incubation at 37° C. without agitation. Luminous signal detection is performed on a Dynex Microtiter Plate Luminometer using RLU (Relative Light Units).

Specificity, Ubiquity and Sensitivity Tests for Oligonucleotide Primers and Probes

The specificity of oligonucleotide primers and probes was tested by amplification of DNA or by hybridization with bacterial or fungal or parasitical species selected from a panel comprising closely related species and species sharing the same anatomo-pathological site (see Annexes and Examples). All of the bacterial, fungal and parasitical species tested were likely to be pathogens associated with infections or potential contaminants which can be isolated from clinical specimens. Each target DNA could be released from microbial cells using standard chemical and/or physical treatments to lyse the cells (Sambrook et al., 1989, Molecular Cloning: A Laboratory Manual, 2nd ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y.) or alternatively, genomic DNA purified with the GNOMETM DNA kit (Bio101, Vista, Calif.) was used. Subsequently, the DNA was subjected to amplification with the primer pairs. Specific primers or probes amplified only the target microbial species, genus, family or group.

Oligonucleotides primers found to amplify specifically the target species, genus, family or group were subsequently tested for their ubiquity by amplification (i.e. ubiquitous primers amplified efficiently most or all isolates of the target species or genus or family or group). Finally, the sensitivity of the primers or probes was determined by using 10-fold or 2-fold dilutions of purified genomic DNA from the targeted microorganism. For most assays, sensitivity levels in the range of 1-100 copies were obtained. The specificity, ubiquity and sensitivity of the PCR assays using the selected amplification primer pairs were tested either directly from cultures of microbial species or from purified microbial genomic DNA.

Probes were tested in hybrid capture assays as described above. An oligonucleotide probe was considered specific only when it hybridized solely to DNA from the species or genus or family or group from which it was selected. Oligonucleotide probes found to be specific were subsequently tested for their ubiquity (i.e. ubiquitous probes detected efficiently most or all isolates of the target species or genus or family or group) by hybridization to microbial DNAs from different clinical isolates of the species or genus or family or group of interest including ATCC reference strains. Similarly, oligonucleotide primers and probes could be derived from antimicrobial agents resistance or toxin genes which are objects of the present invention.

Reference Strains

The reference strains used to build proprietary tuf, atpD and recA sequence data subrepertoires, as well as to test the amplification and hybridization assays were obtained from (i) the American Type Culture Collection (ATCC), (ii) the Laboratoire de santé publique du Québec (LSPQ), (iii) the Centers for Disease Control and Prevention (CDC), (iv) the National Culture Type Collection (NCTC) and (v) several other reference laboratories throughout the world. The identity of our

reference strains was confirmed by phenotypic testing and reconfirmed by analysis of tuf, atpD and recA sequences (see Example 13).

Antimicrobial Agents Resistance Genes

Antimicrobial resistance complicates treatment and often leads to therapeutic failures. Furthermore, overuse of antibiotics inevitably leads to the emergence of microbial resistance. Our goal is to provide clinicians, in approximately one hour, the needed information to prescribe optimal treatments. Besides the rapid identification of negative clinical specimens with DNA-based tests for universal algal, archaeal, bacterial, fungal or parasitical detection and the identification of the presence of a specific pathogen in the positive specimens with species- and/or genus- and/or family- and/or group-specific DNA-based tests, clinicians also need timely information about the ability of the microbial pathogen to resist antibiotic treatments. We feel that the most efficient strategy to evaluate rapidly microbial resistance to antimicrobials is to detect directly from the clinical specimens the most common and clinically important antimicrobial agents resistance genes (i.e. DNA-based tests for the specific detection of antimicrobial agents resistance genes). Since the sequence from the most important and common antimicrobial agents resistance genes are available from public databases, our strategy is to use the sequence from a portion or from the entire resistance gene to design specific oligonucleotide primers or probes which will be used as a basis for the development of sensitive and rapid DNA-based tests. The list of each of the antimicrobial agents resistance genes selected on the basis of their clinical relevance (i.e. high incidence and importance) is given in Table 5; descriptions of the designed amplification primers and internal probes are given in Tables 72-75, 77, 84, and 88-90. Our approach is unique because the antimicrobial agents resistance genes detection and the microbial detection and identification can be performed simultaneously, or independently, or sequentially in multiplex or parallel or sequential assays under uniform PCR amplification conditions. These amplifications can also be done separately.

Toxin Genes

Toxin identification is often very important to prescribe optimal treatments. Besides the rapid identification of negative clinical specimens with DNA-based tests for universal bacterial detection and the identification of the presence of a specific pathogen in the positive specimens with species- and/or genus- and/or family- and/or group-specific DNA-based tests, clinicians sometimes need timely information about the ability of certain bacterial pathogens to produce toxins. Since the sequence from the most important and common bacterial toxin genes are available from public databases, our strategy is to use the sequence from a portion or from the entire toxin gene to design specific oligonucleotide primers or probes which will be used as a basis for the development of sensitive and rapid DNA-based tests. The list of each of the bacterial toxin genes selected on the basis of their clinical relevance (i.e. high incidence and importance) is given in Table 6; descriptions of the designed amplification primers and internal probes are given in Tables 60, 70 and 71. Our approach is unique because the toxin genes detection and the bacterial detection and identification can be performed simultaneously, or independently, or sequentially, in multiplex or parallel or sequential assays under uniform PCR amplification conditions. These amplifications can also be done separately.

Universal Bacterial Detection

In the routine microbiology laboratory, a high percentage of clinical specimens sent for bacterial identification are negative by culture. Testing clinical samples with universal

amplification primers or universal probes to detect the presence of bacteria prior to specific identification and screening out the numerous negative specimens is thus useful as it reduces costs and may rapidly orient the clinical management of the patients. Several amplification primers and probes were therefore synthesized from highly conserved portions of bacterial sequences from the tuf, atpD and recA nucleic acids and/or sequences. The universal primers selection was based on a multiple sequence alignment constructed with sequences from our repertory.

All computer analysis of amino acid and nucleotide sequences were performed by using the GCG programs. Subsequently, optimal PCR primers for the universal amplification of bacteria were selected with the help of the Oligo™ program. The selected primers are degenerated at several nucleotide positions and contain several inosines in order to allow the amplification of all clinically relevant bacterial species. Inosine is a nucleotide analog able to specifically bind to any of the four nucleotides A, C, G or T. Degenerated oligonucleotides consist of an oligonucleotide mix having two or more of the four nucleotides A, C, G or T at the site of mismatches. The inclusion of inosine and/or of base ambiguities in the amplification primers allow mismatch tolerance thereby permitting the amplification of a wider array of target nucleotide sequences (Dieffenbach and Dveksler, 1995 PCR Primer: A Laboratory Manual, Cold Spring Harbor Laboratory Press, Plainview, N.Y.).

The amplification conditions with the universal primers are very similar to those used for the species- and genus-specific amplification assays except that the annealing temperature is slightly lower. The original universal PCR assay described in our assigned WO98/20157 (SEQ ID NOS. 23-24 of the latter application) was specific and nearly ubiquitous for the detection of bacteria. The specificity for bacteria was verified by amplifying genomic DNA isolated from the 12 fungal species as well as genomic DNA from *Leishmania donovani*, *Saccharomyces cerevisiae* and human lymphocytes. None of the above eukaryotic DNA preparations could be amplified by the universal assay, thereby suggesting that this test is specific for bacteria. The ubiquity of the universal assay was verified by amplifying genomic DNAs from 116 reference strains which represent 95 of the most clinically relevant bacterial species. These species have been selected from the bacterial species listed in Table 4. We found that at least 104 of these strains could be amplified. However, the assay could be improved since bacterial species which could not be amplified with the original tuf nucleic acids and/or sequences-based assay included species belonging to the following genera: *Corynebacterium* (11 species) and *Stenotrophomonas* (1 species). Sequencing of the tuf genes from these bacterial species and others has been performed in the scope of the present invention in order to improve the universal assay. This sequencing data has been used to select new universal primers which may be more ubiquitous and more sensitive. Also, we improved our primer and probes design strategy by taking into consideration the phylogeny observed in analysing our repertory of tuf, atpD and recA sequences. Data from each of the 3 main subrepertoires (tuf, atpD and recA) was subjected to a basic phylogenetic analysis using the Pileup command from version 10 of the GCG package (Genetics Computer Group, inc.). This analysis indicated the main branches or phyla reflecting the relationships between sequences. Instead of trying to design primers or probes able to hybridize to all phyla, we designed primers or probes able to hybridize to the main phyla while trying to use the largest phylum possible. This strategy should allow less degenerated primers hence improving sensitivity and by combining primers in a multiplex

assay, improve ubiquity. Universal primers SEQ ID NOS. 643-645 based on tuf sequences have been designed to amplify most pathogenic bacteria except Actinomycetaceae, Clostridiaceae and the Cytophaga, Flexibacter and *Bacteroides* phylum (pathogenic bacteria of this phylum include mostly *Bacteroides*, *Porphyromonas* and *Prevotella* species). Primers to fill these gaps have been designed for Actinomycetaceae (SEQ ID NOS. 646-648), Clostridiaceae (SEQ ID NOS. 796-797, 808-811), and the Cytophaga, Flexibacter and *Bacteroides* phylum (SEQ ID NOS. 649-651), also derived from tuf nucleic acids and/or sequences. These primers sets could be used alone or in conjunction to render the universal assay more ubiquitous.

Universal primers derived from atpD sequences include SEQ ID NOS. 562-565. Combination of these primers does not amplify human DNA but should amplify almost all pathogenic bacterial species except proteobacteria belonging to the epsilon subdivision (*Campylobacter* and *Helicobacter*), the bacteria from the Cytophaga, Flexibacter and *Bacteroides* group and some actinomycetes and *corynebacteria*. By analysing atpD sequences from the latter species, primers and probes to specifically fill these gaps could be designed and used in conjunction with primers SEQ ID NOS. 562-565, also derived from atpD nucleic acids and/or sequences.

In addition, universality of the assay could be expanded by mixing atpD sequences-derived primers with tuf sequences-derived primers. Ultimately, even recA sequences-derived primers could be added to fill some gaps in the universal assay.

It is important to note that the 95 bacterial species selected to test the ubiquity of the universal assay include all of the most clinically relevant bacterial species associated with a variety of human infections acquired in the community or in hospitals (nosocomial infections). The most clinically important bacterial and fungal pathogens are listed in Tables 1 and 2.

Amino Acid Sequences Derived from Tuf, atpD and recA Nucleic Acids and/or Sequences

The amino acid sequences translated from the repertory of tuf, atpD and recA nucleic acids and/or sequences are also an object of the present invention. The amino acid sequence data will be particularly useful for homology modeling of three-dimensional (3D) structure of the elongation factor Tu, elongation factor G, elongation factor 1a, ATPase subunit beta and RecA recombinase. For all these proteins, at least one structure model has been published using X-ray diffraction data from crystals. Based on those structural informations it is possible to use computer software to build 3D model structures for any other protein having peptide sequence homologies with the known structure (Greer, 1991, Methods in Enzymology, 202:239-252; Taylor, 1994, Trends Biotechnol., 12(5):154-158; Sali, 1995, Curr. Opin. Biotechnol. 6:437-451; Sanchez and Sali, 1997, Curr. Opin. Struct. Biol. 7:206-214; Fischer and Eisenberg, 1999, Curr. Opin. Struct. Biol. 9:208-211; Guex et al., 1999, Trends Biochem. Sci. 24: 364-367). Model structures of target proteins are used for the design or to predict the behavior of ligands and inhibitors such as antibiotics. Since EF-Tu and EF-G are already known as antibiotic targets (see above) and since the beta subunit of ATPase and RecA recombinase are essential to the survival of the microbial cells in natural conditions of infection, all four proteins could be considered antibiotic targets. Sequence data, especially the new data generated by us could be very useful to assist the creation of new antibiotic molecules with desired spectrum of activity. In addition, model structures could be used to improve protein function for commercial

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purposes such as improving antibiotic production by microbial strains or increasing biomass.

The following detailed embodiments and appended drawings are provided as illustrative examples of his invention, with no intention to limit the scope thereof.

Examples and Annexes

For sake of clarity, here is a list of Examples and Annexes:

Example 1: Sequencing of bacterial atpD (F-type and V-type) gene fragments.

Example 2: Sequencing of eukaryotic atpD (F-type and V-type) gene fragments.

Example 3: Sequencing of eukaryotic tuf (EF-1) gene fragments.

Example 4: Sequencing of eukaryotic tuf (organelle origin, M) gene fragments.

Example 5: Specific detection and identification of *Streptococcus agalactiae* using tuf sequences.

Example 6: Specific detection and identification of *Streptococcus agalactiae* using atpD sequences.

Example 7: Development of a PCR assay for detection and identification of staphylococci at genus and species levels.

Example 8: Differentiating between the two closely related yeast species *Candida albicans* and *Candida dubliniensis*.

Example 9: Specific detection and identification of *Entamoeba histolytica*.

Example 10: Sensitive detection and identification of *Chlamydia trachomatis*.

Example 11: Genus-specific detection and identification of enterococci.

Example 12: Detection and identification of the major bacterial platelets contaminants using tuf sequences with a multiplex PCR test.

Example 13: The resolving power of the tuf and atpD sequences databases is comparable to the biochemical methods for bacterial identification.

Example 14: Detection of group B streptococci from clinical specimens.

Example 15: Simultaneous detection and identification of *Streptococcus pyogenes* and its pyrogenic exotoxin A.

Example 16: Real-time detection and identification of Shiga toxin-producing bacteria.

Example 17: Development of a PCR assay for the detection and identification of staphylococci at genus and species levels and its associated *mecA* gene.

Example 18: Sequencing of *pbp1a*, *pbp2b* and *pbp2x* genes of *Streptococcus pneumoniae*.

Example 19: Sequencing of *hexA* genes of *Streptococcus* species.

Example 20: Development of a multiplex PCR assay for the detection of *Streptococcus pneumoniae* and its penicillin resistance genes.

Example 21: Sequencing of the vancomycin resistance *vanA*, *vanC1*, *vanC2* and *vanC3* genes.

Example 22: Development of a PCR assay for the detection and identification of enterococci at genus and species levels and its associated resistance genes *vanA* and *vanB*.

Example 23: Development of a multiplex PCR assay for detection and identification of vancomycin-resistant *Enterococcus faecalis*, *Enterococcus faecium*, *Enterococcus gallinarum*, *Enterococcus casseliflavus*, and *Enterococcus flave-scens*.

Example 24: Universal amplification involving the EF-G (*fusA*) subdivision of tuf sequences.

Example 25: DNA fragment isolation from *Staphylococcus saprophyticus* by arbitrarily primed PCR.

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Example 26: Sequencing of prokaryotic tuf gene fragments.

Example 27: Sequencing of prokaryotic *recA* gene fragments.

Example 28: Specific detection and identification of *Escherichia coli/Shigella* sp. using tuf sequences.

Example 29: Specific detection and identification of *Klebsiella pneumoniae* using atpD sequences.

Example 30: Specific detection and identification of *Acinetobacter baumanii* using tuf sequences.

Example 31: Specific detection and identification of *Neisseria gonorrhoeae* using tuf sequences.

Example 32: Sequencing of bacterial *gyrA* and *parC* gene fragments.

Example 33: Development of a PCR assay for the specific detection and identification of *Staphylococcus aureus* and its quinolone resistance genes *gyrA* and *parC*.

Example 34: Development of a PCR assay for the detection and identification of *Klebsiella pneumoniae* and its quinolone resistance genes *gyrA* and *parC*.

Example 35: Development of a PCR assay for the detection and identification of *Streptococcus pneumoniae* and its quinolone resistance genes *gyrA* and *parC*.

Example 36: Detection of extended-spectrum TEM-type β -lactamases in *Escherichia coli*.

Example 37: Detection of extended-spectrum SHV-type β -lactamases in *Klebsiella pneumoniae*.

Example 38: Development of a PCR assay for the detection and identification of *Neisseria gonorrhoeae* and its associated tetracycline resistance gene *tetM*.

Example 39: Development of a PCR assay for the detection and identification of *Shigella* sp. and their associated trimethoprim resistance gene *dhfr1a*.

Example 40: Development of a PCR assay for the detection and identification of *Acinetobacter baumanii* and its associated aminoglycoside resistance gene *aph(3')-VIa*.

Example 41: Specific detection and identification of *Bacteroides fragilis* using atpD (V-type) sequences.

Example 42: Evidence for horizontal gene transfer in the evolution of the elongation factor Tu in Enterococci.

Example 43: Elongation factor Tu (tuf) and the F-ATPase beta-subunit (atpD) as phylogenetic tools for species of the family Enterobacteriaceae.

Example 44: Testing new pairs of PCR primers selected from two species-specific genomic DNA fragments which are objects of U.S. Pat. No. 6,001,564.

Example 45: Testing modified versions of PCR primers derived from the sequence of several primers which are objects of U.S. Pat. No. 6,001,564.

The various Annexes show the strategies used for the selection of a variety of DNA amplification primers, nucleic acid hybridization probes and molecular beacon internal probes:

(i) Table 39 shows the amplification primers used for nucleic acid amplification from tuf sequences.

(ii) Table 40 shows the amplification primers used for nucleic acid amplification from atpD sequences.

(iii) Table 41 shows the internal hybridization probes for detection of tuf sequences.

(iv) Table 42 illustrates the strategy used for the selection of the amplification primers specific for atpD sequences of the F-type.

(v) Table 43 illustrates the strategy used for the selection of the amplification primers specific for atpD sequences of the V-type.

(vi) Table 44 illustrates the strategy used for the selection of the amplification primers specific for the tuf sequences

- of organelle lineage (M, the letter M is used to indicate that in most cases, the organelle is the mitochondria).
- (vii) Table 45 illustrates the strategy used for the selection of the amplification primers specific for the tuf sequences of eukaryotes (EF-1). 5
- (viii) Table 46 illustrates the strategy for the selection of *Streptococcus agalactiae*-specific amplification primers from tuf sequences.
- (ix) Table 47 illustrates the strategy for the selection of *Streptococcus agalactiae*-specific hybridization probes from tuf sequences. 10
- (x) Table 48 illustrates the strategy for the selection of *Streptococcus agalactiae*-specific amplification primers from atpD sequences.
- (xi) Table 49 illustrates the strategy for the selection from tuf sequences of *Candida albicans/dubliniensis*-specific amplification primers, *Candida albicans*-specific hybridization probe and *Candida dubliniensis*-specific hybridization probe. 15
- (xii) Table 50 illustrates the strategy for the selection of *Staphylococcus*-specific amplification primers from tuf sequences.
- (xiii) Table 51 illustrates the strategy for the selection of the *Staphylococcus*-specific hybridization probe from tuf 20 sequences.
- (xiv) Table 52 illustrates the strategy for the selection of *Staphylococcus saprophyticus*-specific and *Staphylococcus haemolyticus*-specific hybridization probes from tuf sequences.
- (xv) Table 53 illustrates the strategy for the selection of *Staphylococcus aureus*-specific and *Staphylococcus epidermidis*-specific hybridization probes from tuf 25 sequences.
- (xvi) Table 54 illustrates the strategy for the selection of the *Staphylococcus hominis*-specific hybridization probe from tuf sequences. 30
- (xvii) Table 55 illustrates the strategy for the selection of the *Enterococcus*-specific amplification primers from tuf sequences.
- (xviii) Table 56 illustrates the strategy for the selection of the *Enterococcus faecalis*-specific hybridization probe, of the *Enterococcus faecium*-specific hybridization probe and of the *Enterococcus casseliflavus/flavescens-gallinarum* group-specific hybridization probe from tuf 45 sequences.
- (xix) Table 57 illustrates the strategy for the selection of primers from tuf sequences for the identification of platelets contaminants.
- (xx) Table 58 illustrates the strategy for the selection of the universal amplification primers from atpD sequences. 50
- (xxi) Table 59 shows the amplification primers used for nucleic acid amplification from recA sequences.
- (xxii) Table 60 shows the specific and ubiquitous primers for nucleic acid amplification from speA sequences. 55
- (xxiii) Table 61 illustrates the first strategy for the selection of *Streptococcus pyogenes*-specific amplification primers from speA sequences.
- (xxiv) Table 62 illustrates the second strategy for the selection of *Streptococcus pyogenes*-specific amplification primers from speA sequences. 60
- (xxv) Table 63 illustrates the strategy for the selection of *Streptococcus pyogenes*-specific amplification primers from tuf sequences.
- (xxvi) Table 64 illustrates the strategy for the selection of stx₁-specific amplification primers and hybridization probe. 65

- (xxvii) Table 65 illustrates the strategy for the selection of stx₂-specific amplification primers and hybridization probe.
- (xxviii) Table 66 illustrates the strategy for the selection of vanA-specific amplification primers from van sequences.
- (xxix) Table 67 illustrates the strategy for the selection of vanB-specific amplification primers from van sequences.
- (xxx) Table 68 illustrates the strategy for the selection of vanC-specific amplification primers from vanC sequences.
- (xxxi) Table 69 illustrates the strategy for the selection of *Streptococcus pneumoniae*-specific amplification primers and hybridization probes from pbp1a sequences.
- (xxxii) Table 70 shows the specific and ubiquitous primers for nucleic acid amplification from toxin gene sequences.
- (xxxiii) Table 71 shows the molecular beacon internal hybridization probes for specific detection of toxin sequences.
- (xxxiv) Table 72 shows the specific and ubiquitous primers for nucleic acid amplification from van sequences.
- (xxxv) Table 73 shows the internal hybridization probes for specific detection of van sequences.
- (xxxvi) Table 74 shows the specific and ubiquitous primers for nucleic acid amplification from pbp sequences.
- (xxxvii) Table 75 shows the internal hybridization probes for specific detection of pbp sequences.
- (xxxviii) Table 76 illustrates the strategy for the selection of vanAB-specific amplification primers and vanA- and vanB-specific hybridization probes from van sequences.
- (xxxix) Table 77 shows the internal hybridization probe for specific detection of mecA.
- (xl) Table 78 shows the specific and ubiquitous primers for nucleic acid amplification from hexA sequences.
- (xli) Table 79 shows the internal hybridization probe for specific detection of hexA.
- (xlii) Table 80 illustrates the strategy for the selection of *Streptococcus pneumoniae* species-specific amplification primers and hybridization probe from hexA sequences.
- (xlii) Table 81 shows the specific and ubiquitous primers for nucleic acid amplification from pep sequences.
- (xliv) Table 82 shows specific and ubiquitous primers for nucleic acid amplification of *S. saprophyticus* sequences of unknown coding potential.
- (xlv) Table 83 shows the molecular beacon internal hybridization probes for specific detection of antimicrobial agents resistance gene sequences.
- (xlii) Table 84 shows the molecular beacon internal hybridization probe for specific detection of *S. aureus* gene sequences of unknown coding potential.
- (xlvii) Table 85 shows the molecular beacon hybridization internal probe for specific detection of tuf sequences.
- (xlviii) Table 86 shows the molecular beacon internal hybridization probes for specific detection of ddl and mtl sequences.
- (xlii) Table 87 shows the internal hybridization probe for specific detection of *S. aureus* sequences of unknown coding potential.
- (li) Table 88 shows the amplification primers used for nucleic acid amplification from antimicrobial agents resistance genes sequences.
- (li) Table 89 shows the internal hybridization probes for specific detection of antimicrobial agents resistance genes sequences.

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- (iii) Table 90 shows the molecular beacon internal hybridization probes for specific detection of atpD sequences.
- (iii) Annex Table 91 shows the internal hybridization probes for specific detection of atpD sequences.
- (iv) Table 92 shows the internal hybridization probes for specific detection of ddI and mtI sequences.

As shown in these Annexes, the selected amplification primers may contain inosines and/or base ambiguities. Inosine is a nucleotide analog able to specifically bind to any of the four nucleotides A, C, G or T. Alternatively, degenerated oligonucleotides which consist of an oligonucleotide mix having two or more of the four nucleotides A, C, G or T at the site of mismatches were used. The inclusion of inosine and/or of degeneracies in the amplification primers allows mismatch tolerance thereby permitting the amplification of a wider array of target nucleotide sequences (Dieffenbach and Dveksler, 1995 PCR Primer: A Laboratory Manual, Cold Spring Harbor Laboratory Press, Plainview, N.Y.).

EXAMPLES

Example 1

Sequencing of Bacterial atpD (F-Type and V-Type) Gene Fragments

As shown in Table 42, the comparison of publicly available atpD (F-type) sequences from a variety of bacterial species revealed conserved regions allowing the design of PCR primers able to amplify atpD sequences (F-type) from a wide range of bacterial species. Using primers pairs SEQ ID NOs. 566 and 567, 566 and 814, 568 and 567, 570 and 567, 572 and 567, 569 and 567, 571 and 567, 700 and 567, it was possible to amplify and sequence atpD sequences SEQ ID NOs. 242-270, 272-398, 673-674, 737-767, 866-867, 942-955, 1245-1254, 1256-1265, 1527, 1576, 1577, 1600-1604, 1640-1646, 1649, 1652, 1655, 1657, 1659-1660, 1671, 1844-1845, and 1849-1865.

Similarly, Table 43 shows the strategy to design the PCR primers able to amplify atpD sequences of the V-type from a wide range of archaeal and bacterial species. Using primers SEQ ID NOs. 681-683, it was possible to amplify and sequence atpD sequences SEQ ID NOs. 827-832, 929-931, 958 and 966. As the gene was difficult to amplify for several species, additional amplification primers were designed inside the original amplicon (SEQ ID NOs. 1203-1207) in order to obtain sequence information for these species. Other primers (SEQ ID NO. 1212, 1213, 2282-2285) were also designed to amplify regions of the atpD gene (V-type) in archaebacteria.

Example 2

Sequencing of Eukaryotic atpD (F-Type and V-Type) Gene Fragments

The comparison of publicly available atpD (F-type) sequences from a variety of fungal and parasitical species revealed conserved regions allowing the design of PCR primers able to amplify atpD sequences from a wide range of fungal and parasitical species. Using primers pairs SEQ ID NOs. 568 and 573, 574 and 573, 574 and 708, and 566 and 567, it was possible to amplify and sequence atpD sequences SEQ ID NOs. 458-497, 530-538, 663, 667, 676, 678-680, 768-778, 856-862, 889-896, 941, 1638-1639, 1647, 1650-1651, 1653-1654, 1656, 1658, 1684, 1846-1848, and 2189-2192.

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In the same manner, the primers described in Table 43 (SEQ ID NOs. 681-683) could amplify the atpD (V-type) gene from various fungal and parasitical species. This strategy allowed to obtain SEQ ID NOs. 834-839, 956-957, and 959-965.

Example 3

Sequencing of Eukaryotic tuf (EF-1) Gene Fragments

As shown in Table 45, the comparison of publicly available tuf (EF-1) sequences from a variety of fungal and parasitical species revealed conserved regions allowing the design of PCR primers able to amplify tuf sequences from a wide range of fungal and parasitical species. Using primers pairs SEQ ID NOs. 558 and 559, 813 and 559, 558 and 815, 560 and 559, 653 and 559, 558 and 655, and 654 and 559, 1999 and 2000, 2001 and 2003, 2002 and 2003, it was possible to amplify and sequence tuf sequences SEQ ID NOs. 399-457, 509-529, 622-624, 677, 779-790, 840-842, 865, 897-903, 1266-1287, 1561-1571 and 1685.

Example 4

Sequencing of Eukaryotic tuf (Organelle Origin, M) Gene Fragments

As shown in Table 44, the comparison of publicly available tuf (organelle origin, M) sequences from a variety of fungal and parasitical organelles revealed conserved regions allowing the design of PCR primers able to amplify tuf sequences of several organelles belonging to a wide range fungal and parasitical species. Using primers pairs SEQ ID NOs. 664 and 652, 664 and 561, 911 and 914, 912 and 914, 913 and 915, 916 and 561, 664 and 917, it was possible to amplify and sequence tuf sequences SEQ ID NOs. 498-508, 791-792, 843-855, 904-910, 1664, 1666-1667, 1669-1670, 1673-1683, 1686-1689, 1874-1876, 1879, 1956-1960, and 2193-2199.

Example 5

Specific Detection and Identification of *Streptococcus agalactiae* Using tuf Sequences

As shown in Table 46, the comparison of tuf sequences from a variety of bacterial species allowed the selection of PCR primers specific for *S. agalactiae*. The strategy used to design the PCR primers was based on the analysis of a multiple sequence alignment of various tuf sequences. The multiple sequence alignment includes the tuf sequences of four bacterial strains from the target species as well as tuf sequences from other species and bacterial genera, especially representatives of closely related species. A careful analysis of this alignment allowed the selection of oligonucleotide sequences which are conserved within the target species but which discriminate sequences from other species and genera, especially from the closely related species, thereby permitting the species-specific, ubiquitous and sensitive detection and identification of the target bacterial species.

The chosen primer pair, oligos SEQ ID NO. 549 and SEQ ID NO. 550, gives an amplification product of 252 bp. Standard PCR was carried out using 0.4 μM of each primer, 2.5 mM MgCl₂, BSA 0.05 mM, 1× Taq Buffer (Promega), dNTP 0.2 mM (Pharmacia), 0.5 U Taq DNA polymerase (Promega) coupled with TaqStart™ antibody (Clontech Laboratories Inc., Palo Alto), 1 μl of genomic DNA sample in a final

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volume of 20 μ l using a PTC-200 thermocycler (MJ Research Inc.). The optimal cycling conditions for maximum sensitivity and specificity were 3 minutes at 95° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 62° C., followed by terminal extension at 72° C. for 2 minutes. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 μ g/ml of ethidium bromide.

Specificity of the assay was tested by adding into the PCR reactions, 0.1 ng of genomic DNA from each of the bacterial species listed in Table 8. Efficient amplification was observed only for the 5 *S. agalactiae* strains listed. Of the other bacterial species, including 32 species representative of the vaginal flora and 27 other streptococcal species, only *S. acidominimus* yielded amplification. The signal with 0.1 ng of *S. acidominimus* genomic DNA was weak and the detection limit for this species was 10 pg (corresponding to more than 4000 genome copies) while the detection limit for *S. agalactiae* was 2.5 fg (corresponding to one genome copy) of genomic DNA.

To increase the specificity of the assay, internal probes were designed for FRET (Fluorescence Resonance Energy Transfer) detection using the LightCycler™ (Idaho Technology). As illustrated in Table 47, a multiple sequence alignment of streptococcal tuf sequence fragments corresponding to the 252 bp region amplified by primers SEQ ID NO. 549 and SEQ ID NO. 550, was used for the design of internal probes TSagHF436 (SEQ ID NO. 582) and TSagHF465 (SEQ ID NO. 583). The region of the amplicon selected for internal probes contained sequences unique and specific to *S. agalactiae*. SEQ ID NO. 583, the more specific probe, is labelled with fluorescein in 3', while SEQ ID NO. 582, the less discriminant probe, is labelled with CY5 in 5' and blocked in 3' with a phosphate group. However, since the FRET signal is only emitted if both probes are adjacently hybridized on the same target amplicon, detection is highly specific.

Real-time detection of PCR products using the LightCycler™ was carried out using 0.4 μ M of each primer (SEQ ID NO. 549-550), 0.2 μ M of each probe (SEQ ID NO. 582-583), 2.5 mM MgCl₂, BSA 450 μ g/ml, 1 \times PC2 Buffer (AB Peptides, St-Louis, Mo.), dNTP 0.2 mM (Pharmacia), 0.5 U Klen-Taq1™ DNA polymerase (AB Peptides) coupled with TaqStart™ antibody (Clontech Laboratories Inc., Palo Alto), 0.7 μ l of genomic DNA sample in a final volume of 7 μ l using a LightCycler thermocycler (Idaho Technology). The optimal cycling conditions for maximum sensitivity and specificity were 3 minutes at 94° C. for initial denaturation, then forty cycles of three steps consisting of 0 second (this setting meaning the LightCycler will reach the target temperature and stay at it for its minimal amount of time) at 94° C., 10 seconds at 64° C., 20 seconds at 72° C. Amplification was monitored during each annealing steps using the fluorescence ratio. The streptococcal species having close sequence homologies with the tuf sequence of *S. agalactiae* (*S. acidominimus*, *S. anginosus*, *S. Bovis*, *S. dysgalactiae*, *S. equi*, *S. ferus*, *S. gordonii*, *S. intermedius*, *S. parasanguis*, *S. parauberis*, *S. salivarius*, *S. sanguis*, *S. suis*) as well as *S. agalactiae* were tested in the LightCycler with 0.07 ng of genomic DNA per reaction. Only *S. agalactiae* yielded an amplification signal, hence demonstrating that the assay is species-specific. With the LightCycler™ assay using the internal FRET probes, the detection limit for *S. agalactiae* was 1-2 genome copies of genomic DNA.

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Example 6

Specific Detection and Identification of *Streptococcus agalactiae* Using atpD Sequences

As shown in Table 48, the comparison of atpD sequences from a variety of bacterial species allowed the selection of PCR primers specific for *S. agalactiae*. The primer design strategy is similar to the strategy described in the preceding Example except that atpD sequences were used in the alignment.

Four primers were selected, ASag42 (SEQ ID NO. 627), ASag52 (SEQ ID NO. 628), ASag206 (SEQ ID NO. 625) and ASag371 (SEQ ID NO. 626). The following combinations of these four primers give four amplicons; SEQ ID NO. 627+SEQ ID NO. 625=190 bp, SEQ ID NO. 628+SEQ ID NO. 625=180 bp, SEQ ID NO. 627+SEQ ID NO. 626=355 bp, and SEQ ID NO. 628+SEQ ID NO. 626=345 bp.

Standard PCR was carried out on PTC-200 thermocyclers (MJ Research Inc) using 0.4 μ M of each primers pair, 2.5 mM MgCl₂, BSA 0.05 mM, 1 \times taq Buffer (Promega), dNTP 0.2 mM (Pharmacia), 0.5 U Taq DNA polymerase (Promega) coupled with TaqStart™ antibody (Clontech Laboratories Inc., Palo Alto), 1 μ l of genomic DNA sample in a final volume of 20 μ L. The optimal cycling conditions for maximum sensitivity and specificity were adjusted for each primer pair. Three minutes at 95° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at the optimal annealing temperature specified below were followed by terminal extension at 72° C. for 2 minutes. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 μ g/ml of ethidium bromide. Since atpD sequences are relatively more specific than tuf sequences, only the most closely related species namely, the streptococcal species listed in Table 9, were tested.

All four primer pairs only amplified the six *S. agalactiae* strains. With an annealing temperature of 63° C., the primer pair SEQ ID NO. 627+SEQ ID NO. 625 had a sensitivity of 1-5 fg (equivalent to 1-2 genome copies). At 55° C., the primer pair SEQ ID NO. 628+SEQ ID NO. 625 had a sensitivity of 2.5 fg (equivalent to 1 genome copy). At 60° C., the primer pair SEQ ID NO. 627+SEQ ID NO. 626 had a sensitivity of 10 fg (equivalent to 4 genome copies). At 58° C., the primer pair SEQ ID NO. 628+SEQ ID NO. 626 had a sensitivity of 2.5-5 fg (equivalent to 1-2 genome copies). This proves that all four primer pairs can detect *S. agalactiae* with high specificity and sensitivity. Together with Example 5, this example demonstrates that both tuf and atpD sequences are suitable and flexible targets for the identification of microorganisms at the species level. The fact that 4 different primer pairs based on atpD sequences led to efficient and specific amplification of *S. agalactiae* demonstrates that the challenge is to find target genes suitable for diagnostic purposes, rather than finding primer pairs from these target sequences.

Example 7

Development of a PCR Assay for Detection and Identification of Staphylococci at Genus and Species Levels

Materials and Methods

Bacterial strains. The specificity of the PCR assay was verified by using a panel of ATCC (America Type Culture Collection) and DSMZ (Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH; German Collection of

Microorganisms and Cell Cultures) reference strains consisting of 33 gram-negative and 47 gram-positive bacterial species (Table 12). In addition, 295 clinical isolates representing 11 different species of staphylococci from the microbiology laboratory of the Centre Hospitalier Universitaire de Québec, Pavillon Centre Hospitalier de l'Université Laval (CHUL) (Step-Foy, Québec, Canada) were also tested to further validate the *Staphylococcus*-specific PCR assay. These strains were all identified by using (i) conventional methods or (ii) the automated MicroScan Autoscanner system equipped with the Positive BP Combo Panel Type 6 (Dade Diagnostics, Mississauga, Ontario, Canada). Bacterial strains from frozen stocks kept at -80°C. in brain heart infusion (BHI) broth containing 10% glycerol were cultured on sheep blood agar or in BHI broth (Quelab Laboratories Inc, Montréal, Québec, Canada).

PCR primers and internal probes. Based on multiple sequence alignments, regions of the tuf gene unique to staphylococci were identified. *Staphylococcus*-specific PCR primers TStaG422 (SEQ ID NO. 553) and TStaG765 (SEQ ID NO. 575) were derived from these regions (Table 50). These PCR primers are displaced by two nucleotide positions compared to original *Staphylococcus*-specific PCR primers described in our patent publication WO98/20157 (SEQ ID NOS. 17 and 20 in the said patent publication). These modifications were done to ensure specificity and ubiquity of the primer pair, in the light of new tuf sequence data revealed in the present patent application for several additional staphylococcal species and strains.

Similarly, sequence alignment analysis were performed to design genus and species-specific internal probes (see Tables 61 to 64). Two internal probes specific for *Staphylococcus* (SEQ ID NOS. 605-606), five specific for *S. aureus* (SEQ ID NOS. 584-588), five specific for *S. epidermidis* (SEQ ID NO. 589-593), two specific for *S. haemolyticus* (SEQ ID NOS. 594-595), three specific for *S. hominis* (SEQ ID NOS. 596-598), four specific for *S. saprophyticus* (SEQ ID NOS. 599-601 and 695), and two specific for coagulase-negative *Staphylococcus* species including *S. epidermidis*, *S. hominis*, *S. saprophyticus*, *S. auricularis*, *S. capitis*, *S. haemolyticus*, *S. lugdunensis*, *S. simulans*, *S. cohnii* and *S. warneri* (SEQ ID NOS. 1175-1176) were designed. The range of mismatches between the *Staphylococcus*-specific 371-bp amplicon and each of the 20-mer species-specific internal probes was from 1 to 5, in the middle of the probe when possible. No mismatches were present in the two *Staphylococcus*-specific probes for the 11 species analyzed: *S. aureus*, *S. auricularis*, *S. capitis*, *S. cohnii*, *S. epidermidis*, *S. haemolyticus*, *S. hominis*, *S. lugdunensis*, *S. saprophyticus*, *S. simulans* and *S. warneri*. In order to verify the intra-specific sequence conservation of the nucleotide sequence, sequences were obtained for the 371-bp amplicon from five unrelated ATCC and clinical strains for each of the species *S. aureus*, *S. epidermidis*, *S. haemolyticus*, *S. hominis* and *S. saprophyticus*. The Oligo™ (version 5.0) primer analysis software (National Biosciences, Plymouth, Minn.) was used to confirm the absence of self-complementary regions within and between the primers or probes. When required, the primers contained inosines or degenerated nucleotides at one or more variable positions. Oligonucleotide primers and probes were synthesized on a model 394 DNA synthesizer (Applied Biosystems, Mississauga, Ontario, Canada). Detection of the hybridization was performed with the DIG-labeled dUTP incorporated during amplification with the *Staphylococcus*-specific PCR assay, and the hybridization signal was detected with a luminometer (Dynex Technologies) as described above in the section on

luminescent detection of amplification products. Tables 61 to 64 illustrate the strategy for the selection of several internal probes.

PCR amplification. For all bacterial species, amplification was performed from purified genomic DNA or from a bacterial suspension whose turbidity was adjusted to that of a 0.5 McFarland standard, which corresponds to approximately 1.5×10^8 bacteria per ml. One nanogram of genomic DNA or 1 μ l of the standardized bacterial suspension was transferred directly to a 19 μ l PCR mixture. Each PCR reaction contained 50 mM KCl, 10 mM Tris-HCl (pH 9.0), 0.1% Triton X-100, 2.5 mM MgCl₂, 0.20M (each) of the two *Staphylococcus* genus-specific primers (SEQ ID NOS. 553 and 575), 2000M (each) of the four deoxynucleoside triphosphates (Pharmacia Biotech), 3.3 μ g/ μ l bovine serum albumin (BSA) (Sigma-Aldrich Canada Ltd, Oakville, Ontario, Canada), and 0.5 U Taq polymerase (Promega) coupled with TaqStart™ Antibody (Clontech). The PCR amplification was performed as follows: 3 min. at 94°C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95°C. and 30 seconds at 55°C., plus a terminal extension at 72°C. for 2 minutes. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 μ g/ml of ethidium bromide. Visualization of the PCR products was made under UV at 254 nm.

For determination of the sensitivities of the PCR assays, two-fold dilutions of purified genomic DNA were used to determine the minimal number of genome copies which can be detected.

Results

Amplifications with the *Staphylococcus* genus-specific PCR assay. The specificity of the assay was assessed by performing 30-cycle and 40-cycle PCR amplifications with the panel of gram-positive (47 species from 8 genera) and gram-negative (33 species from 22 genera) bacterial species listed in Table 12. The PCR assay was able to detect efficiently 27 of 27 staphylococcal species tested in both 30-cycle and 40-cycle regimens. For 30-cycle PCR, all bacterial species tested other than staphylococci were negative. For 40-cycle PCR, *Enterococcus faecalis* and *Macrococcus caseolyticus* were slightly positive for the *Staphylococcus*-specific PCR assay. The other species tested remained negative. Ubiquity tests performed on a collection of 295 clinical isolates provided by the microbiology laboratory of the Centre Hospitalier Universitaire de Québec, Pavillon Centre Hospitalier de l'Université Laval (CHUL), including *Staphylococcus aureus* (n=34), *S. auricularis* (n=2), *S. capitis* (n=19), *S. cohnii* (n=5), *S. epidermidis* (n=18), *S. haemolyticus* (n=21), *S. hominis* (n=73), *S. lugdunensis* (n=17), *S. saprophyticus* (n=6), *S. simulans* (n=3), *S. warneri* (n=32) and *Staphylococcus* sp. (n=65), showed a uniform amplification signal with the 30-cycle PCR assays and a perfect relation between the genotype and classical identification schemes.

The sensitivity of the *Staphylococcus*-specific assay with 30-cycle and 40-cycle PCR protocols was determined by using purified genomic DNA from the 11 staphylococcal species previously mentioned. For PCR with 30 cycles, a detection limit of 50 copies of genomic DNA was consistently obtained. In order to enhance the sensitivity of the assay, the number of cycles was increased. For 40-cycle PCR assays, the detection limit was lowered to a range of 5-10 genome copies, depending on the staphylococcal species tested.

Hybridization between the *Staphylococcus*-specific 371-bp amplicon and species-specific or genus-specific internal probes. Inter-species polymorphism was sufficient to gener-

ate species-specific internal probes for each of the principal species involved in human diseases (*S. aureus*, *S. epidermidis*, *S. haemolyticus*, *S. hominis* and *S. saprophyticus*). In order to verify the intra-species sequence conservation of the nucleotide sequence, sequence comparisons were performed on the 371-bp amplicon from five unrelated ATCC and clinical strains for each of the 5 principal staphylococcal species: *S. aureus*, *S. epidermidis*, *S. haemolyticus*, *S. hominis* and *S. saprophyticus*. Results showed a high level of conservation of nucleotide sequence between different unrelated strains from the same species. This sequence information allowed the development of staphylococcal species identification assays using species-specific internal probes hybridizing to the 371-bp amplicon. These assays are specific and ubiquitous for those five staphylococcal species. In addition to the species-specific internal probes, the genus-specific internal probes were able to recognize all or most *Staphylococcus* species tested.

Example 8

Differentiating Between the Two Closely Related Yeast Species *Candida albicans* and *Candida dubliniensis*

It is often useful for the clinician to be able to differentiate between two very closely related species of microorganisms. *Candida albicans* is the most important cause of invasive human mycoses. In recent years, a very closely related species, *Candida dubliniensis*, was isolated in immunosuppressed patients. These two species are difficult to distinguish by classic biochemical methods. This example demonstrates the use of tuf sequences to differentiate *Candida albicans* and *Candida dubliniensis*. PCR primers SEQ ID NOs. 11-12, from previous patent publication WO98/20157, were selected for their ability to specifically amplify a tuf (elongation factor 1 alpha type) fragment from both species (see Annex XI for primer positions). Within this tuf fragment, a region differentiating *C. albicans* and *C. dubliniensis* by two nucleotides was selected and used to design two internal probes (see Table 49 for probe design, SEQ ID NOs. 577 and 578) specific for each species. Amplification of genomic DNA from *C. albicans* and *C. dubliniensis* was carried out using DIG-11-dUTP as described above in the section on chemiluminescent detection of amplification products. Internal probes SEQ ID NOs. 577 and 578 were immobilized on the bottom of individual microtiter plates and hybridization was carried out as described above in the above section on chemiluminescent detection of amplification products. Luminometer data showed that the amplicon from *C. albicans* hybridized only to probe SEQ ID NO. 577 while the amplicon from *C. dubliniensis* hybridized only to probe SEQ ID NO. 578, thereby demonstrating that each probe was species-specific.

Example 9

Specific Identification of *Entamoeba histolytica*

Upon analysis of tuf (elongation factor 1 alpha) sequence data, it was possible to find four regions where *Entamoeba histolytica* sequences remained conserved while other parasitic and eukaryotic species have diverged. Primers TEntG38 (SEQ ID NO. 703), TEntG442 (SEQ ID NO. 704), TEntG534 (SEQ ID NO. 705), and TEntG768 (SEQ ID NO. 706) were designed so that SEQ ID NO. 703 could be paired with the three other primers. On PTC-200 thermocyclers (MJ

Research), the cycling conditions for initial sensitivity and specificity testing were 3 min. at 94° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 55° C., followed by terminal extension at 72° C. for 2 minutes. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 µg/ml of ethidium bromide. The three primer pairs could detect the equivalent of less than 200 *E. histolytica* genome copies. Specificity was tested using 0.5 ng of purified genomic DNA from a panel of microorganisms including *Babesia bovis*, *Babesia microti*, *Candida albicans*, *Crithidia fasciculata*, *Leishmania major*, *Leishmania hertigi* and *Neospora caninum*. Only *E. histolytica* DNA could be amplified, thereby suggesting that the assay was species-specific.

Example 10

Sensitive Identification of *Chlamydia trachomatis*

Upon analysis of tuf sequence data, it was possible to find two regions where *Chlamydia trachomatis* sequences remained conserved while other species have diverged. Primers Ctr82 (SEQ ID NO. 554) and Ctr249 (SEQ ID NO. 555) were designed. With the PTC-200 thermocyclers (MJ Research), the optimal cycling conditions for maximum sensitivity and specificity were determined to be 3 min. at 94° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 60° C., followed by terminal extension at 72° C. for 2 minutes. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 µg/ml of ethidium bromide. The assay could detect the equivalent of 8 *C. trachomatis* genome copies. Specificity was tested with 0.1 ng of purified genomic DNA from a panel of microorganisms including 22 species commonly encountered in the vaginal flora (*Bacillus subtilis*, *Bacteroides fragilis*, *Candida albicans*, *Clostridium difficile*, *Corynebacterium cervicis*, *Corynebacterium urealyticum*, *Enterococcus faecalis*, *Enterococcus faecium*, *Escherichia coli*, *Fusobacterium nucleatum*, *Gardnerella vaginalis*, *Hæmophilus influenzae*, *Klebsiella oxytoca*, *Lactobacillus acidophilus*, *Peptococcus niger*, *Peptostreptococcus prevotii*, *Porphyromonas asaccharolytica*, *Prevotella melanogengenica*, *Propionibacterium acnes*, *Staphylococcus aureus*, *Streptococcus acidominimus*, and *Streptococcus agalactiae*). Only *C. trachomatis* DNA could be amplified, thereby suggesting that the assay was species-specific.

Example 11

Genus-Specific Detection and Identification of Enterococci

Upon analysis of tuf sequence data and comparison with the repertory of tuf sequences, it was possible to find two regions where *Enterococcus* sequences remained conserved while other genera have diverged (Table 65). Primer pair Encg313dF and Encg599c (SEQ ID NOs. 1137 and 1136) was tested for its specificity by using purified genomic DNA from a panel of bacteria listed in Table 10. Using the PTC-200 thermocycler (MJ Research), the optimal cycling conditions for maximum sensitivity and specificity were determined to be 3 min. at 94° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 55° C., followed by terminal extension at 72° C. for 2 minutes. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 µg/ml of ethidium bromide. Visualization of the PCR products was

made under UV at 254 nm. The 18 enterococcal species listed in Table 10 were all amplified efficiently. The only other species amplified were *Abiotrophia adiacens*, *Gemella haemolysans* and *Gemella morbillorum*, three gram-positive species. Sensitivity tested with several strains of *E. casseliflavus*, *E. faecium*, *E. faecalis*, *E. flavescentis* and *E. gallinarum* and with one strain of each other *Enterococcus* species listed in Table 10 ranged from 1 to 10 copies of genomic DNA. The sequence variation within the 308-bp amplicon was sufficient so that internal probes could be used to speciate the amplicon and differentiate enterococci from *Abiotrophia adiacens*, *Gemella haemolysans* and *Gemella morbillorum*, thereby allowing to achieve excellent specificity. Species-specific internal probes were generated for each of the clinically important species, *E. faecalis* (SEQ ID NO. 1174), *E. faecium* (SEQ ID NO. 602), and the group including *E. casseliflavus*, *E. flavescentis* and *E. gallinarum* (SEQ ID NO. 1122) (Table 66). The species-specific internal probes were able to differentiate their respective *Enterococcus* species from all other *Enterococcus* species. These assays are sensitive, specific and ubiquitous for those five *Enterococcus* species.

Example 12

Identification of the Major Bacterial Platelets Contaminants Using Tuf Sequences with a Multiplex PCR Test

Blood platelets preparations need to be monitored for bacterial contaminations. The tuf sequences of 17 important bacterial contaminants of platelets were aligned. As shown in Table 57, analysis of these sequences allowed the design of PCR primers. Since in the case of contamination of platelet concentrates, detecting all species (not just the more frequently encountered ones) is desirable, perfect specificity of primers was not an issue in the design. However, sensitivity is important. That is why, to avoid having to put too much degeneracy, only the most frequent contaminants were included in primer design, knowing that the selected primers would anyway be able to amplify more species than the 17 used in the design because they target highly conserved regions of tuf sequences. Oligonucleotide sequences which are conserved in these 17 major bacterial contaminants of platelet concentrates were chosen (oligos Tplaq 769 and Tplaq 991, respectively SEQ ID NOS. 636 and 637) thereby permitting the detection of these bacterial species. However, sensitivity was slightly deficient with staphylococci. To ensure maximal sensitivity in the detection of all the more frequent bacterial contaminants, a multiplex assay also including oligonucleotide primers targeting the *Staphylococcus* genera (oligos Stag 422, SEQ ID NO. 553; and Stag 765, SEQ ID NO. 575) was developed. The bacterial species detected with the assay are listed in Table 14.

The primer pairs, oligos SEQ ID NO. 636 and SEQ ID NO. 637 that give an amplification product of 245 pb, and oligos SEQ ID NO. 553 and SEQ ID NO. 575 that give an amplification product of 368 pb, were used simultaneously in the multiplex PCR assay. Detection of these PCR products was made on the LightCycler thermocycler (Idaho Technology) using SYBR® Green I (Molecular Probe Inc.). SYBR® Green I is a fluorescent dye that binds specifically to double-stranded DNA.

Fluorogenic detection of PCR products with the LightCycler was carried out using 1.0 µM of both Tplaq primers (SEQ ID NOS. 636-637) and 0.4 µM of both TStaG primers (SEQ ID NOS. 553 and 575), 2.5 mM MgCl₂, BSA 7.5 µM, dNTP 0.2 mM (Pharmacia), 10 mM Tris-HCl (pH 8.3), 50 mM KCl,

0.5 U Taq DNA polymerase (Boehringer Mannheim) coupled with TaqStart™ antibody (Clontech), and 0.07 ng of genomic DNA sample in a final volume of 7. The optimal cycling conditions for maximum sensitivity and specificity were 1 minute at 94° C. for initial denaturation, then forty-five cycles of three steps consisting of 0 second at 95° C., 5 seconds at 60° C. and 9 seconds at 72° C. Amplification was monitored during each elongation cycle by measuring the level of SYBR® Green I. However, real analysis takes place after PCR. Melting curves are done for each sample and transformation of the melting peak allows determination of Tm. Thus primer-dimer and specific PCR product are discriminated. With this assay, all prominent bacterial contaminants of platelet concentrates listed in Table 57 and Table 14 were detected. Sensitivity tests were performed on the 9 most frequent bacterial contaminants of platelets. The detection limit was less than 20 genome copies for *E. cloacae*, *B. cereus*, *S. choleraesuis* and *S. marcescens*; less than 15 genome copies for *P. aeruginosa*; and 2 to 3 copies were detected for *S. aureus*, *S. epidermidis*, *E. coli* and *K. pneumoniae*. Further refinements of assay conditions should increase sensitivity levels.

Example 13

The Resolving Power of the tuf and atpD Sequences Databases is Comparable to the Biochemical Methods for Bacterial Identification

The present gold standard for bacterial identification is mainly based on key morphological traits and batteries of biochemical tests. Here we demonstrate that the use of tuf and atpD sequences combined with simple phylogenetic analysis of databases formed by these sequences is comparable to the gold standard. In the process of acquiring data for the tuf sequences, we sequenced the tuf gene of a strain that was given to us labelled as *Staphylococcus hominis* ATCC 35982. That tuf sequence (SEQ ID NO. 192) was incorporated into the tuf sequences database and subjected to a basic phylogenetic analysis using the Pileup command from version 10 of the GCG package (Genetics Computer Group). This analysis indicated that SEQ ID NO. 192 is not associated with other *S. hominis* strains but rather with the *S. warneri* strains. The ATCC 35982 strain was sent to the reference laboratory of the Laboratoire de santé publique du Québec (LSPQ). They used the classic identification scheme for staphylococci (Kloos and Schleifer, 1975., J. Clin. Microbiol. 1:82-88). Their results shown that although the colonial morphology could correspond to *S. hominis*, the more precise biochemical assays did not. These assays included discriminant mannitol, mannose and ribose acidification tests as well as rapid and dense growth in deep thioglycolate agar. The LSPQ report identified strain ATCC 35982 as *S. warneri* which confirms our database analysis. The same thing happened for *S. warneri* (SEQ ID NO. 187) which had initially been identified as *S. haemolyticus* by a routine clinical laboratory using a low resolving power automated system (MicroScan, AutoScan-4™). Again, the tuf and LSPQ analysis agreed on its identification as *S. warneri*. In numerous other instances, in the course of acquiring tuf and atpD sequence data from various species and genera, analysis of our tuf and/or atpD sequence databases permitted the exact identification of mislabelled or erroneously identified strains. These results clearly demonstrate the usefulness and the high resolving power of our sequence-based identification assays using the tuf and atpD sequences databases.

Example 14

Detection Of Group B Streptococci From Clinical Specimens*

Introduction

Streptococcus agalactiae, the group B *streptococcus* (GBS), is responsible for a severe illness affecting neonate infants. The bacterium is passed from the healthy carrier mother to the baby during delivery. To prevent this infection, it is recommended to treat expectant mothers susceptible of carrying GBS in their vaginal/anal flora. Carrier status is often a transient condition and rigorous monitoring requires cultures and classic bacterial identification weeks before delivery. To improve the detection and identification of GBS we developed a rapid, specific and sensitive PCR test fast enough to be performed right at delivery.

Materials and Methods

GBS clinical specimens. A total of 66 duplicate vaginal/anal swabs were collected from 41 consenting pregnant women admitted for delivery at the Centre Hospitalier Universitaire de Québec, Pavillon Saint-François d'Assise following the CDC recommendations. The samples were obtained either before or after rupture of membranes. The swab samples were tested at the Centre de Recherche en Infectiologie de l'Université Laval within 24 hours of collection. Upon receipt, one swab was cut and then the tip of the swab was added to GNS selective broth for identification of group B streptococci (GBS) by the standard culture methods recommended by the CDC. The other swab was processed following the instruction of the IDI DNA extraction kit (Infectio Diagnostics (IDI) Inc.) prior to PCR amplification.

Oligonucleotides. PCR primers, Tsag340 (SEQ ID NO. 549) and Tsag552 (SEQ ID NO. 550) complementary to the regions of the tuf gene unique for GBS were designed based upon a multiple sequence alignment using our repertory of tuf sequences. Oligo primer analysis software (version 5.0) (National Biosciences) was used to analyse primers annealing temperature, secondary structure potential as well as mispriming and dimerization potential. The primers were synthesized using a model 391 DNA synthesizer (Applied Biosystems).

A pair of fluorescently labeled adjacent hybridization probes Sag465-F (SEQ ID NO. 583) and Sag436-C (SEQ ID NO. 582) were synthesized and purified by Operon Technologies. They were designed to meet the recommendations of the manufacturer (Idaho Technology) and based upon multiple sequence alignment analysis using our repertory of tuf sequences to be specific and ubiquitous for GBS. These adjacent probes, which are separated by one nucleotide, allow fluorescence resonance energy transfer (FRET), generating an increased fluorescence signal when both hybridized simultaneously to their target sequences. The probe SEQ ID NO. 583 was labeled with FITC in 3 prime while SEQ ID NO. 582 was labeled with Cy5 in 5 prime. The Cy5-labeled probes contained a 3'-blocking phosphate group to prevent extension of the probes during the PCR reactions.

PCR amplification. Conventional amplifications were performed either from 2 µl of a purified genomic DNA preparation or cell lysates of vaginal/anal specimens. The 20 µl PCR mixture contained 0.4 µM of each GBS-specific primer (SEQ ID NOS. 549-550), 200 µM of each deoxyribonucleotide (Pharmacia Biotech), 10 mM Tris-HCl (pH 9.0), 50 mM KCl, 0.1% Triton X-100, 2.5 mM MgCl₂, 3.3 mg/ml bovine serum albumin (BSA) (Sigma), and 0.5 U of Taq polymerase (Promega) combined with the TaqStart™ antibody (Clontech). The TaqStart™ antibody, which is a neutralizing mono-

clonal antibody of Taq DNA polymerase, was added to all PCR reactions to enhance the efficiency of the amplification. The PCR mixtures were subjected to thermal cycling (3 min at 95° C. and then 40 cycles of 1 s at 95° C., and 30 s at 62° C. with a 2-min final extension at 72° C.) with a PTC-200 DNA Engine thermocycler (MJ research). The PCR-amplified reaction mixture was resolved by agarose gel electrophoresis.

The LightCycler™ PCR amplifications were performed with 1 µl of a purified genomic DNA preparation or cell lysates of vaginal/anal specimens. The 100 amplification mixture consisted of 0.4 µM each GBS-specific primer (SEQ ID NOS. 549-550), 200 µM each dNTP, 0.2 µM each fluorescently labeled probe (SEQ ID NOS. 582-583), 300 µg/ml BSA (Sigma), and 1 µl of 10×PC2 buffer (containing 50 mM Tris-HCl (pH 9.1), 16 mM ammonium sulfate, 3.5 mM Mg²⁺, and 150 µg/ml BSA) and 0.5 U KlenTaq1™ (AB Peptides) coupled with TaqStart™ antibody (Clontech). KlenTaq1™ is a highly active and more heat-stable DNA polymerase without 5'-exonuclease activity. This prevents hydrolysis of hybridized probes by the 5' to 3' exonuclease activity. A volume of 7 µl of the PCR mixture was transferred into a composite capillary tube (Idaho Technology). The tubes were then centrifuged to move the reaction mixture to the tips of the capillaries and then cleaned with optical-grade methanol. Subsequently the capillaries were loaded into the carousel of a LC32 LightCycler™ (Idaho Technology), an instrument that combines rapid-cycle PCR with fluorescence analysis for continuous monitoring during amplification. The PCR reaction mixtures were subjected to a denaturation step at 94° C. for 3 min followed by 45 cycles of 0 s at 94° C., 20 s at 64° C. and 10 s at 72° C. with a temperature transition rate of 20° C./s. Fluorescence signals were obtained at each cycle by sequentially positioning each capillary on the carousel at the focus of optical elements affiliated to the built-in fluorimeter for 100 milliseconds. Complete amplification and analysis required about 35 min.

Specificity and sensitivity tests. The specificity of the conventional and LightCycler™ PCR assays was verified by using purified genomic DNA (0.1 ng/reaction) from a battery of ATCC reference strains representing 35 clinically relevant gram-positive species (*Abiotrophia defectiva* ATCC 49176, *Bifidobacterium breve* ATCC 15700, *Clostridium difficile* ATCC 9689, *Corynebacterium urealyticum* ATCC 43042, *Enterococcus casseliflavus* ATCC 25788, *Enterococcus durans* ATCC 19432, *Enterococcus faecalis* ATCC 29212, *Enterococcus faecium* ATCC 19434, *Enterococcus gallinarum* ATCC 49573, *Enterococcus raffinosus* ATCC 49427, *Lactobacillus reuteri* ATCC 23273, *Lactococcus lactis* ATCC 19435, *Listeria monocytogenes* ATCC 15313, *Peptococcus niger* ATCC 27731, *Peptostreptococcus anaerobius* ATCC 27337, *Peptostreptococcus prevotii* ATCC 9321, *Staphylococcus aureus* ATCC 25923, *Staphylococcus epidermidis* ATCC 14990, *Staphylococcus haemolyticus* ATCC 29970, *Staphylococcus saprophyticus* ATCC 15305, *Streptococcus agalactiae* ATCC 27591, *Streptococcus anginosus* ATCC 33397, *Streptococcus Bovis* ATCC 33317, *Streptococcus constellatus* ATCC 27823, *Streptococcus dysgalactiae* ATCC 43078, *Streptococcus gordoni* ATCC 10558, *Streptococcus mitis* ATCC 33399, *Streptococcus mutans* ATCC 25175, *Streptococcus oralis* ATCC 35037, *Streptococcus parauberis* ATCC 6631, *Streptococcus pneumoniae* ATCC 6303, *Streptococcus pyogenes* ATCC 19615, *Streptococcus salivarius* ATCC 7073, *Streptococcus sanguinis* ATCC 10556, *Streptococcus uberis* ATCC 19436). These microbial species included 15 species of streptococci and many members of the normal vaginal and anal floras. In addition, 40 GBS isolates of human origin, whose identification was con-

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firmed by a latex agglutination test (Streptex, Murex), were also used to evaluate the ubiquity of the assay.

For determination of the sensitivities (i.e., the minimal number of genome copies that could be detected) for conventional and LightCycler™ PCR assays, serial 10-fold or 2-fold dilutions of purified genomic DNA from 5 GBS ATCC strains were used.

Results

Evaluation of the GBS-specific conventional and LightCycler™ PCR assays. The specificity of the two assays demonstrated that only DNAs from GBS strains could be amplified. Both PCR assays did not amplify DNAs from any other bacterial species tested including 14 streptococcal species other than GBS as well as phylogenetically related species belonging to the genera *Enterococcus*, *Peptostreptococcus* and *Lactococcus*. Important members of the vaginal or anal flora, including coagulase-negative staphylococci, *Lactobacillus* sp., and *Bacteroides* sp. were also negative with the GBS-specific PCR assay. The LightCycler™ PCR assays detected only GBS DNA by producing an increased fluorescence signal which was interpreted as a positive PCR result. Both PCR methods were able to amplify all of 40 GBS clinical isolates, showing a perfect correlation with the phenotypic identification methods.

The sensitivity of the assay was determined by using purified genomic DNA from the 5 ATCC strains of GBS. The detection limit for all of these 5 strains was one genome copy of GBS. The detection limit of the assay with the LightCycler™ was 3.5 fg of genomic DNA (corresponding to 1-2 genome copies of GBS). These results confirmed the high sensitivity of our GBS-specific PCR assay.

Direct Detection of GBS from vaginal/anal specimens. Among 66 vaginal/anal specimens tested, 11 were positive for GBS by both culture and PCR. There was one sample positive by culture only. The sensitivity of both PCR methods with vaginal/anal specimens for identifying colonization status in pregnant women at delivery was 91.7% when compared to culture results. The specificity and positive predictive values were both 100% and the negative predictive value was 97.8%. The time for obtaining results was approximately 45 min for LightCycler™ PCR, approximately 100 min for conventional PCR and 48 hours for culture.

Conclusion

We have developed two PCR assays (conventional and LightCycler™) for the detection of GBS, which are specific (i.e., no amplification of DNA from a variety of bacterial species other than GBS) and sensitive (i.e., able to detect around 1 genome copy for several reference ATCC strains of GBS). Both PCR assays are able to detect GBS directly from vaginal/anal specimens in a very short turnaround time. Using the real-time PCR assay on LightCycler™, we can detect GBS carriage in pregnant women at delivery within 45 minutes.

Example 15

Simultaneous Detection and Identification of *Streptococcus pyogenes* and its Pyrogenic Exotoxin A

The rapid detection of *Streptococcus pyogenes* and of its pyrogenic exotoxin A is of clinical importance. We developed a multiplex assay which permits the detection of strains of *S. pyogenes* carrying the pyrogenic toxin A gene, which is associated with scarlet fever and other pathologies. In order to

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specifically detect *S. pyogenes*, nucleotide sequences of the pyrrolidone carboxylyl peptidase (pcp) gene were aligned to design PCR primers Spy291 (SEQ ID NO. 1211) and Spy473 (SEQ ID NO. 1210). Next, we designed primers for the specific detection of the pyrogenic exotoxin A. Nucleotide sequences of the speA gene, carried on the bacteriophage T12, were aligned as shown in Table 60 to design PCR primers Spytx814 (SEQ ID NO. 994) and Spytx 927 (SEQ ID NO. 995).

The primer pairs: oligos SEQ ID NOs. 1210-1211, yielding an amplification product of 207 bp, and oligos SEQ ID NOs. 994-995, yielding an amplification product of 135 bp, were used in a multiplex PCR assay.

PCR amplification was carried out using 0.4 μM of both pairs of primers, 2.5 mM MgCl₂, BSA 0.05 μM, dNTP 0.2 μM (Pharmacia), 10 mM Tris-HCl (pH 9.0), 0.1% Triton X-100, 2.5 mM MgCl₂, 0.5 U Taq DNA polymerase (Promega) coupled with TaqStart™ antibody (Clontech Laboratories Inc.), and 1 μl of genomic DNA sample in a final volume of 20 μl. PCR amplification was performed using a PTC-200 thermal cycler (MJ Research). The optimal cycling conditions for maximum specificity and sensitivity were 3 minutes at 94° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 63° C., followed by a final step of 2 minutes at 72° C. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 μg/ml of ethidium bromide. Visualization of the PCR products was made under UV at 254 nm.

The detection limit was less than 5 genome copies for both *S. pyogenes* and its pyrogenic exotoxin A. The assay was specific for pyrogenic exotoxin A-producing *S. pyogenes*: strains of the 27 other species of *Streptococcus* tested, as well as 20 strains of various gram-positive and gram-negative bacterial species were all negative.

A similar approach was used to design an alternative set of speA-specific primers (SEQ ID NOs. 996 to 998, see Table 62). In addition, another set of primers based on the tuf gene (SEQ ID NOs. 999 to 1001, see Annex XXV) could be used to specifically detect *Streptococcus pyogenes*.

Example 16

Real-Time Detection and Identification of Shiga Toxin-Producing Bacteria

Shiga toxin-producing *Escherichia coli* and *Shigella dysenteriae* cause bloody diarrhea. Currently, identification relies mainly on the phenotypic identification of *S. dysenteriae* and *E. coli* serotype O157:H7. However, other serotypes of *E. coli* are increasingly found to be producers of type 1 and/or type 2 Shiga toxins. Two pairs of PCR primers targeting highly conserved regions present in each of the Shiga toxin genes stx₁ and stx₂ were designed to amplify all variants of those genes (see Tables 64 and 65). The first primer pair, oligonucleotides 1SLT224 (SEQ ID NO. 1081) and 1SLT385 (SEQ ID NO. 1080), yields an amplification product of 186 bp from the stx₁ gene. For this amplicon, the 1SLTB1-Fam (SEQ ID NO. 1084) molecular beacon was designed for the specific detection of stx₁ using the fluorescent label 6-carboxy-fluorescein. The 1SltS1-FAM (SEQ ID NO. 2012) molecular scorpion was also designed as an alternate way for the specific detection of stx₁. A second pair of PCR primers, oligonucleotides 2SLT537 (SEQ ID NO. 1078) and 2SLT678b (SEQ ID NO. 1079), yields an amplification product of 160 bp from the stx₂ gene. Molecular beacon 2SLTB1-Tet (SEQ ID NO. 1085) was designed for the specific detection of stx₂.

tion of *stx*₂ using the fluorescent label 5-tetrachloro-fluorescein. Both primer pairs were combined in a multiplex PCR assay.

PCR amplification was carried out using 0.8 μ M of primer pair SEQ ID NOS. 1080-1081, 0.5 μ M of primer pair SEQ ID NOS. 1078-1079, 0.3 μ M of each molecular beacon, 8 mM MgCl₂, 490 μ g/mL BSA, 0.2 mM dNTPs (Pharmacia), 50 mM Tris-HCl, 16 mM NH₄SO₄, 1 \times TaqMaster (Eppendorf), 2.5 U KlenTaq1 DNA polymerase (AB Peptides) coupled with TaqStart™ antibody (Clontech Laboratories Inc.), and 1 μ L of genomic DNA sample in a final volume of 25 μ L. PCR amplification was performed using a SmartCycler thermal cycler (Cepheid). The optimal cycling conditions for maximum sensitivity and specificity were 60 seconds at 95° C. for initial denaturation, then 45 cycles of three steps consisting of 10 seconds at 95° C., 15 seconds at 56° C. and 5 seconds at 72° C. Detection of the PCR products was made in real-time by measuring the fluorescent signal emitted by the molecular beacon when it hybridizes to its target at the end of the annealing step at 56° C.

The detection limit was the equivalent of less than 5 genome copies. The assay was specific for the detection of both toxins, as demonstrated by the perfect correlation between PCR results and the phenotypic characterization performed using antibodies specific for each Shiga toxin type. The assay was successfully performed on several Shiga toxin-producing strains isolated from various geographic areas of the world, including 10 O157:H7 *E. coli*, 5 non-O157:H7 *E. coli* and 4 *S. dysenteriae*.

Example 17

Development of a PCR Assay for the Detection and Identification of Staphylococci at Genus and Species Levels and its Associated *mecA* Gene

The *Staphylococcus*-specific PCR primers described in Example 7 (SEQ ID NOS. 553 and 575) were used in multiplex with the *mecA*-specific PCR primers and the *S. aureus*-specific primers described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NOS. 261 and 262 for *mecA* and SEQ ID NOS. 152 and 153 for *S. aureus* in the said patent). Sequence alignment analysis of 10 publicly available *mecA* gene sequences allowed to design an internal probe specific to *mecA* (SEQ ID NO. 1177). An internal probe was also designed for the *S. aureus*-specific amplicon (SEQ ID NO 1234). PCR amplification and agarose gel electrophoresis of the amplified products were performed as described in Example 7, with the exception that 0.4 μ M (each) of the two *Staphylococcus*-specific primers (SEQ ID NOS. 553 and 575) and 0.4 μ M (each) of the *mecA*-specific primers and 0.4 μ M (each) of the *S. aureus*-specific primers were used in the PCR mixture. The specificity of the multiplex assay with 40-cycle PCR protocols was verified by using purified genomic DNA from five methicillin-resistant and fifteen methicillin-sensitive staphylococcal strains. The sensitivity of the multiplex assay with 40-cycle PCR protocols was determined by using purified genomic DNA from twenty-three methicillin-resistant and twenty-eight methicillin-sensitive staphylococcal strains. The detection limit was 2 to 10 genome copies of genomic DNA, depending on the staphylococcal species tested. Furthermore, the *mecA*-specific internal probe, the *S. aureus*-specific internal probe and the coagulase-negative staphylococci-specific internal probe (described in Example 7) were able to recognize twenty-three methicillin-resistant staphylococcal strains and twenty-eight methicillin-sensitive staphylococcal strains with high sensitivity and specificity.

The format of the assay is not limited to the one described above. A person skilled in the art could adapt the assay for different formats such as PCR with real-time detection using molecular beacon probes. Molecular beacon probes designed to be used in this assay include, but are not limited to, SEQ ID NO. 1232 for detection of the *S. aureus*-specific amplicon, SEQ ID NO. 1233 for detection of coagulase-negative staphylococci and SEQ ID NO. 1231 for detection of *mecA*.

Alternatively, a multiplex PCR assay containing the *Staphylococcus*-specific PCR primers described in Example 7 (SEQ ID NOS. 553 and 575) and the *mecA*-specific PCR primers described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NOS. 261 and 262 in the said patent) were developed. PCR amplification and agarose gel electrophoresis of the amplified products were performed as described in Example 7, with the exception that 0.4 μ M (each) of the *Staphylococcus*-specific primers (SEQ ID NOS. 553 and 575) and 0.4 μ M (each) of the *mecA*-specific primers described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NOS. 261 and 262 in the said patent) were used in the PCR mixture. The sensitivity of the multiplex assay with 40-cycle PCR protocols was determined by using purified genomic DNA from two methicillin-resistant and five methicillin-sensitive staphylococcal strains. The detection limit was 2 to 5 copies of genomic DNA, depending on the staphylococcal species tested. The specificity of the multiplex PCR assay coupled with capture-probe hybridization was tested with two strains of methicillin-resistant *S. aureus*, two strains of methicillin-sensitive *S. aureus* and seven strains of methicillin-sensitive coagulase-negative staphylococci. The *mecA*-specific internal probe (SEQ ID NO. 1177) and the *S. aureus*-specific internal probe (SEQ ID NO. 587) described in Example 7 were able to recognize all the strains with high specificity showing a perfect correlation with susceptibility to methicillin. The sensitivity of the PCR assay coupled with capture-probe hybridization was tested with one strain of methicillin-resistant *S. aureus*. The detection limit was around 10 copies of genomic DNA.

Example 18

Sequencing of pbp1a, pbp2b and pbp2x genes of *Streptococcus pneumoniae*

Penicillin resistance in *Streptococcus pneumoniae* involves the sequential alteration of up to five penicillin-binding proteins (PBPs) 1A, 1B, 2A, 2x and 2B in such a way that their affinity is greatly reduced toward the antibiotic molecule. The altered PBP genes have arisen as the result of interspecies recombination events from related streptococcal species. Among the PBPs usually found in *S. pneumoniae*, PBPs 1A, 2B, and 2x play the most important role in the development of penicillin resistance. Alterations in PBP 2B and 2x mediate low-level resistance to penicillin while additional alterations in PBP 1A plays a significant role in full penicillin resistance.

In order to generate a database for pbp sequences that can be used for design of primers and/or probes for the specific and ubiquitous detection of β -lactam resistance in *S. pneumoniae*, pbp1a, pbp2b and pbp2x DNA fragments sequenced by us or selected from public databases (GenBank and EMBL) from a variety of *S. pneumoniae* strains were used to design oligonucleotide primers. This database is essential for the design of specific and ubiquitous primers and/or probes for detection of β -lactam resistance in *S. pneumoniae* since the altered PBP 1A, PBP 2B and PBP 2x of β -lactam resistant *S. pneumoniae* are encoded by mosaic genes with numerous

sequence variations among resistant isolates. The PCR primers were located in conserved regions of pbp genes and were able to amplify pbp1a, pbp2b, and pbp2x sequences of several strains of *S. pneumoniae* having various levels of resistance to penicillin and third-generation cephalosporins. Using primer pairs SEQ ID NOS. 1125 and 1126, SEQ ID NOS. 1142 and 1143, SEQ ID NOS. 1146 and 1147, it was possible to amplify and determine pbp1a sequences SEQ ID NOS. 1004-1018, 1648, 2056-2060 and 2062-2064, pbp2b sequences SEQ ID NOS. 1019-1033, and pbp2x sequences SEQ ID NOS. 1034-1048. Six other PCR primers (SEQ ID NOS. 1127-1128, 1144-1145, 1148-1149) were also designed and used to complete the sequencing of pbp1a, pbp2b and pbp2x amplification products. The described primers (SEQ ID NOS. 1125 and 1126, SEQ ID NOS. 1142 and 1143, SEQ ID NOS. 1146 and 1147, SEQ ID NOS. 1127-1128, 1144-1145, 1148-1149) represent a powerful tool for generating new pbp sequences for design of primers and/or probes for detection of β -lactam resistance in *S. pneumoniae*.

Example 19

Sequencing of hexA Genes of *Streptococcus* Species

The hexA sequence of *S. pneumoniae* described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NO. 31 in the said patent, SEQ ID NO. 1183 in the present application) allowed the design of a PCR primer (SEQ ID NO. 1182) which was used with primer Spn1401 described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NO. 156 in the said patent, SEQ ID NO. 1179 in the present application) to generate a database for hexA sequences that can be used to design primers and/or probes for the specific identification and detection of *S. pneumoniae* (Table 80). Using primers SEQ ID NO. 1179 and SEQ ID NO. 1182 (Annex XIII), it was possible to amplify and determine the hexA sequence from *S. pneumoniae* (4 strains) (SEQ ID NOS. 1184-1187), *S. mitis* (three strains) (SEQ ID NOS. 1189-1191) and *S. oralis* (SEQ ID NO. 1188).

Example 20

Development of Multiplex PCR Assays Coupled with Capture Probe Hybridization for the Detection and Identification of *Streptococcus pneumoniae* and its Penicillin Resistance Genes.

Two different assays were developed to identify *S. pneumoniae* and its susceptibility to penicillin.

Assay I:

Bacterial strains. The specificity of the multiplex PCR assay was verified by using a panel of ATCC (American Type Culture Collection) reference strains consisting of 33 gram-negative and 67 gram-positive bacterial species (Table 13). In addition, a total of 98 strains of *S. pneumoniae*, 16 strains of *S. mitis* and 3 strains of *S. oralis* from the American Type Culture Collection, the microbiology laboratory of the Centre Hospitalier Universitaire de Québec, Pavillon Centre Hospitalier de l'Université Laval (CHUL), (Step-Foy, Québec, Canada), the Laboratoire de santé publique du Québec, (Sainte-Anne-de-Bellevue, Québec, Canada), the Sunnybrook and Women's College Health Sciences Centre (Toronto, Canada), the Infectious Diseases Section, Department of Veterans Affairs Medical Center, (Houston, USA) were also tested to further validate the *Streptococcus pneumoniae*-specific PCR assay. The penicillin MICs (minimal inhibitory concentrations) were measured by the broth dilution method according to the recommended protocol of NCCLS.

PCR primers and internal probes. The analysis of hexA sequences from a variety of streptococcal species from the publicly available hexA sequence and from the database described in Example 19 (SEQ ID NOS. 1184-1191) allowed the selection of a PCR primer specific to *S. pneumoniae*, SEQ ID NO. 1181. This primer was used with the *S. pneumoniae*-specific primer SEQ ID NO. 1179 to generate an amplification product of 241 bp (Table 80). The PCR primer SEQ ID NO. 1181 is located 127 nucleotides downstream on the hexA sequence compared to the original *S. pneumoniae*-specific PCR primer Spn1515 described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NO. 157 in the said patent). These modifications were done to ensure the design of the *S. pneumoniae*-specific internal probe according to the new hexA sequences of several streptococcal species from the database described in Example 19 (SEQ ID NOS. 1184-1191).

The analysis of pbp1a sequences from *S. pneumoniae* strains with various levels of penicillin resistance from public databases and from the database described in Example 18 allowed the identification of amino acid substitutions Ile-459 to Met and Ser-462 to Ala that occur in isolates with high-level penicillin resistance ($MICs \geq 1 \mu\text{g/ml}$), and amino acid substitutions Ser-575 to Thr, Gln-576 to Gly and Phe-577 to Tyr that are common to all penicillin-resistant isolates with $MICs \geq 0.25 \mu\text{g/ml}$. As shown in Table 69, PCR primer pair SEQ ID NOS. 1130 and 1131 were designed to detect high-level penicillin resistance ($MICs \geq 1 \mu\text{g/ml}$), whereas PCR primer pair SEQ ID NOS. 1129 and 1131 were designed to detect intermediate- and high-level penicillin resistance ($MICs 0.25 \mu\text{g/ml}$).

The analysis of hexA sequences from the publicly available hexA sequence and from the database described in Example 19 allowed the design of an internal probe specific to *S. pneumoniae* (SEQ ID NO. 1180) (Table 80). The range of mismatches between the *S. pneumoniae*-specific 241-bp amplicon was from 2 to 5, in the middle of the 19-bp probe. The analysis of pbp1a sequences from public databases and from the database described in Example 18 allowed the design of five internal probes containing all possible mutations to detect the high-level penicillin resistance 383-bp amplicon (SEQ ID NOS. 1197, 1217-1220). Alternatively, two other internal probes (SEQ ID NOS. 2024-2025) can also be used to detect the high-level penicillin resistance 383-bp amplicon. Five internal probes containing all possible mutations to detect the 157-bp amplicon which includes intermediate- and high-level penicillin resistance were also designed (SEQ ID NOS. 1094, 1192-1193, 1214 and 1216). Design and synthesis of primers and probes, and detection of the probe hybridization were performed as described in Example 7. Table 69 illustrates one of the internal probe for detection of the high-level penicillin resistance 383-bp amplicon (SEQ ID NO. 1197) and one of the internal probe for detection of the intermediate- and high-level penicillin resistance 157-bp amplicon (SEQ ID NO. 1193).

PCR amplification. For all bacterial species, amplification was performed from purified genomic DNA using a PTC-200 thermocycler (MJ Research). 1 μl of genomic DNA at 0.1 ng/ μl , or 1 μl of a bacterial lysate, was transferred to a 19 μl PCR mixture. Each PCR reaction contained 50 mM KCl, 10 mM Tris-HCl (H 9.0), 0.1% Triton X-100, 2.5 mM MgCl₂, 0.1 μM (each) of the *S. pneumoniae*-specific primers SEQ ID NO. 1179 and SEQ ID NO. 1181, 0.2 μM of primer SEQ ID NO. 1129, 0.7 μM of primer SEQ ID NO. 1131, and 0.6 μM of primer SEQ ID NO. 1130, 0.05 mM bovine serum albumin (BSA), and 0.5 U Taq polymerase (Promega) coupled with TaqStartTM antibody. In order to generate Digoxigenin (DIG)-labeled amplicons for capture probe hybridization, 0.1 \times PCR

DIG labeling four deoxynucleoside triphosphates mix (Boehringer Mannheim GmbH) was used for amplification.

For determination of the sensitivity of the PCR assays, 10-fold dilutions of purified genomic DNA were used to determine the minimal number of genome copies which can be detected.

Capture probe hybridization. The DIG-labeled amplicons were hybridized to the capture probes bound to 96-well plates. The plates were incubated with anti-DIG-alkaline phosphatase and the chemiluminescence was measured by using a luminometer (MLX, Dynex Technologies Inc.) after incubation with CSPD and recorded as Relative Light Unit (RLU). The RLU ratio of tested sample with and without captures probes was then calculated. A ratio ≥ 2.0 was defined as a positive hybridization signal. All reactions were performed in duplicate.

Results

Amplifications with the multiplex PCR assay. The specificity of the assay was assessed by performing 40-cycle PCR amplifications with the panel of gram-positive (67 species from 12 genera) and gram-negative (33 species from 17 genera) bacterial species listed in Table 13. All bacterial species tested other than *S. pneumoniae* were negative except *S. mitis* and *S. oralis*. Ubiquity tests were performed using a collection of 98 *S. pneumoniae* strains including high-level penicillin resistance ($n=53$), intermediate resistance ($n=12$) and sensitive ($n=33$) strains. There was a perfect correlation between PCR and standard susceptibility testing for 33 penicillin-sensitive isolates. Among 12 *S. pneumoniae* isolates with intermediate penicillin resistance based on susceptibility testing, 11 had intermediate resistance based on PCR, but one *S. pneumoniae* isolate with penicillin MIC of 0.25 $\mu\text{g}/\text{ml}$ showed a high-level penicillin resistance based on genotyping. Among 53 isolates with high-level penicillin resistance based on susceptibility testing, 51 had high-level penicillin resistance based on PCR but two isolates with penicillin MIC $>1 \mu\text{g}/\text{ml}$ showed an intermediate penicillin resistance based on genotyping. In general, there was a good correlation between the genotype and classical culture method for bacterial identification and susceptibility testing.

The sensitivity of the *S. pneumoniae*-specific assay with 40-cycle PCR protocols was determined by using purified genomic DNA from 9 isolates of *S. pneumoniae*. The detection limit was around 10 copies of genomic DNA for all of them.

Post-PCR hybridization with internal probes. The specificity of the multiplex PCR assay coupled with capture-probe hybridization was tested with 98 strains of *S. pneumoniae*, 16 strains of *S. mitis* and 3 strains of *S. oralis*. The internal probe specific to *S. pneumoniae* (SEQ ID NO. 1180) detected all 98 *S. pneumoniae* strains but did not hybridize to the *S. mitis* and *S. oralis* amplicons. The five internal probes specific to the high-level resistance amplicon (SEQ ID NOs. 1197, 1217-1220) detected all amplification patterns corresponding to high-level resistance. The two *S. pneumoniae* strains with penicillin MIC $>1 \mu\text{g}/\text{ml}$ that showed an intermediate penicillin resistance based on PCR amplification were also intermediate resistance based on probe hybridization. Similarly, among 12 strains with intermediate-penicillin resistance based on susceptibility testing, 11 showed intermediate-penicillin resistance based on hybridization with the five internal probes specific to the intermediate and high-level resistance amplicon (SEQ ID NOs. 1094, 1192-1193, 1214 and 1216). The strain described above having a penicillin MIC of 0.25 $\mu\text{g}/\text{ml}$ which was high-level penicillin resistance based on PCR amplification was also high-level resistance based on probe hybridization. In summary, the combination of the

multiplex PCR and hybridization assays results in a highly specific test for the detection of penicillin-resistant *Streptococcus pneumoniae*.

Assay II:

Bacterial strains. The specificity of the multiplex PCR assay was verified by using the same strains as those used for the development of Assay I. The penicillin MICs (minimal inhibitory concentrations) were measured by the broth dilution method according to the recommended protocol of NCCLS.

PCR primers and internal probes. The analysis of pbp1a sequences from *S. pneumoniae* strains with various levels of penicillin resistance from public databases and from the database described in Example 18 allowed the design of two primers located in the constant region of pbp1a. PCR primer pair (SEQ ID NOs. 2015 and 2016) was designed to amplify a 888-bp variable region of pbp1a from all *S. pneumoniae* strains. A series of internal probes were designed for identification of the pbp1a mutations associated with penicillin resistance in *S. pneumoniae*. For detection of high-level penicillin resistance (MICs $\geq 1 \mu\text{g}/\text{ml}$), three internal probes were designed (SEQ ID NOs. 2017-2019). Alternatively, ten other internal probes were designed that can also be used for detection of high-level resistance within the 888-bp pbp1a amplicon: (1) three internal probes for identification of the amino acid substitutions Thr-371 to Ser or Ala within the motif S370TMK (SEQ ID NOs. 2031-2033); (2) two internal probes for detection of the amino acid substitutions Ile-459 to Met and Ser-462 to Ala near the motif S428RN (SEQ ID NOs. 2113 and 2026); (3) two internal probes for identification of the amino acid substitutions Asn-443 to Asp (SEQ ID NOs. 1134 and 2027); and (4) three internal probes for detection of all sequence variations within another region (SEQ ID NOs. 2028-2030). For detection of high-level and intermediate penicillin resistance (MICs 0.25 $\mu\text{g}/\text{ml}$), four internal probes were designed (SEQ ID NOs. 2020-2023). Alternatively, six other internal probes were designed for detection of the four consecutive amino acid substitutions T574SQF to A574TGY near the motif K557TG (SEQ ID NOs. 2034-2039) that can also be used for detection of intermediate- and high-level resistance within the 888-bp pbp1a amplicon.

PCR amplification. For all bacterial species, amplification was performed from purified genomic DNA using a PTC-200 thermocycler (MJ Research). 1 μl of genomic DNA at 0.1 ng/ μl , or 1 μl of a bacterial lysate, was transferred to a 19 μl PCR mixture. Each PCR reaction contained 50 mM KCl, 10 mM Tris-HCl (pH 9.0), 0.1% Triton X-100, 2.5 mM MgCl₂, 0.08 μM (each) of the *S. pneumoniae*-specific primers SEQ ID NO. 1179 and SEQ ID NO. 1181, 0.4 μM of the pbp1a-specific primer SEQ ID NO. 2015, 1.2 μM of pbp1a-specific primer SEQ ID NO. 2016, 0.05 mM bovine serum albumin (BSA), and 0.5 U Taq polymerase (Promega) coupled with TaqStart™ antibody. In order to generate Digoxigenin (DIG)-labeled amplicons for capture probe hybridization, 0.1 \times PCR DIG labeling four deoxynucleoside triphosphates mix (Boehringer Mannheim GmbH) was used for amplification.

For determination of the sensitivities of the PCR assays, 10-fold dilutions of purified genomic DNA were used to determine the minimal number of genome copies which can be detected.

Capture probe hybridization. The DIG-labeled amplicons were hybridized to the capture probes bound to 96-well plates as described for Assay I.

Results

Amplifications with the multiplex PCR assay. The specificity of the assay was assessed by performing 40-cycle PCR amplifications with the panel of gram-positive (67 species

from 12 genera) and gram-negative (33 species from 17 genera) bacterial species listed in Table 13. All bacterial species tested other than *S. pneumoniae* were negative except *S. mitis* and *S. oralis*. Ubiquity tests were performed using a collection of 98 *S. pneumoniae* strains including high-level penicillin resistance (n=53), intermediate resistance (n=12) and sensitive (n=33) strains. All the above *S. pneumoniae* strains produced the 888-bp amplicon corresponding to pbp1a and the 241-bp fragment corresponding to hexA.

The sensitivity of the *S. pneumoniae*-specific assay with 40-cycle PCR protocols was determined by using purified genomic DNA from 9 isolates of *S. pneumoniae*. The detection limit was around 10 copies of genomic DNA for all of them.

Post-PCR hybridization with internal probes. The specificity of the multiplex PCR assay coupled with capture-probe hybridization was tested with 98 strains of *S. pneumoniae*, 16 strains of *S. mitis* and 3 strains of *S. oralis*. The internal probe specific to *S. pneumoniae* (SEQ ID NO. 1180) detected all 98 *S. pneumoniae* strains but did not hybridize to the *S. mitis* and *S. oralis* amplicons. The three internal probes (SEQ ID NOs 2017-2019) specific to high-level resistance detected all the 43 strains with high-level penicillin resistance based on susceptibility testing. Among 12 isolates with intermediate-penicillin resistance based on susceptibility testing, 11 showed intermediate-penicillin resistance based on hybridization with 4 internal probes (SEQ ID NOs. 2020-2023) and one strain having penicillin MIC of 0.25 µg/ml was misclassified as high-level penicillin resistance. In summary, the combination of the multiplex PCR and hybridization assays results in a highly specific test for the detection of penicillin-resistant *Streptococcus pneumoniae*.

Example 21

Sequencing of the Vancomycin Resistance vanA, vanC1, vanC2 and vanC3 Genes

The publicly available sequences of the vanH-vanA-vanX-vanY locus of transposon Tn1546 from *E. faecalis*, vanC1 sequence from one strain of *E. gallinarum*, vanC2 and vanC3 sequences from a variety of *E. casseliflavus* and *E. flavescentis* strains, respectively, allowed the design of PCR primers able to amplify the vanA, vanC1, vanC2 and vanC3 sequences of several *Enterococcus* species. Using primer pairs van6877 and van9106 (SEQ ID NOs. 1150 and 1155), vanC1-122 and vanC1-1315 (SEQ ID NOs. 1110 and 1109), and vanC2C3-1 and vanC2C3-1064 (SEQ ID NOs. 1108 and 1107), it was possible to amplify and determine vanA sequences SEQ ID NOs. 1049-1057, vanC1 sequences SEQ ID NOs. 1058-1059, vanC2 sequences SEQ ID NOs. 1060-1063 and vanC3 sequences SEQ ID NOs. 1064-1066, respectively. Four other PCR primers (SEQ ID NOs. 1151-1154) were also designed and used to complete the sequencing of vanA amplification products.

Example 22

Development of a PCR Assay for the Detection and Identification of Enterococci at Genus and Species Levels and its Associated Resistance Genes vanA and vanB

The comparison of vanA and vanB sequences revealed conserved regions allowing the design of PCR primers specific to both vanA and vanB sequences (Annex Table 76). The PCR primer pair vanAB459 and vanAB830R (SEQ ID NOs.

1112 and 1111) was used in multiplex with the *Enterococcus*-specific primers Encg313dF and Encg599c (SEQ ID NOs. 1137 and 1136) described in Example 11. Sequence alignment analysis of vanA and vanB sequences revealed regions suitable for the design of internal probes specific to vanA (SEQ ID NO. 1170) and vanB (SEQ ID NO. 1171). PCR amplification and agarose gel electrophoresis of the amplified products were performed as described in Example 11. The optimal cycling conditions for maximum sensitivity and specificity were found to be 3 min. at 94° C., followed by forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 62° C., plus a terminal extension at 72° C. for 2 minutes. The specificity of the multiplex assay with 40-cycle PCR was verified by using 0.1 nanogram of purified genomic DNA from a panel of bacteria listed in Table 10. The sensitivity of the multiplex assay with 40-cycle PCR was verified with three strains of *E. casseliflavus*, eight strains of *E. gallinarum*, two strains of *E. flavescentis*, two vancomycin-resistant strains of *E. faecalis* and one vancomycin-sensitive strain of *E. faecalis*, three vancomycin-resistant strains of *E. faecium*, one vancomycin-sensitive strain of *E. faecium* and one strain of each of the other enterococcal species listed in Table 10. The detection limit was 1 to 10 copies of genomic DNA, depending on the enterococcal species tested. The vanA- and vanB-specific internal probes (SEQ ID NOs. 1170 and 1171), as well as the *E. faecalis*-and *E. faecium*-specific internal probes (SEQ ID NOs. 1174 and 602) and the internal probe specific to the group including *E. casseliflavus*, *E. gallinarum* and *E. flavescentis* (SEQ ID NO. 1122) described in Example 11, were able to recognize vancomycin-resistant enterococcal species with high sensitivity, specificity and ubiquity showing a perfect correlation between the genotypic and phenotypic analysis.

The format of the assay is not limited to the one described above. A person skilled in the art could adapt the assay for different formats such as PCR with real-time detection using molecular beacon probes. Molecular beacon probes designed to be used in this assay include, but are not limited to, SEQ ID NO. 1236 for the detection of *E. faecalis*, SEQ ID NO. 1235 for the detection of *E. faecium*, SEQ ID NO. 1240 for the detection of vanA, and SEQ ID NO. 1241 for the detection of vanB.

Example 23

Development of a Multiplex PCR Assay for Detection and Identification of Vancomycin-Resistant *Enterococcus faecalis*, *Enterococcus faecium* and the Group including *Enterococcus Gallinarum*, *Enterococcus Casseliflavus*, and *Enterococcus flavescentis*

The analysis of vanA and vanB sequences revealed conserved regions allowing design of a PCR primer pair (SEQ ID NOs. 1089 and 1090) specific to vanA sequences (Table 66) and a PCR primer pair (SEQ ID NOs. 1095 and 1096) specific to vanB sequences (Table 67). The vanA-specific PCR primer pair (SEQ ID NOs. 1089 and 1090) was used in multiplex with the vanB-specific PCR primer pair described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NOs. 1095 and 1096 in the present patent and SEQ ID NOs. 231 and 232 in the said patent). The comparison of vanC1, vanC2 and vanC3 sequences revealed conserved regions allowing design of PCR primers (SEQ ID NOs. 1101 and 1102) able to generate a 158-bp amplicon specific to the group including *E. gallinarum*, *E. casseliflavus* and *E. flavescentis* (Table 68). The vanC-specific PCR primer pair (SEQ ID NOs. 1101 and

1102) was used in multiplex with the *E. faecalis*-specific PCR primer pair described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NOS. 40 and 41 in the said patent) and with the *E. faecium*-specific PCR primer pair described in our patent publication WO_98/20157 (SEQ ID NOS. 1 and 2 in the said publication). For both multiplexes, the optimal cycling conditions for maximum sensitivity and specificity were found to be 3 min. at 94° C., followed by forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 58° C., plus a terminal extension at 72° C. for 2 minutes. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 µg/ml of ethidium bromide. The vanA-specific PCR primer pair (SEQ ID NOS. 1089 and 1090), the vanB-specific primer pair (SEQ ID NOS. 1095 and 1096) and the vanC-specific primer pair (SEQ ID NOS. 1101 and 1102) were tested for their specificity by using 0.1 nanogram of purified genomic DNA from a panel of 5 vancomycin-sensitive *Enterococcus* species, 3 vancomycin-resistant *Enterococcus* species, 13 other gram-positive bacteria and one gram-negative bacterium. Specificity tests were performed with the *E. faecium*-specific PCR primer pair described in our patent publication WO 98/20157 (SEQ ID NOS. 1 and 2 in the said publication) and with the *E. faecalis*-specific PCR primer pair described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NOS. 40 and 41 in the said patent) on a panel of 37 gram-positive bacterial species. All *Enterococcus* strains were amplified with high specificity showing a perfect correlation between the genotypic and phenotypic analysis. The sensitivity of the assays was determined for several strains of *E. gallinarum*, *E. casseliflavus*, *E. flavescent* and vancomycin-resistant *E. faecalis* and *K. faecium*. Using each of the *E. faecalis*-and *E. faecium*-specific PCR primer pairs as well as vanA-, vanB- and vanC-specific PCR primers used alone or in multiplex as described above, the sensitivity ranged from 1 to 10 copies of genomic DNA.

The format of the assay is not limited to the one described above. A person skilled in the art could adapt the assay for different formats such as PCR with real-time detection using molecular beacon probes. Molecular beacon probes designed to be used in this assay include, but are not limited to, SEQ ID NO. 1238 for the detection of *E. faecalis*, SEQ ID NO. 1237 for the detection of *E. faecium*, SEQ ID NO. 1239 for the detection of vanA, and SEQ ID NO. 1241 for the detection of vanB.

Alternatively, another PCR assay was developed for the detection of vancomycin-resistant *E. faecium* and vancomycin-resistant *E. faecalis*. This assay included two multiplex: (1) the first multiplex contained the vanA-specific primer pair (SEQ ID NOS. 1090-1091) and the vanB-specific PCR primer pair described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NOS. 1095 and 1096 in the present patent and SEQ ID NOS. 231 and 232 in the said patent), and (2) the second multiplex contained the *E. faecalis*-specific PCR primer pair described in our assigned U.S. Pat. No. 5,994,066 (SEQ ID NOS. 40 and 41 in the said patent) and the *E. faecium*-specific PCR primer pair described in our patent publication WO98/20157 (SEQ ID NOS. 1 and 2 in the said publication). For both multiplexes, the optimal cycling conditions for maximum sensitivity and specificity were found to be 3 min. at 94° C., followed by forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 58° C., plus a terminal extension at 72° C. for 2 minutes. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 µg/ml of ethidium bromide. The two multiplexes were tested for their specificity by using 0.1 nanogram of purified genomic DNA from a panel of two vancomycin-sensitive *E. faecalis* strains, two vancomycin-resistant *E. faecalis* strains,

two vancomycin-sensitive *E. faecium* strains, two vancomycin-resistant *E. faecium* strains, 16 other enterococcal species and 31 other gram-positive bacterial species. All the *E. faecium* and *E. faecalis* strains were amplified with high specificity showing a perfect correlation between the genotypic analysis and the susceptibility to glycopeptide antibiotics (vancomycin and teicoplanin). The sensitivity of the assay was determined for two vancomycin-resistant *E. faecalis* strains and two vancomycin-resistant *E. faecium* strains. The detection limit was 5 copies of genomic DNA for all the strains.

This multiplex PCR assay was coupled with capture-probe hybridization. Four internal probes were designed: one specific to the vanA amplicon (SEQ ID NO. 2292), one specific to the vanB amplicon (SEQ ID NO. 2294), one specific to the *E. faecalis* amplicon (SEQ ID NO. 2291) and one specific to the *E. faecium* amplicon (SEQ ID NO. 2287). Each of the internal probes detected their specific amplicons with high specificity and sensitivity.

Example 24

Universal Amplification Involving the EF-G (fusA) Subdivision of tuf Sequences

As shown in FIG. 3, primers SEQ ID NOS. 1228 and 1229 were designed to amplify the region between the end of fusA and the beginning of tuf genes in the str operon. Genomic DNAs from a panel of 35 strains were tested for PCR amplification with those primers. In the initial experiment, the following strains showed a positive result: *Abiotrophia adiacens* ATCC 49175, *Abiotrophia defectiva* ATCC 49176, *Bacillus subtilis* ATCC 27370, *Closridium difficile* ATCC 9689, *Enterococcus avium* ATCC 14025, *Enterococcus casseliflavus* ATCC 25788, *Enterococcus cecorum* ATCC 43198, *Enterococcus faecalis* ATCC 29212, *Enterococcus faecium* ATCC 19434, *Enterococcus flavescent* ATCC 49996, *Enterococcus gallinarum* ATCC 49573, *Enterococcus solitarius* ATCC 49428, *Escherichia coli* ATCC 11775, *Haemophilus influenzae* ATCC 9006, *Lactobacillus acidophilus* ATCC 4356, *Peptococcus niger* ATCC 27731, *Proteus mirabilis* ATCC 25933, *Staphylococcus aureus* ATCC 43300, *Staphylococcus auricularis* ATCC 33753, *Staphylococcus capitis* ATCC 27840, *Staphylococcus epidemidis* ATCC 14990, *Staphylococcus haemolyticus* ATCC 29970, *Staphylococcus hominis* ATCC 27844, *Staphylococcus lugdunensis* ATCC 43809, *Staphylococcus saprophyticus* ATCC 15305, *Staphylococcus simulans* ATCC 27848, and *Staphylococcus warneri* ATCC 27836. This primer pair could amplify additional bacterial species; however, there was no amplification for some species, suggesting that the PCR cycling conditions could be optimized or the primers modified. For example, SEQ ID NO. 1227 was designed to amplify a broader range of species.

In addition to other possible primer combinations to amplify the region covering fusA and tuf, FIG. 3 illustrates the positions of amplification primers SEQ ID NOS. 1221-1227 which could be used for universal amplification of fusA segments. All of the above mentioned primers (SEQ ID NOS. 1221-1229) could be useful for the universal and/or the specific detection of bacteria.

Moreover, different combinations of primers SEQ ID NOS. 1221-1229, sometimes in combination with tuf sequencing primer SEQ ID NO. 697, were used to sequence portions of the str operon, including the intergenic region. In this manner, the following sequences were generated: SEQ ID NOS. 1518-

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1526, 1578-1580, 1786-1821, 1822-1834, 1838-1843, 2184, 2187, 2188, 2214-2249, and 2255-2269.

Example 25

DNA Fragment Isolation from *Staphylococcus saprophyticus* by Arbitrarily Primed PCR

DNA sequences of unknown coding potential for the species-specific detection and identification of *Staphylococcus saprophyticus* were obtained by the method of arbitrarily primed PCR (AP-PCR).

AP-PCR is a method which can be used to generate specific DNA probes for microorganisms (Fani et al., 1993, Molecular Ecology 2:243-250). A description of the AP-PCR protocol used to isolate a species-specific genomic DNA fragment from *Staphylococcus saprophyticus* follows. Twenty different oligonucleotide primers of 10 nucleotides in length (all included in the AP-PCR kit OPAD (Operon Technologies, Inc., Alameda, Calif.)) were tested systematically with DNAs from 5 bacterial strains of *Staphylococcus saprophyticus* as well as with bacterial strains of 27 other staphylococcal (non-*S. saprophyticus*) species. For all bacterial species, amplification was performed directly from one μ L (0.1 ng/ μ L) of purified genomic DNA. The 25 μ L PCR reaction mixture contained 50 mM KCl, 10 mM Tris-HCl (pH 9.0), 0.1% Triton X-100, 2.5 mM MgCl₂, 1.2 μ M of only one of the 20 different AP-PCR primers OPAD, 200 μ M of each of the four dNTPs, 0.5 U of Taq DNA polymerase (Promega Corp., Madison, Wis.) coupled with TaqStartTM antibody (Clontech Laboratories Inc., Palo Alto, Calif.). PCR reactions were subjected to cycling using a MJ Research PTC-200 thermal cycler as follows: 3 min at 96° C. followed by 42 cycles of 1 min at 94° C. for the denaturation step, 1 min at 31° C. for the annealing step and 2 min at 72° C. for the extension step. A final extension step of 7 min at 72° C. followed the 42 cycles to ensure complete extension of PCR products. Subsequently, twenty microliters of the PCR-amplified mixture were resolved by electrophoresis on a 1.5% agarose gel containing 0.25 μ g/ml of ethidium bromide. The size of the amplification products was estimated by comparison with a 50-bp molecular weight ladder.

Amplification patterns specific for *Staphylococcus saprophyticus* were observed with the AP-PCR primer OPAD-16 (sequence: 5'-AACGGCGTC-3'). Amplification with this primer consistently showed a band corresponding to a DNA fragment of approximately 380 bp for all *Staphylococcus saprophyticus* strains tested but not for any of the other staphylococcal species tested.

The band corresponding to the 380 bp amplicon, specific and ubiquitous for *S. saprophyticus* based on AP-PCR, was excised from the agarose gel and purified using the QIAquickTM gel extraction kit (QIAGEN Inc.). The gel-purified DNA fragment was cloned into the T/A cloning site of the pCR 2.1TM plasmid vector (Invitrogen Inc.) using T4 DNA ligase (New England Biolabs). Recombinant plasmids were transformed into *E. coli* DH5a competent cells using standard procedures. All reactions were performed according to the manufacturer's instructions. Plasmid DNA isolation was done by the method of Birnboim and Doly (Nucleic Acid Res., 1979, 7:1513-1523) for small-scale preparations. All plasmid DNA preparations were digested with the EcoRI restriction endonuclease to ensure the presence of the approximately 380 bp AP-PCR insert into the plasmid. Subsequently, a large-scale and highly purified plasmid DNA preparation was performed from two selected clones shown to carry the AP-PCR insert by using the QIAGEN plasmid

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purification kit (midi format). These large-scale plasmid preparations were used for automated DNA sequencing.

The 380 bp nucleotide sequence was determined for three strains of *S. saprophyticus* (SEQ ID NOS. 74, 1093, and 1198). Both strands of the AP-PCR insert from the two selected clones were sequenced by the dideoxynucleotide chain termination sequencing method with SP6 and T7 sequencing primers by using the Applied Biosystems automated DNA sequencer (model 373A) with their PRISMTM Sequenase[®] Terminator Double-stranded DNA Sequencing Kit (Applied Biosystems, Foster City, Calif.).

Optimal species-specific amplification primers (SEQ ID NOS. 1208 and 1209) have been selected from the sequenced AP-PCR *Staphylococcus saprophyticus* DNA fragments with the help of the primer analysis software OligoTM 5.0 (National BioSciences Inc.). The selected primers were tested in PCR assays to verify their specificity and ubiquity. Data obtained with DNA preparations from reference ATCC strains of 49 gram-positive and 31 gram-negative bacterial species, including 28 different staphylococcal species, indicate that the selected primer pairs are specific for *Staphylococcus saprophyticus* since no amplification signal has been observed with DNAs from the other staphylococcal or bacterial species tested. This assay was able to amplify efficiently DNA from all 60 strains of *S. saprophyticus* from various origins tested. The sensitivity level achieved for three *S. saprophyticus* reference ATCC strains was around 6 genome copies.

Example 26

Sequencing of Prokaryotic tuf Gene Fragments

The comparison of publicly available tuf sequences from a variety of bacterial species revealed conserved regions, allowing the design of PCR primers able to amplify tuf sequences from a wide range of bacterial species. Using primer pair SEQ ID NOS. 664 and 697, it was possible to amplify and determine tuf sequences SEQ ID NOS.: 1-73, 75-241, 607-618, 621, 662, 675, 717-736, 868-888, 932, 967-989, 992, 1002, 1572-1575, 1662-1663, 1715-1733, 1835-1837, 1877-1878, 1880-1881, 2183, 2185, 2200, 2201, and 2270-2272.

Example 27

Sequencing of Prokaryotic recA Gene Fragments

The comparison of publicly available recA sequences from a variety of bacterial species revealed conserved regions, allowing the design of PCR primers able to amplify recA sequences from a wide range of bacterial species. Using primer pairs SEQ ID NOS. 921-922 and 1605-1606, it was possible to amplify and determine recA sequences SEQ ID NOS.: 990-991, 1003, 1288-1289, 1714, 1756-1763, 1866-1873 and 2202-2212.

Example 28

Specific Detection and Identification of *Escherichia coli*/Shigella Sp. Using tuf Sequences

The analysis of tuf sequences from a variety of bacterial species allowed the selection of PCR primers (SEQ ID NOS. 1661 and 1665) and of an internal probe (SEQ ID NO. 2168) specific to *Escherichia coli*/Shigella sp. The strategy used to design the PCR primers was based on the analysis of a multiple sequence alignment of various tuf sequences. The mul-

multiple sequence alignment included the tuf sequences of *Escherichia coli/Shigella* sp. as well as tuf sequences from other species and bacterial genera, especially representatives of closely related species. A careful analysis of this alignment allowed the selection of oligonucleotide sequences which are conserved within the target species but which discriminate sequences from other species, especially from the closely related species, thereby permitting the species-specific and ubiquitous detection and identification of the target bacterial species.

The chosen primer pair, oligos SEQ ID NOs. 1661 and 1665, gives an amplification product of 219 bp. Standard PCR was carried out using 0.4 μ M of each primer, 2.5 mM MgCl₂, BSA 0.05 mM, 50 mM KCl, 10 mM Tris-HCl (pH 9.0), 0.1% Triton X-100, dNTPs 0.2 mM (Pharmacia), 0.5 U Taq DNA polymerase (Promega) coupled with TaqStart™ antibody (Clontech Laboratories Inc.), 1 μ l of genomic DNA sample in a final volume of 20 μ l using a PTC-200 thermocycler (MJ Research). The optimal cycling conditions for maximum sensitivity and specificity were 3 minutes at 95° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 60° C., followed by terminal extension at 72° C. for 2 minutes. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 μ g/ml of ethidium bromide. Visualization of the PCR products was made under UV at 254 nm.

Specificity of the assay was tested by adding to the PCR reactions 0.1 ng of genomic DNA from each of the following bacterial species: *Escherichia coli* (7 strains), *Shigella sonnei*, *Shigella flexneri*, *Shigella dysenteriae*, *Salmonella typhimurium*, *Salmonella typhi*, *Salmonella enteritidis*, *Tatumella ptyseos*, *Klebsiella pneumoniae* (2 strains), *Enterobacter aerogenes*, *Citrobacter farmeri*, *Campylobacter jejuni*, *Serratia marcescens*. Amplification was observed only for the *Escherichia coli* and *Shigella* sp. strains listed and *Escherichia fergusonii*. The sensitivity of the assay with 40-cycle PCR was verified with one strain of *E. coli* and three strains of *Shigella* sp. The detection limit for *E. coli* and *Shigella* sp. was 1 to 10 copies of genomic DNA, depending on the strains tested.

Example 29

Specific Detection and Identification of *Klebsiella pneumoniae* Using atpD Sequences

The analysis of atpD sequences from a variety of bacterial species allowed the selection of PCR primers specific to *K. pneumoniae*. The primer design strategy is similar to the strategy described in Example 28 except that atpD sequences were used in the alignment.

Two *K. pneumoniae*-specific primers were selected, (SEQ ID NOs. 1331 and 1332) which give an amplification product of 115 bp. Standard PCR was carried out on PTC-200 thermocyclers (MJ Research) using 0.4 μ M of each primer as described in Example 28. The optimal cycling conditions for maximum sensitivity and specificity were as follow: three minutes at 95° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 55° C., followed by terminal extension at 72° C. for 2 minutes.

Specificity of the assay was tested by adding to the PCR reactions 0.1 ng of genomic DNA from each of the following bacterial species: *Klebsiella pneumoniae* (2 strains), *Klebsiella ornitholytica*, *Klebsiella oxytoca* (2 strains), *Klebsiella planticola*, *Klebsiella terrigena*, *Citrobacter freundii*, *Escherichia coli*, *Salmonella cholerasuis typhi*, *Serratia*

marcescens, *Enterobacter aerogenes*, *Proteus vulgaris*, *Kluyvera ascorbata*, *Kluyvera georgiana*, *Kluyvera cryoconis* and *Yersinia enterolitica*. Amplification was detected for the two *K. pneumoniae* strains, *K. planticola*, *K. terrigena* and the three *Kluyvera* species tested. Analysis of the multiple alignment sequence of the atpD gene allowed the design of an internal probe SEQ ID NO. 2167 which can discriminate *Klebsiella pneumoniae* from other *Klebsiella* sp. and *Kluyvera* sp. The sensitivity of the assay with 40-cycle PCR was verified with one strain of *K. pneumoniae*. The detection limit for *K. pneumoniae* was around 10 copies of genomic DNA.

Example 30

Specific Detection and Identification of *Acinetobacter baumannii* Using atpD Sequences

The analysis of atpD sequences from a variety of bacterial species allowed the selection of PCR primers specific to *Acinetobacter baumannii*. The primer design strategy is similar to the strategy described in Example 28.

Two *A. baumannii*-specific primers were selected, SEQ ID NOs. 1690 and 1691, which give an amplification product of 233 bp. Standard PCR was carried out on PTC-200 thermocyclers (MJ Research) using 0.4 μ M of each primer as described in Example 28. The optimal cycling conditions for maximum sensitivity and specificity were as follow: three minutes at 95° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 60° C., followed by terminal extension at 72° C. for 2 minutes.

Specificity of the assay was tested by adding to the PCR reactions 0.1 ng of genomic DNA from each of the following bacterial species: *Acinetobacter baumannii* (3 strains), *Acinetobacter anitratus*, *Acinetobacter lwoffii*, *Serratia marcescens*, *Enterobacter cloacae*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Psychrobacter phenylpyruvicus*, *Neisseria gonorrhoeae*, *Haemophilus haemoliticus*, *Yersinia enterolitica*, *Proteus vulgaris*, *Eikenella corrodens*, *Escherichia coli*. Amplification was detected only for *A. baumannii*, *A. anitratus* and *A. lwoffii*. The sensitivity of the assay with 40-cycle PCR was verified with two strains of *A. baumannii*. The detection limit for the two *A. baumannii* strains tested was 5 copies of genomic DNA. Analysis of the multiple alignment sequence of the atpD gene allowed the design of a *A. baumannii*-specific internal probe (SEQ ID NO. 2169).

Example 31

Specific Detection and Identification of *Neisseria gonorrhoeae* Using tuf Sequences

The analysis of tuf sequences from a variety of bacterial species allowed the selection of PCR primers specific to *Neisseria gonorrhoeae*. The primer design strategy is similar to the strategy described in Example 28.

Two *N. gonorrhoeae*-specific primers were selected, SEQ ID NOs. 551 and 552, which give an amplification product of 139 bp. PCR amplification was carried out on PTC-200 thermocyclers (MJ Research) using 0.4 μ M of each primer as described in Example 28. The optimal cycling conditions for maximum sensitivity and specificity were as follow: three minutes at 95° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 65° C., followed by terminal extension at 72° C. for 2 minutes.

Specificity of the assay was tested by adding into the PCR reactions, 0.1 ng of genomic DNA from each of the following

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bacterial species: *Neisseria gonorrhoeae* (19 strains), *Neisseria meningitidis* (2 strains), *Neisseria lactamica*, *Neisseria flavaescens*, *Neisseria animalis*, *Neisseria canis*, *Neisseria cuniculi*, *Neisseria elongata*, *Neisseria mucosa*, *Neisseria polysaccharea*, *Neisseria sicca*, *Neisseria subflava*, *Neisseria weaveri*. Amplification was detected only for *N. gonorrhoeae*, *N. sicca* and *N. polysaccharea*. The sensitivity of the assay with 40-cycle PCR was verified with two strains of *N. gonorrhoeae*. The detection limit for the *N. gonorrhoeae* strains tested was 5 copies of genomic DNA. Analysis of the multiple alignment sequence of the *tuf* gene allowed the design of an internal probe, SEQ ID NO. 2166, which can discriminate *N. gonorrhoeae* from *N. sicca* and *N. polysaccharea*.

Example 32

Sequencing of Bacterial *gyrA* and *parC* Gene Fragments. Sequencing of Bacterial *gyrA* and *parC* Fragments

One of the major mechanism of resistance to quinolone in various bacterial species is mediated by target changes (DNA gyrase and/or topoisomerase IV). These enzymes control DNA topology and are vital for chromosome function and replication. Each of these enzymes is a tetramer composed of two subunits: GyrA and GyrB forming A₂B₂ complex in DNA gyrase; and ParC and ParE forming and C₂E₂ complex in DNA topoisomerase IV. It has been shown that they are hotspots, called the quinolone-resistance-determining region (QRDR) for mutations within *gyrA* that encodes for the GyrA subunit of DNA gyrase and within *parC* that encodes the parC subunit of topoisomerase IV.

In order to generate a database for *gyrA* and *parC* sequences that can be used for design of primers and/or probes for the specific detection of quinolone resistance in various bacterial species, *gyrA* and *parC* DNA fragments selected from public database (GenBank and EMBL) from a variety of bacterial species were used to design oligonucleotide primers.

Using primer pair SEQ ID NOS. 1297 and 1298, it was possible to amplify and determine *gyrA* sequences from *Klebsiella oxytoca* (SEQ ID NO. 1764), *Klebsiella pneumoniae* subsp. *ozaneae* (SEQ ID NO. 1765), *Klebsiella planticola* (SEQ ID NO. 1766), *Klebsiella pneumoniae* (SEQ ID NO. 1767), *Klebsiella pneumoniae* subsp. *pneumoniae* (two strains) (SEQ ID NOS. 1768-1769), *Klebsiella pneumoniae* subsp. *rhinoscleromatis* (SEQ ID NO. 1770), *Klebsiella terrigena* (SEQ ID NO. 1771), *Kluvera ascorbata* (SEQ ID NO. 2013), *Kluvera georgiana* (SEQ ID NO. 2014) and *Escherichia coli* (4 strains) (SEQ ID NOS. 2277-2280). Using primer pair SEQ ID NOS. 1291 and 1292, it was possible to amplify and determine *gyrA* sequences from *Legionella pneumophila* subsp. *pneumophila* (SEQ ID NO. 1772), *Proteus mirabilis* (SEQ ID NO. 1773), *Providencia rettgeri* (SEQ ID NO. 1774), *Proteus vulgaris* (SEQ ID NO. 1775) and *Yersinia enterolitica* (SEQ ID NO. 1776). Using primer pair SEQ ID NOS. 1340 and 1341, it was possible to amplify and determine *gyrA* sequence from *Staphylococcus aureus* (SEQ ID NO. 1255).

Using primers SEQ ID NOS. 1318 and 1319, it was possible to amplify and determine *parC* sequences from *K. oxytoca* (two strains) (SEQ ID NOS. 1777-1778), *Klebsiella pneumoniae* subsp. *ozaneae* (SEQ ID NO. 1779), *Klebsiella planticola* (SEQ ID NO. 1780), *Klebsiella pneumoniae* (SEQ ID NO. 1781), *Klebsiella pneumoniae* subsp. *pneumoniae* (two strains) (SEQ ID NOS. 1782-1783), *Klebsiella pneumo-*

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niae subsp. *rhinoscleromatis* (SEQ ID NO. 1784) and *Klebsiella terrigena* (SEQ ID NO. 1785).

Example 33

Development of a PCR Assay for the Specific Detection and Identification of *Staphylococcus aureus* and its Quinolone Resistance Genes *GyrA* and *ParC*

The analysis of *gyrA* and *parC* sequences from a variety of bacterial species revealed conserved regions allowing the design of PCR primers specific to the quinolone-resistance-determining region (QRDR) of *gyrA* and *parC* from *Staphylococcus aureus*. PCR primer pair SEQ ID NOS. 1340 and 1341 was designed to amplify the *gyrA* sequence of *S. aureus*, whereas PCR primer pair SEQ ID NOS. 1342 and 1343 was designed to amplify *S. aureus* *parC*. The comparison of *gyrA* and *parC* sequences from *S. aureus* strains with various levels of quinolone resistance allowed the identification of amino acid substitutions Ser-84 to Leu, Glu-88 to Gly or Lys in the *GyrA* subunit of DNA gyrase encoded by *gyrA* and amino acid changes Ser-80 to Phe or Tyr and Ala-116 to Glu in the *ParC* subunit of topoisomerase IV encoded by *parC*. These amino acid substitutions in *GyrA* and *ParC* subunits occur in isolates with intermediate- or high-level quinolone resistance. Internal probes for the specific detection of wild-type *S. aureus* *gyrA* (SEQ ID NO. 1940) and wild-type *S. aureus* *parC* (SEQ ID NO. 1941) as well as internal probes for the specific detection of each of the *gyrA* (SEQ ID NOS. 1333-1335) and *parC* mutations identified in quinolone-resistant *S. aureus* (SEQ ID NOS. 1336-1339) were designed.

The *gyrA*- and *parC*-specific primer pairs (SEQ ID NOS. 1340-1341 and SEQ ID NOS. 1342-1343) were used in multiplex. PCR amplification was carried out on PTC-200 thermocyclers (MJ Research) using 0.3, 0.3, 0.6 and 0.6 μM of each primers, respectively, as described in Example 28. The optimal cycling conditions for maximum sensitivity and specificity were 3 minutes at 95° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 62° C., followed by terminal extension at 72° C. for 2 minutes. Detection of the PCR products was made by electrophoresis in agarose gels (2%) containing 0.25 μg/ml of ethidium bromide. The specificity of the multiplex assay with 40-cycle PCR was verified by using 0.1 ng of purified genomic DNA from a panel of gram-positive bacteria. The list included the following: *Abiotrophia adiacens*, *Abiotrophia defectiva*, *Bacillus cereus*, *Bacillus mycoides*, *Enterococcus faecalis* (2 strains), *Enterococcus flavescentis*, *Gemella morbillorum*, *Lactococcus lactis*, *Listeria innocua*, *Listeria monocytogenes*, *Staphylococcus aureus* (5 strains), *Staphylococcus auricalis*, *Staphylococcus capitis* subsp. *urealyticus*, *Staphylococcus carnosus*, *Staphylococcus chromogenes*, *Staphylococcus epidermidis* (3 strains), *Staphylococcus gallinarum*, *Staphylococcus haemolyticus* (2 strains), *Staphylococcus hominis*, *Staphylococcus hominis* subsp. *hominis*, *Staphylococcus lentus*, *Staphylococcus lugdunensis*, *Staphylococcus saccharolyticus*, *Staphylococcus saprophyticus* (3 strains), *Staphylococcus simulans*, *Staphylococcus warneri*, *Staphylococcus xylosus*, *Streptococcus agalactiae*, *Streptococcus pneumoniae*. Strong amplification of both *gyrA* and *parC* genes was only detected for the *S. aureus* strains tested. The sensitivity of the multiplex assay with 40-cycle PCR was verified with one quinolone-sensitive and four quinolone-resistant strains of *S. aureus*. The detection limit was 2 to 10 copies of genomic DNA, depending on the strains tested.

Detection of the hybridization with the internal probes was performed as described in Example 7. The internal probes specific to wild-type gyrA and parC of *S. aureus* and to the gyrA and parC variants of *S. aureus* were able to recognize two quinolone-resistant and one quinolone-sensitive *S. aureus* strains showing a perfect correlation with the susceptibility to quinolones.

The complete assay for the specific detection of *S. aureus* and its susceptibility to quinolone contains the *Staphylococcus*-specific primers (SEQ ID NOs. 553 and 575) described in Example 7 and the multiplex containing the *S. aureus* gyrA- and parC-specific primer pairs (SEQ ID NOs. 1340-1341 and SEQ ID NOs. 1342-1343). Amplification is coupled with post-PCR hybridization with the internal probe specific to *S. aureus* (SEQ ID NO. 587) described in Example 7 and the internal probes specific to wild-type *S. aureus* gyrA and parC (SEQ ID NOs. 1940-1941) and to the *S. aureus* gyrA and parC variants (SEQ ID NOs. 1333-1338).

An assay was also developed for the detection of quinolone-resistant *S. aureus* using the SmartCycler (Cepheid). Real-time detection is based on the use of *S. aureus* parC-specific primers (SEQ ID NOs. 1342 and 1343) and the *Staphylococcus*-specific primers (SEQ ID NOs. 553 and 575) described in Example 7. Internal probes were designed for molecular beacon detection of the wild-type *S. aureus* parC (SEQ ID NO. 1939), for detection of the Ser-80 to Tyr or Phe amino acid substitutions in the ParC subunit encoded by *S. aureus* parC (SEQ ID NOs. 1938 and 1955) and for detection of *S. aureus* (SEQ ID NO. 2282).

Example 34

Development of a PCR Assay for the Detection and Identification of *Klebsiella pneumoniae* and Its Quinolone Resistance Genes gyrA and parC

The analysis of gyrA and parC sequences from a variety of bacterial species from the public databases and from the database described in Example 32 revealed conserved regions allowing the design of PCR primers specific to the quinolone-resistance-determining region (QRDR) of gyrA and parC from *K. pneumoniae*. PCR primer pair SEQ ID NOs. 1936 and 1937, or pair SEQ ID NOs. 1937 and 1942, were designed to amplify the gyrA sequence of *K. pneumoniae*, whereas PCR primer pair SEQ ID NOs. 1934 and 1935 was designed to amplify *K. pneumoniae* parC sequence. An alternative pair, SEQ ID NOs. 1935 and 1936, can also amplify *K. pneumoniae* parC. The comparison of gyrA and parC sequences from *K. pneumoniae* strains with various levels of quinolone resistance allowed the identification of amino acid substitutions Ser-83 to Tyr or Phe and Asp-87 to Gly or Ala and Asp-87 to Asn in the GyrA subunit of DNA gyrase encoded by gyrA and amino acid changes Ser-80 to Ile or Arg and Glu-84 to Gly or Lys in the ParC subunit of topoisomerase IV encoded by parC. These amino acid substitutions in the GyrA and ParC subunits occur in isolates with intermediate- or high-level quinolone resistance. Internal probes for the specific detection of wild-type *K. pneumoniae* gyrA (SEQ ID NO. 1943) and wild-type *K. pneumoniae* parC (SEQ ID NO. 1944) as well as internal probes for the specific detection of each of the gyrA (SEQ ID NOs. 1945-1949) and parC mutations identified in quinolone-resistant *K. pneumoniae* (SEQ ID NOs. 1950-1953) were designed.

Two multiplex using the *K. pneumoniae* gyrA- and parC-specific primer pairs were used: the first multiplex contained *K. pneumoniae* gyrA-specific primers (SEQ ID NOs. 1937 and 1942) and *K. pneumoniae* parC-specific primers (SEQ ID

NOs. 1934 and 1935) and the second multiplex contained *K. pneumoniae* gyrA/parC-specific primer (SEQ ID NOs. 1936), *K. pneumoniae* gyrA-specific primer (SEQ ID NO. 1937) and *K. pneumoniae* parC-specific primer (SEQ ID NO. 1935). Standard PCR was carried out on PTC-200 thermocyclers (MJ Research) using for the first multiplex 0.6, 0.6, 0.4, 0.4 μ M of each primer, respectively, and for the second multiplex 0.8, 0.4, 0.4 μ M of each primer, respectively. PCR amplification and agarose gel electrophoresis of the amplified products were performed as described in Example 28. The optimal cycling conditions for maximum sensitivity and specificity were 3 minutes at 95° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 62° C., followed by terminal extension at 72° C. for 2 minutes. The specificity of the two multiplex assays with 40-cycle PCR was verified by using 0.1 ng of purified genomic DNA from a panel of gram-negative bacteria. The list included: *Acinetobacter baumannii*, *Citrobacter freundii*, *Eikenella corrodens*, *Enterobacter aerogenes*, *Enterobacter cancerogenes*, *Enterobacter cloacae*, *Escherichia coli* (10 strains), *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Klebsiella ornitholytica*, *Klebsiella oxytoca* (2 strains), *Klebsiella planticola*, *Klebsiella terrigena*, *Kluuyvera ascorbata*, *Kluuyvera cryocrescens*, *Kluuyvera georgiana*, *Neisseria gonorrhoeae*, *Proteus mirabilis*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella choleraesuis* subsp. *typhimurium*, *Salmonella enteritidis*, *Serratia liquefaciens*, *Serratia marcescens* and *Yersinia enterocolytica*. For both multiplex, strong amplification of both gyrA and parC was observed only for the *K. pneumoniae* strain tested. The sensitivity of the two multiplex assays with 40-cycle PCR was verified with one quinolone-sensitive strain of *K. pneumoniae*. The detection limit was around 10 copies of genomic DNA.

The complete assay for the specific detection of *K. pneumoniae* and its susceptibility to quinolone contains the *Klebsiella*-specific primers (SEQ ID NOs. 1331 and 1332) described in Example 29 and either the multiplex containing the *K. pneumoniae* gyrA- and parC-specific primers (SEQ ID NOs. 1935, 1936, 1937) or the multiplex containing the *K. pneumoniae* gyrA- and parC-specific primers (SEQ ID NOs. 1934, 1937, 1939, 1942). Amplification is coupled with post-PCR hybridization with the internal probe specific to *K. pneumoniae* (SEQ ID NO. 2167) described in Example 29 and the internal probes specific to wild-type *K. pneumoniae* gyrA and parC (SEQ ID NOs. 1943, 1944) and to the *K. pneumoniae* gyrA and parC variants (SEQ ID NOs. 1945-1949 and 1950-1953).

An assay was also developed for the detection of quinolone-resistant *K. pneumoniae* using the SmartCycler (Cepheid). Real-time detection is based on the use of resistant *K. pneumoniae* gyrA-specific primers (SEQ ID NOs. 1936 and 1937) and the *K. pneumoniae*-specific primers (SEQ ID NOs. 1331 and 1332) described in Example 29. Internal probes were designed for molecular beacon detection of the wild-type *K. pneumoniae* gyrA (SEQ ID NO. 2251), for detection of the Ser-83 to Tyr or Phe and/or Asp-87 to Gly or Asn in the GyrA subunit of DNA gyrase encoded by gyrA (SEQ ID NOs. 2250) and for detection of *K. pneumoniae* (SEQ ID NO. 2281).

Example 35

Development of a PCR Assay for Detection and Identification of *S. Pneumoniae* and its Quinolone Resistance Genes gyrA and parC

The analysis of gyrA and parC sequences from a variety of bacterial species revealed conserved regions allowing the

design of PCR primers able to amplify the quinolone-resistance-determining region (QRDR) of gyrA and parC from all *S. pneumoniae* strains. PCR primer pair SEQ ID NOS. 2040 and 2041 was designed to amplify the QRDR of *S. pneumoniae* gyrA, whereas PCR primer pair SEQ ID NOS. 2044 and 2045 was designed to amplify the QRDR of *S. pneumoniae* parC. The comparison of gyrA and parC sequences from *S. pneumoniae* strains with various levels of quinolone resistance allowed the identification of amino acid substitutions Ser-81 to Phe or Tyr in the GyrA subunit of DNA gyrase encoded by gyrA and amino acid changes Ser-79 to Phe in the ParC subunit of topoisomerase IV encoded by parC. These amino acid substitutions in the GyrA and ParC subunits occur in isolates with intermediate- or high-level quinolone resistance. Internal probes for the specific detection of each of the gyrA (SEQ ID NOS. 2042 and 2043) and parC (SEQ ID NO. 2046) mutations identified in quinolone-resistant *S. pneumoniae* were designed.

For all bacterial species, amplification was performed from purified genomic DNA. 1 μ L of genomic DNA at 0.1 ng/1 μ L, was transferred directly to a 19 μ L PCR mixture. Each PCR reaction contained 50 mM KCl, 10 mM Tris-HCl (pH 9.0), 0.1% Triton X-100, 2.5 mM MgCl₂, 0.4 μ M (each) of the above primers SEQ ID NOS. 2040, 2041, 2044 and 2045, 0.05 mM bovine serum albumin (BSA) and 0.5 U Taq polymerase coupled with TaqStartTM antibody. The optimal cycling conditions for maximum sensitivity and specificity were 3 minutes at 95° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 58° C., followed by terminal extension at 72° C. for 2 minutes. In order to generate Digoxigenin (DIG)-labeled amplicons for capture probe hybridization, 0.1 \times PCR DIG labeling four deoxynucleoside triphosphates mix (Boehringer Mannheim GmbH) was used for amplification.

The DIG-labeled amplicons were hybridized to the capture probes bound to 96-well plates. The plates were incubated with anti-DIG-alkaline phosphatase and the chemiluminescence was measured by using a luminometer (MLX, Dynex Technologies Inc.) after incubation with CSPD and recorded as Relative Light Unit (RLU). The RLU ratio of tested sample with and without captures probes was then calculated. A ratio 2.0 was defined as a positive hybridization signal. All reactions were performed in duplicate.

The specificity of the multiplex assay with 40-cycle PCR was verified by using 0.1 ng of purified genomic DNA from a panel of bacteria listed in Table 13. Strong amplification of both gyrA and parC was detected only for the *S. pneumoniae* strains tested. Weak amplification of both gyrA and parC genes was detected for *Staphylococcus simulans*. The detection limit tested with purified genomic DNA from 5 strains of *S. pneumoniae* was 1 to 10 genome copies. In addition, 5 quinolone-resistant and 2 quinolone-sensitive clinical isolates of *S. pneumoniae* were tested to further validate the developed multiplex PCR coupled with capture probe hybridization assays. There was a perfect correlation between detection of *S. pneumoniae* gyrA and parC mutations and the susceptibility to quinolone.

The complete assay for the specific detection of *S. pneumoniae* and its susceptibility to quinolone contains the *S. pneumoniae*-specific primers (SEQ ID NOS. 1179 and 1181) described in Example 20 and the multiplex containing the *S. pneumoniae* gyrA-specific and parC-specific primer pairs (SEQ ID NOS. 2040 and 2041 and SEQ ID NOS. 2044 and 2045). Amplification is coupled with post-PCR hybridization with the internal probe specific to *S. pneumoniae* (SEQ ID NO. 1180) described in Example and the internal probes

specific to each of the *S. pneumoniae* gyrA and parC variants (SEQ ID NOS. 2042, 2043 and 2046).

Example 36

Detection of Extended-Spectrum TEM-Type β -Lactamases in *Escherichia coli*

The analysis of TEM sequences which confer resistance to third-generation cephalosporins and to β -lactamase inhibitors allowed the identification of amino acid substitutions Met-69 to Ile or Leu or Val, Ser-130 to Gly, Arg-164 to Ser or H is, Gly-238 to Ser, Glu-240 to Lys and Arg-244 to Ser or Cys or Thr or His or Leu. PCR primers SEQ ID NOS. 1907 and 1908 were designed to amplify TEM sequences. Internal probes for the specific detection of wild-type TEM (SEQ ID NO. 2141) and for each of the amino acid substitutions (SEQ ID NOS. 1909-1926) identified in TEM variants were designed to detect resistance to third-generation cephalosporins and to β -lactamase inhibitors. Design and synthesis of primers and probes, and detection of the hybridization were performed as described in Example 7.

For all bacterial species, amplification was performed from purified genomic DNA. One μ L of genomic DNA at 0.1 ng/ μ L was transferred directly to a 19 μ L PCR mixture. Each PCR reaction contained 50 mM KCl, 10 mM Tris-HCl (pH 9.0); 0.1% Triton X-100, 2.5 mM MgCl₂, 0.4 μ M of the TEM-specific primers SEQ ID NOS. 1907 and 1908, 200 μ M (each) of the four deoxynucleoside triphosphates, 0.05 mM bovine serum albumin (BSA) and 0.5 U Taq polymerase (Promega) coupled with TaqStartTM antibody. PCR amplification and agarose gel analysis of the amplified products were performed as described in Example 28. The optimal cycling conditions for maximum sensitivity and specificity were 3 minutes at 95° C. for initial denaturation, then forty cycles of three steps consisting of 5 seconds at 95° C., 30 seconds at 55° C. and 30 seconds at 72° C., followed by terminal extension at 72° C. for 2 minutes.

The specificity of the TEM-specific primers with 40-cycle PCR was verified by using 0.1 ng of purified genomic from the following bacteria: three third-generation cephalosporin-resistant *Escherichia coli* strains (one with TEM-10, one with TEM-28 and the other with TEM-49), two third-generation cephalosporin-sensitive *Escherichia coli* strain (one with TEM-1 and the other without TEM), one third-generation cephalosporin-resistant *Klebsiella pneumoniae* strain (with TEM-47), and one β -lactamase-inhibitor-resistant *Proteus mirabilis* strain (with TEM-39). Amplification with the TEM-specific primers was detected only for strains containing TEM.

The sensitivity of the assay with 40-cycle PCR was verified with three *E. coli* strains containing TEM-1 or TEM-10 or TEM-49, one *K. pneumoniae* strain containing TEM-47 and one *P. mirabilis* strain containing TEM-39. The detection limit was 5 to 10 copies of genomic DNA, depending on the TEM-containing strains tested.

The TEM-specific primers SEQ ID NOS. 1907 and 1908 were used in multiplex with the *Escherichia coli/Shigella* sp.-specific primers SEQ ID NOS. 1661 and 1665 described in Example 28 to allow the complete identification of *Escherichia coli/Shigella* sp. and the susceptibility to β -lactams. PCR amplification with 0.4 μ M of each of the primers and agarose gel analysis of the amplified products was performed as described above.

The specificity of the multiplex with 40-cycle PCR was verified by using 0.1 ng of purified genomic DNA from the following bacteria: three third-generation cephalosporin-re-

sistant *Escherichia coli* strains (one with TEM-10, one with TEM-28 and the other with TEM-49), two third-generation cephalosporin-sensitive *Escherichia coli* strain (one with TEM-1 and the other without TEM), one third-generation cephalosporin-resistant *Klebsiella pneumoniae* strain (with TEM-47), and one β -lactamase-inhibitor-resistant *Proteus mirabilis* strain (with TEM-39). The multiplex was highly specific to *Escherichia coli* strains containing TEM.

The complete assay for detection of TEM-type β -lactamases in *E. coli* includes PCR amplification using the multiplex containing the TEM-specific primers (SEQ ID NOS. 1907 and 1908) and the *Escherichia coli/Shigella* sp.-specific primers (SEQ ID NOS. 1661 and 1665) coupled with post PCR-hybridization with the internal probes specific to wild-type TEM (SEQ ID NO. 2141) and to the TEM variants (SEQ ID NOS. 1909-1926).

Example 37

Detection of Extended-Spectrum SHV-Type β -Lactamases in *Klebsiella pneumoniae*

The comparison of SHV sequences, which confer resistance to third-generation cephalosporins and to β -lactamase inhibitors, allowed the identification of amino acid substitutions Ser-130 to Gly, Asp-179 to Ala or Asn, Gly-238 to Ser, and Glu-240 to Lys. PCR primer pair SEQ ID NOS. 1884 and 1885 was designed to amplify SHV sequences. Internal probes for the specific identification of wild-type SHV (SEQ ID NO. 1896) and for each of the amino acid substitutions (SEQ ID NOS. 1886-1895 and 1897-1898) identified in SHV variants were designed to detect resistance to third-generation cephalosporins and to β -lactamase inhibitors. Design and synthesis of primers and probes, and detection of the hybridization were performed as described in Example 7.

For all bacterial species, amplification was performed from purified genomic DNA. One μ l of genomic DNA at 0.1 ng/ μ l was transferred directly to a 19 μ l PCR mixture. Each PCR reaction contained 50 mM KCl, 10 mM Tris-HCl (pH 9.0), 0.1% Triton X-100, 2.5 mM MgCl₂, 0.4 μ M of the SHV-specific primers SEQ ID NO. 1884 and 1885, 200 μ M (each) of the four deoxynucleoside triphosphates, 0.05 mM bovine serum albumin (BSA) and 0.5 U Taq polymerase (Promega) coupled with TaqStartTM antibody. PCR amplification and agarose gel analysis of the amplified products were performed as described in Example 28. The optimal cycling conditions for maximum sensitivity and specificity were 3 minutes at 95° C. for initial denaturation, then forty cycles of three steps consisting of 5 seconds at 95° C., 30 seconds at 55° C. and 30 seconds at 72° C., followed by terminal extension at 72° C. for 2 minutes.

The specificity of the SHV-specific primers with 40-cycle PCR was verified by using 0.1 ng of purified genomic from the following bacteria: two third-generation cephalosporin-resistant *Klebsiella pneumoniae* strains (one with SHV-2a and the other with SHV-12), one third-generation cephalosporin-sensitive *Klebsiella pneumoniae* strain (with SHV-1), two third-generation cephalosporin-resistant *Escherichia coli* strains (one with SHV-8 and the other with SHV-7), and two third-generation cephalosporin-sensitive *Escherichia coli* strains (one with SHV-1 and the other without any SHV). Amplification with the SHV-specific primers was detected only for strains containing SHV.

The sensitivity of the assay with 40-cycle PCR was verified with four strains containing SHV. The detection limit was 10 to 100 copies of genomic DNA, depending on the SHV-containing strains tested.

The amplification was coupled with post-PCR hybridization with the internal probes specific for identification of

wild-type SHV (SEQ ID NO. 1896) and for each of the amino acid substitutions (SEQ ID NOS. 1886-1895 and 1897-1898) identified in SHV variants. The specificity of the probes was verified with six strains containing various SHV enzymes, one *Klebsiella pneumoniae* strain containing SHV-1, one *Klebsiella pneumoniae* strain containing SHV-2a, one *Klebsiella pneumoniae* strain containing SHV-12, one *Escherichia coli* strain containing SHV-1, one *Escherichia coli* strain containing SHV-7 and one *Escherichia coli* strain containing SHV-8. The probes correctly detected each of the SHV genes and their specific mutations. There was a perfect correlation between the SHV genotype of the strains and the susceptibility to β -lactam antibiotics.

The SHV-specific primers SEQ ID NOS. 1884 and 1885 were used in multiplex with the *K. pneumoniae*-specific primers SEQ ID NOS. 1331 and 1332 described in Example 29 to allow the complete identification of *K. pneumoniae* and the susceptibility to β -lactams. PCR amplification with 0.4 μ M of each of the primers and agarose gel analysis of the amplified products were performed as described above.

The specificity of the multiplex with 40-cycle PCR was verified by using 0.1 ng of purified genomic DNA from the following bacteria: three *K. pneumoniae* strains containing SHV-1, one *Klebsiella pneumoniae* strain containing SHV-2a, one *Klebsiella pneumoniae* strain containing SHV-12, one *K. rhinoscleromatis* strain containing SHV-1, one *Escherichia coli* strain without SHV. The multiplex was highly specific to *Klebsiella pneumoniae* strain containing SHV.

Example 38

Development of a PCR Assay for the Detection and Identification of *Neisseria gonorrhoeae* and its Associated Tetracycline Resistance Gene tetM

The analysis of publicly available tetM sequences revealed conserved regions allowing the design of PCR primers specific to tetM sequences. The PCR primer pair SEQ ID NOS. 1588 and 1589 was used in multiplex with the *Neisseria gonorrhoeae*-specific primers SEQ ID NOS. 551 and 552 described in Example 31. Sequence alignment analysis of tetM sequences revealed regions suitable for the design of an internal probe specific to tetM (SEQ ID NO. 2254). PCR amplification was carried out on PTC-200 thermocyclers (MJ Research) using 0.4 μ M of each primer pair as described in Example 28. The optimal cycling conditions for maximum sensitivity and specificity were as follow: three minutes at 95° C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95° C. and 30 seconds at 60° C., followed by terminal extension at 72° C. for 2 minutes.

The specificity of the multiplex PCR assay with 40-cycle PCR was verified by using 0.1 ng of purified genomic DNA from the following bacteria: two tetracycline-resistant *Escherichia coli* strains (one containing the tetracycline-resistant gene tetB and the other containing the tetracycline-resistant gene tetC), one tetracycline-resistant *Pseudomonas aeruginosa* strain (containing the tetracycline-resistant gene tetA), nine tetracycline-resistant *Neisseria gonorrhoeae* strains, two tetracycline-sensitive *Neisseria meningitidis* strains, one tetracycline-sensitive *Neisseria polysaccharea* strain, one tetracycline-sensitive *Neisseria sicca* strain and one tetracycline-sensitive *Neisseria subflava* strain. Amplification with both the tetM-specific and *Neisseria gonorrhoeae*-specific primers was detected only for *N. gonorrhoeae* strains containing tetM. There was a weak amplification signal using *Neisseria gonorrhoeae*-specific primers for the following species: *Neisseria sicca*, *Neisseria polysaccharea* and *Neisseria meningitidis*. There was a perfect correlation between the tetM genotype and the tetracy-

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cline susceptibility pattern of the *Neisseria gonorrhoeae* strains tested. The internal probe specific to *N. gonorrhoeae* SEQ ID NO. 2166 described in Example 31 can discriminate *Neisseria gonorrhoeae* from the other *Neisseria* sp.

The sensitivity of the assay with 40-cycle PCR was verified with two tetracycline resistant strains of *N. gonorrhoeae*. The detection limit was 5 copies of genomic DNA for both strains.

Example 39

Development of a PCR Assay for the Detection and Identification of *Shigella* Sp. and Their Associated Trimethoprim Resistance Gene dhfrIa

The analysis of publicly available dhfrIa and other dhfr sequences revealed regions allowing the design of PCR primers specific to dhfrIa sequences. The PCR primer pair (SEQ ID NOS. 1459 and 1460) was used in multiplex with the *Escherichia coli*/*Shigella* sp.-specific primers SEQ ID NOS. 1661 and 1665 described in Example 28. Sequence alignment analysis of dhfrIa sequences revealed regions suitable for the design of an internal probe specific to dhfrIa (SEQ ID NO. 2253). PCR amplification and agarose gel analysis of the amplified products were performed as described in Example 28 with an annealing temperature of 60°C. The specificity of the multiplex assay with 40-cycle PCR was verified by using 0.1 ng of purified genomic DNA from a panel of bacteria. The list included the following trimethoprim-sensitive strains, *Salmonella typhimurium*, *Salmonella typhi*, *Salmonella enteritidis*, *Tatumella ptyseos*, *Klebsiella pneumoniae*, *Enterobacter aerogenes*, *Citrobacter farmeri*, *Campylobacter jejuni*, *Serratia marcescens*, *Shigella dysenteriae*, *Shigella flexneri*, *Shigella sonnei*, six trimethoprim-resistant *Escherichia coli* strains (containing dhfrIa or dhfrV or dhfrVII or dhfrXII or dhfrXIII or dhfrXV), four trimethoprim-resistant strains containing dhfrIa (*Shigella sonnei*, *Shigella flexneri*, *Shigella dysenteriae* and *Escherichia coli*). There was a perfect correlation between the dhfrIa genotype and the trimethoprim susceptibility pattern of the *Escherichia coli* and *Shigella* sp. strains tested. The dhfrIa primers were specific to the dhfrIa gene and did not amplify any of the other trimethoprim-resistant dhfr genes tested. The sensitivity of the multiplex assay with 40-cycle PCR was verified with three strains of trimethoprim-resistant strains of *Shigella* sp. The detection limit was 5 to 10 genome copies of DNA, depending on the *Shigella* sp. strains tested.

Example 40

Development of a PCR Assay for the Detection and Identification of *Acinetobacter baumannii* and its Associated Aminoglycoside Resistance Gene aph(3')-VIa

The comparison of publicly available aph(3')-VIa sequence revealed regions allowing the design of PCR primers specific to aph(3')-VIa. The PCR primer pair (SEQ ID NOS. 1404 and 1405) was used in multiplex with the *Acinetobacter baumannii*-specific primers SEQ ID NOS. 1692 and 1693 described in Example 30. Analysis of the aph(3')-VIa sequence revealed region suitable for the design of an internal probe specific to aph(3')-VIa (SEQ ID NO. 2252). PCR amplification and agarose gel analysis of the amplified products were performed as described in Example 28. The specificity of the multiplex assay with 40-cycle PCR was verified by using 0.1 ng of purified genomic DNA from a panel of bacteria including: two aminoglycoside-resistant *A. baumannii* strains (containing aph(3')-VIa), one aminoglycoside-sensitive *A. baumanii* strain, one of each of the following

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aminoglycoside-resistant bacteria, one *Serratia marcescens* strain containing the aminoglycoside-resistant gene aacC1, one *Serratia marcescens* strain containing the aminoglycoside-resistant gene aacC4, one *Enterobacter cloacae* strain containing the aminoglycoside-resistant gene aacC2, one *Enterococcus faecalis* containing the aminoglycoside-resistant gene aacA-aphD, one *Pseudomonas aeruginosa* strain containing the aminoglycoside-resistant gene aac6IIa and one of each of the following aminoglycoside-sensitive bacterial species, *Acinetobacter anitratus*, *Acinetobacter lwoffii*, *Psychobacter phenylpyruvian*, *Neisseria gonorrhoeae*, *Haemophilus haemolyticus*, *Haemophilus influenzae*, *Yersinia enterolitica*, *Proteus vulgaris*, *Eikenella corrodens*, *Escherichia coli*. There was a perfect correlation between the aph(3')-VIa genotype and the aminoglycoside susceptibility pattern of the *A. baumannii* strains tested. The aph(3')-VIa-specific primers were specific to the aph(3')-VIa gene and did not amplify any of the other aminoglycoside-resistant genes tested. The sensitivity of the multiplex assay with 40-cycle PCR was verified with two strains of aminoglycoside-resistant strains of *A. baumannii*. The detection limit was 5 genome copies of DNA for both *A. baumannii* strains tested.

Example 41

Specific Identification of *Bacteroides fragilis* Using atpD (V-Type) Sequences

The comparison of atpD (V-type) sequences from a variety of bacterial species allowed the selection of PCR primers for *Bacteroides fragilis*. The strategy used to design the PCR primers was based on the analysis of a multiple sequence alignment of various atpD sequences from *B. fragilis*, as well as atpD sequences from the related species *B. dispar*, bacterial genera and archaea, especially representatives with phylogenetically related atpD sequences. A careful analysis of this alignment allowed the selection of oligonucleotide sequences which are conserved within the target species but which discriminate sequences from other species, especially from closely related species *B. dispar*, thereby permitting the species-specific and ubiquitous detection and identification of the target bacterial species.

The chosen primer pair, SEQ ID NOS. 2134-2135, produces an amplification product of 231 bp. Standard PCR was carried out on PTC-200 thermocyclers (MJ Research Inc.) using 0.4 μM of each primers pair as described in Example 28. The optimal cycling conditions for maximum sensitivity and specificity were as follows: three minutes at 95°C. for initial denaturation, then forty cycles of two steps consisting of 1 second at 95°C. and 30 seconds at 60°C., followed by terminal extension at 72°C. for 2 minutes.

The format of this assay is not limited to the one described above. A person skilled in the art could adapt the assay for different formats such as PCR with real-time detection using molecular beacon probes. Molecular beacon probes designed to be used in this assay include, but are not limited to, SEQ ID NO. 2136 for the detection of the *B. fragilis* amplicon.

Example 42

Evidence for Horizontal Gene Transfer in the Evolution of the Elongation Factor Tu in Enterococci

Overview

The elongation factor Tu, encoded by tuf genes, is a GTP binding protein that plays a central role in protein synthesis. One to three tuf genes per genome are present depending on the bacterial species. Most low G+C gram-positive bacteria carry only one tuf gene. We have designed degenerate PCR

primers derived from consensus sequences of the tuf gene to amplify partial tuf sequences from 17 enterococcal species and other phylogenetically related species. The amplified DNA fragments were sequenced either by direct sequencing or by sequencing cloned inserts containing putative amplicons. Two different tuf genes (tufA and tufB) were found in 11 enterococcal species, including *Enterococcus avium*, *E. casseliflavus*, *E. dispar*, *E. durans*, *E. faecium*, *E. gallinarum*, *E. hirae*, *E. malodoratus*, *E. mundtii*, *E. pseudoavium*, and *E. raffinosus*. For the other six enterococcal species (*E. cecorum*, *E. columbae*, *E. faecalis*, *E. sulfureus*, *E. saccharolyticus*, and *E. solitarius*), only the tufA gene was present. Based on 16S rRNA gene sequence analysis, the 11 species having two tuf genes all share a common ancestor, while the six species having only one copy diverged from the enterococcal lineage before that common ancestor. The presence of one or two copies of the tuf gene in enterococci was confirmed by Southern hybridization. Phylogenetic analysis of tuf sequences demonstrated that the enterococcal tufA gene branches with the *Bacillus*, *Listeria* and *Staphylococcus* genera, while the enterococcal tufB gene clusters with the genera *Streptococcus* and *Lactococcus*. Primary structure analysis showed that four amino acid residues within the sequenced regions are conserved and unique to the enterococcal tufB genes and the tuf genes of streptococci and *L. lactis*. The data suggest that an ancestral *streptococcus* or a *streptococcus*-related species may have horizontally transferred a tuf gene to the common ancestor of the 11 enterococcal species which now carry two tuf genes.

Introduction

The elongation factor Tu (EF-Tu) is a GTP binding protein playing a central role in protein synthesis. It mediates the recognition and transport of aminoacyl-tRNAs and their positioning to the A-site of the ribosome. The highly conserved function and ubiquitous distribution render the elongation factor a valuable phylogenetic marker among eubacteria and even throughout the archaeabacterial and eukaryotic kingdoms. The tuf genes encoding elongation factor Tu are present in various copy numbers per bacterial genome. Most gram-negative bacteria contain two tuf genes. As found in *Escherichia coli*, the two genes, while being almost identical in sequence, are located in different parts of the bacterial chromosome. However, recently completed microbial genomes revealed that only one tuf gene is found in *Helicobacter pylori* as well as in some obligate parasitic bacteria, such as *Borrelia burgdorferi*, *Rickettsia prowazekii*, and *Treponema pallidum*, and in some cyanobacteria. In most gram-positive bacteria studied so far, only one tuf gene was found. However, Southern hybridization showed that there are two tuf genes in some clostridia as well as in *Streptomyces coelicolor* and *S. lividans*. Up to three tuf-like genes have been identified in *S. ramocissimus*.

Although massive prokaryotic gene transfer is suggested to be one of the factors responsible for the evolution of bacterial genomes, the genes encoding components of the translation machinery are thought to be highly conserved and difficult to be transferred horizontally due to the complexity of their interactions. However, a few recent studies demonstrated evidence that horizontal gene transfer has also occurred in the evolution of some genes coding for the translation apparatus, namely, 16S rRNA and some aminoacyl-tRNA synthetases. No further data suggest that such a mechanism is involved in the evolution of the elongation factors. Previous studies concluded that the two copies of tuf genes in the genomes of some bacteria resulted from an ancient event of gene duplication. Moreover, a study of the tuf gene in *R. prowazekii* suggested

that intrachromosomal recombination has taken place in the evolution of the genome of this organism.

To date, little is known about the tuf genes of enterococcal species. In this study, we analyzed partial sequences of tuf genes in 17 enterococcal species, namely, *E. avium*, *E. casseliflavus*, *E. cecorum*, *E. columbae*, *E. dispar*, *E. durans*, *E. faecalis*, *E. faecium*, *E. gallinarum*, *E. hirae*, *E. malodoratus*, *E. mundtii*, *E. pseudoavium*, *E. raffinosus*, *E. saccharolyticus*, *E. solitarius*, and *E. sulfureus*. We report here the presence of two divergent copies of tuf genes in 11 of these enterococcal species. The 6 other species carried a single tuf gene. The evolutionary implications are discussed.

Materials and Methods

Bacterial strains. Seventeen enterococcal strains and other 15 gram-positive bacterial strains obtained from the American Type Culture Collection (ATCC, Manassas, Va.) were used in this study (Table 16). All strains were grown on sheep blood agar or in brain-heart infusion broth prior to DNA isolation.

DNA isolation. Bacterial DNAs were prepared using the G 20 NOME DNA extraction kit (Bio101, Vista, Calif.) as previously described.

Sequencing of putative tuf genes. In order to obtain the tuf gene sequences of enterococci and other gram-positive bacteria, two sequencing approaches were used: 1) sequencing of 25 cloned PCR products and 2) direct sequencing of PCR products. A pair of degenerate primers (SEQ ID NOS. 664 and 697) were used to amplify an 886-bp portion of the tuf genes from enterococcal species and other gram-positive bacteria as previously described. For *E. avium*, *E. casseliflavus*, *E. dispar*, *E. durans*, *E. faecium*, *E. gallinarum*, *E. hirae*, *E. mundtii*, *E. pseudoavium*, and *E. raffinosus*, the amplicons 30 were cloned using the Original TA cloning kit (Invitrogen, Carlsbad, Calif.) as previously described. Five clones for each species were selected for sequencing. For *E. cecorum*, *E. faecalis*, *E. saccharolyticus*, and *E. solitarius* as well as the other gram-positive bacteria, the sequences of the 886-bp amplicons were obtained by direct sequencing. Based on the results obtained from the earlier rounds of sequencing, two 35 pairs of primers were designed for obtaining the partial tuf sequences from the other enterococcal species by direct sequencing. One pair of primers (SEQ ID NOS. 543 and 660) were used to amplify the enterococcal tuf gene fragments from *E. columbae*, *E. malodoratus*, and *E. sulfureus*. Another pair of primers (SEQ ID NOS. 664 and 661) were used to 40 amplify the second tuf gene fragments from *E. avium*, *E. malodoratus*, and *E. pseudoavium*.

Prior to direct sequencing, PCR products were electrophoresed on 1% agarose gel at 120V for 2 hours. The gel was then stained with 0.02% methylene blue for 30 minutes and washed twice with autoclaved distilled water for 15 minutes. The gel slices containing PCR products of the expected sizes 55 were cut out and purified with the QIAquick gel extraction kit (QIAGen Inc., Mississauga, Ontario, Canada) according to the manufacturer's instructions. PCR mixtures for sequencing were prepared as described previously. DNA sequencing was carried out with the Big Dye™ Terminator Ready Reaction cycle sequencing kit using a 377 DNA sequencer (PE Applied Biosystems, Foster City, Calif.). Both strands of the 60 amplified DNA were sequenced. The sequence data were verified using the Sequencer™ 3.0 software (Gene Codes Corp., Ann Arbor, Mich.).

Sequence analysis and phylogenetic study. Nucleotide sequences of the tuf genes and their respective flanking regions for *E. faecalis*, *Staphylococcus aureus*, and *Streptococcus pneumoniae*, were retrieved from the TIGR microbial genome database and *S. pyogenes* from the University of Oklahoma database. DNA sequences and deduced protein

sequences obtained in this study were compared with those in all publicly available databases using the BLAST and FASTA programs. Unless specified, sequence analysis was conducted with the programs from GCG package (Version 10; Genetics Computer Group, Madison, Wisc.). Sequence alignment of the tuf genes from 74 species representing all three kingdoms of life (Tables 16 and 17) were carried out by use of Pileup and corrected upon visual analysis. The N- and C-termini extremities of the sequences were trimmed to yield a common block of 201 amino acids sequences and equivocal residues were removed. Phylogenetic analysis was performed with the aid of PAUP 4.0b4 written by Dr. David L. Swofford (Sinauer Associates, Inc., Publishers, Sunderland, Mass.). The distance matrix and maximum parsimony were used to generate phylogenetic trees and bootstrap resampling procedures were performed using 500 and 100 replications in each analysis, respectively.

Protein structure analysis. The crystal structures of (i) *Thermus aquaticus* EF-Tu in complex with Phe-tRNA^{Phe} and a GTP analog and (ii) *E. coli* EF-Tu in complex with GDP served as templates for constructing the equivalent models for enterococcal EF-Tu. Homology modeling of protein structure was performed using the SWISS-MODEL server and inspected using the SWISS-PDB viewer version 3.1.

Southern hybridization. In a previous study, we amplified and cloned an 803-bp PCR product of the tuf gene fragment from *E. faecium*. Two divergent sequences of the inserts, which we assumed to be tufA and tufB genes, were obtained. The recombinant plasmid carrying either tufA or tufB sequence was used to generate two probes labeled with Digoxigenin (DIG)-11-dUTP by PCR incorporation following the instructions of the manufacturer (Boehringer Mannheim, Laval, Québec, Canada). Enterococcal genomic DNA samples (1-2 µg) were digested to completion with restriction endonucleases BglII and XbaI as recommended by the supplier (Amersham Pharmacia Biotech, Mississauga, Ontario, Canada). These restriction enzymes were chosen because no restriction sites were observed within the amplified tuf gene fragments of most enterococci. Southern blotting and filter hybridization were performed using positively charged nylon membranes (Boehringer Mannheim) and QuikHyb hybridization solution (Stratagene Cloning Systems, La Jolla, Calif.) according to the manufacturers' instructions with modifications. Twenty µl of each digestion were electrophoresed for 2 h at 120V on a 0.8% agarose gel. The DNA fragments were denatured with 0.5 M NaOH and transferred by Southern blotting onto a positively charged nylon membrane (Boehringer Mannheim). The filters were pre-hybridized for 15 min and then hybridized for 2 h in the QuikHyb solution at 68° C. with either DIG-labeled probe. Posthybridization washings were performed twice with 0.5xSSC, 1% SDS at room temperature for 15 min and twice in the same solution at 60° C. for 15 min. Detection of bound probes was achieved using disodium 3-(4-methoxyspiro(1,2-dioxetane-3,2'-(5'-chloro)tricyclo(3.3.1.1^{3,7}) decan)-4-yl)phenyl phosphate (CSPD) (Boehringer Mannheim) as specified by the manufacturer.

GenBank submission. The GenBank accession numbers for partial tuf gene sequences generated in this study are given in Table 16.

Results

Sequencing and nucleotide sequence analysis. In this study, all gram-positive bacteria other than enterococci yielded a single tuf sequence of 886 bp using primers SEQ ID NOs. 664 and 697 (Table 16). Each of four enterococcal species including *E. cecorum*, *E. faecalis*, *E. saccharolyticus*, and *E. solitarius* also yielded one 886-bp tuf sequence. On the

other hand, for *E. avium*, *E. casseliflavus*, *E. dispar*, *E. durans*, *E. faecium*, *E. gallinarum*, *E. hirae*, *E. mundtii*, *E. pseudoavium*, and *E. raffinosus*, direct sequencing of the 886-bp fragments revealed overlapping peaks according to their sequence chromatograms, suggesting the presence of additional copies of the tuf gene. Therefore, the tuf gene fragments of these 10 species were cloned first and then sequenced. Sequencing data revealed that two different types of tuf sequences (tufA and tufB) are found in eight of these species including *E. casseliflavus*, *E. dispar*, *E. durans*, *E. faecium*, *E. gallinarum*, *E. hirae*, *E. mundtii*, and *E. raffinosus*. Five clones from *E. avium* and *E. pseudoavium* yielded only a single tuf sequence. These new sequence data allowed the design of new primers specific for the enterococcal tufA or tufB sequences. Primers SEQ ID NOs. 543 and 660 were designed to amplify only enterococcal tufA sequences and a 694-bp fragment was amplified from all 17 enterococcal species. The 694-bp sequences of tufA genes from *E. columbae*, *E. malodoratus*, and *E. sulfureus* were obtained by direct sequencing using these primers. Primers SEQ ID NOs. 664 and 661 were designed for the amplification of 730-bp portion of tufB genes and yielded the expected fragments from 11 enterococcal species, including *E. malodoratus* and the 10 enterococcal species in which heterogeneous tuf sequences were initially found. The sequences of the tufB fragments for *E. avium*, *E. malodoratus* and *E. pseudoavium* were determined by direct sequencing using the primers SEQ ID NOs. 664 and 661. Overall, tufA gene fragments were obtained from all 17 enterococcal species but tufB gene fragments were obtained with only 11 enterococcal species (Table 16).

The identities between tufA and tufB for each enterococcal species were 68-79% at the nucleotide level and 81 to 89% at the amino acid level. The tufA gene is highly conserved among all enterococcal species with identities varying from 87% to 99% for DNA and 93% to 99% for amino acid sequences, while the identities among tufB genes of enterococci varies from 77% to 92% for DNA and 91% to 99% for amino acid sequences, indicating their different origins and evolution (Table 18). Since *E. solitarius* has been transferred to the genus *Tetragenococcus*, which is also a low G+C gram-positive bacterium, our sequence comparison did not include this species as an enterococcus. G+C content of enterococcal tufA sequences ranged from 40.8% to 43.1%, while that of enterococcal tufB sequences varied from 37.8% to 46.3%. Based on amino acid sequence comparison, the enterococcal tufA gene products share higher identities with those of *Abiotrophia adiacens*, *Bacillus subtilis*, *Listeria monocytogenes*, *S. aureus*, and *S. epidermidis*. On the other hand, the enterococcal tufB gene products share higher percentages of amino acid identity with the tuf genes of *S. pneumoniae*, *S. pyogenes* and *Lactococcus lactis* (Table 18).

In order to elucidate whether the two enterococcal tuf sequences encode genuine EF-Tu, the deduced amino acid sequences of both genes were aligned with other EF-Tu sequences available in SWISSPROT (Release 38). Sequence alignment demonstrated that both gene products are highly conserved and carry all conserved residues present in this portion of prokaryotic EF-Tu (FIG. 4). Therefore, it appears that both gene products could fulfill the function of EF-Tu. The partial tuf gene sequences encode the portion of EF-Tu from residues 117 to 317, numbered as in *E. coli*. This portion makes up of the last four α-helices and two β-strands of domain I, the entire domain II and the N-terminal part of domain III on the basis of the determined structures of *E. coli* EF-Tu.

Based on the deduced amino acid sequences, the enterococcal tufB genes have unique conserved residues Lys129,

Leu140, Ser230, and Asp234 (*E. coli* numbering) that are also conserved in streptococci and *L. lactis*, but not in the other bacteria (FIG. 4). All these residues are located in loops except for Ser230. In other bacteria the residue Ser230 is substituted for highly conserved Thr, which is the 5th residue of the third β-strand of domain II. This region is partially responsible for the interaction between the EF-Tu and aminoacyl-tRNA by the formation of a deep pocket for any of the 20 naturally occurring amino acids. According to our three-dimensional model (data not illustrated), the substitution Thr230→Ser in domain II of EF-Tu may have little impact on the capability of the pocket to accommodate any amino acid. However, the high conservation of Thr230 comparing to the unique Ser substitution found only in streptococci and 11 enterococci could suggest a subtle functional role for this residue.

The tuf gene sequences obtained for *E. faecalis*, *S. aureus*, *S. pneumoniae* and *S. pyogenes* were compared with their respective incomplete genome sequence. Contigs with more than 99% identity were identified. Analysis of the *E. faecalis* genome data revealed that the single *E. faecalis* tuf gene is located within an str operon where tuf is preceded by fus that encodes the elongation factor G. This str operon is present in *S. aureus* and *B. subtilis* but not in the two streptococcal genomes examined. The 700-bp or so sequence upstream the *S. pneumoniae* tuf gene has no homology with any known gene sequences. In *S. pyogenes*, the gene upstream of tuf is similar to a cell division gene, ftsW, suggesting that the tuf genes in streptococci are not arranged in a str operon.

Phylogenetic analysis. Phylogenetic analysis of the tuf amino acid sequences with representatives of eubacteria, archeabacteria, and eukaryotes using neighbor-joining and maximum parsimony methods showed three major clusters representing the three kingdoms of life. Both methods gave similar topologies consistent with the rRNA gene data (data not shown). Within the bacterial Glade, the tree is polyphyletic but tufA genes from all enterococcal species always clustered with those from other low G+C gram-positive bacteria (except for streptococci and lactococci), while the tufB genes of the 11 enterococcal species form a distinct cluster with streptococci and *L. lactis* (FIG. 5). Duplicated genes from the same organism do not cluster together, thereby not suggesting evolution by recent gene duplication.

Southern hybridization. Southern hybridization of BgIII/XbaI digested genomic DNA from 12 enterococcal species tested with the tufA probe (DIG-labeled tufA fragment from *E. faecium*) yielded two bands of different sizes in 9 species, which also carried two divergent tuf sequences according to their sequencing data. For *E. faecalis* and *E. solitarius*, a single band was observed indicating that one tuf gene is present (FIG. 6). A single band was also found when digested genomic DNA from *S. aureus*, *S. pneumoniae*, and *S. pyogenes* were hybridized with the tufA probe (data not shown). For *E. faecium*, the presence of three bands can be explained by the existence of a XbaI restriction site in the middle of the tufA sequence, which was confirmed by sequencing data. Hybridization with the tufB probe (DIG-labeled tufB fragment of *E. faecium*) showed a banding profile similar to the one obtained with the tufA probe (data not shown).

Discussion

In this study, we have shown that two divergent copies of genes encoding the elongation factor Tu are present in some enterococcal species. Sequence data revealed that both genes are highly conserved at the amino acid level. One copy (tufA) is present in all enterococcal species, while the other (tufB) is present only in 11 of the 17 enterococcal species studied. Based on 16S rRNA sequence analysis, these 11 species are

members of three different enterococcal subgroups (*E. avium*, *E. faecium*, and *E. gallinarum* species groups) and a distinct species (*E. dispar*). Moreover, 16S rDNA phylogeny suggests that these 11 species possessing 2 tuf genes all share a common ancestor before they further evolved to become the modern species. Since the six other species having only one copy diverged from the enterococcal lineage before that common ancestor, it appears that the presence of one tuf gene in these six species is not attributable to gene loss.

Two clusters of low G+C gram-positive bacteria were observed in the phylogenetic tree of the tuf genes: one contains a majority of low G+C gram-positive bacteria and the other contains lactococci and streptococci. This is similar to the finding on the basis of phylogenetic analysis of the 16S rRNA gene and the hrcA gene coding for a unique heat-shock regulatory protein. The enterococcal tufA genes branched with most of the low G+C gram-positive bacteria, suggesting that they originated from a common ancestor. On the other hand, the enterococcal tufB genes branched with the genera *Streptococcus* and *Lactococcus* that form a distinct lineage separated from other low G+C gram-positive bacteria (FIG. 5). The finding that these EF-Tu proteins share some conserved amino acid residues unique to this branch also supports the idea that they may share a common ancestor. Although these conserved residues might result from convergent evolution upon a specialized function, such convergence at the sequence level, even for a few residues, seems to be rare, making it an unlikely event. Moreover, no currently known selective pressure, if any, would account for keeping one versus two tuf genes in bacteria. The G+C contents of enterococcal tufA and tufB sequences are similar, indicating that they both originated from low G+C gram-positive bacteria, in accordance with the phylogenetic analysis.

The tuf genes are present in various copy numbers in different bacteria. Furthermore, the two tuf genes are normally associated with characteristic flanking genes. The two tuf gene copies commonly encountered within gram-negative bacteria are part of the bacterial str operon and tRNA-tufB operon, respectively. The arrangement of tufA in the str operon was also found in a variety of bacteria, including *Thermotoga maritima*, the most ancient bacteria sequenced so far, *Aquifex aeolicus*, cyanobacteria, *Bacillus* sp., *Micrococcus luteus*, *Mycobacterium tuberculosis*, and *Streptomyces* sp. Furthermore, the tRNA-tufB operon has also been identified in *Aquifex aeolicus*, *Thermus thermophilus*, and *Chlamydia trachomatis*. The two widespread tuf gene arrangements argue in favor of their ancient origins. It is noteworthy that most obligate intracellular parasites, such as *Mycoplasma* sp., *R. prowazekii*, *B. burgdorferi*, and *T. pallidum*, contain only one tuf gene. Their flanking sequences are distinct from the two conserved patterns as a result of selection for effective propagation by an extensive reduction in genome size by intragenomic recombination and rearrangement.

Most gram-positive bacteria with low G+C content sequenced to date contain only a single copy of the tuf gene as a part of the str operon. This is the case for *B. subtilis*, *S. aureus* and *E. faecalis*. PCR amplification using a primer targeting a conserved region of the fus gene and the tufA-specific primer SEQ ID NO. 660, but not the tufB-specific primer SEQ ID NO. 661, yielded the expected amplicons for all 17 enterococcal species tested, indicating the presence of the fus-tuf organization in all enterococci (data not shown). However, in the genomes of *S. pneumoniae* and *S. pyogenes*, the sequences flanking the tuf genes varies although the tuf gene itself remains highly conserved. The enterococcal tufB genes are clustered with streptococci, but at present we do not

have enough data to identify the genes flanking the enterococcal tufB genes. Furthermore, the functional role of the enterococcal tufB genes remains unknown. One can only postulate that the two divergent gene copies are expressed under different conditions.

The amino acid sequence identities between the enterococcal tufA and tufB genes are lower than either i) those between the enterococcal tufA and the tuf genes from other low G+C gram-positive bacteria (streptococci and lactococci excluded) or ii) those between the enterococcal tufB and streptococcal and lactococcal tuf genes. These findings suggest that the enterococcal tufA genes share a common ancestor with other low G+C gram-positive bacteria via the simple scheme of vertical evolution, while the enterococcal tufB genes are more closely related to those of streptococci and lactococci. The facts that some enterococci possess an additional tuf gene and that the single streptococcal tuf gene is not clustered with other low G+C gram-positive bacteria cannot be explained by the mechanism of gene duplication or intrachromosomal recombination. According to sequence and phylogenetic analysis, we propose that the presence of the additional copy of the tuf genes in 11 enterococcal species is due to horizontal gene transfer. The common ancestor of the 11 enterococcal species now carrying tufB genes acquired a tuf gene from an ancestral *streptococcus* or a *streptococcus*-related species during enterococcal evolution through gene transfer before the diversification of modern enterococci. Further study of the flanking regions of the gene may provide more clues for the origin and function of this gene in enterococci.

Recent studies of genes and genomes have demonstrated that considerable horizontal transfer occurred in the evolution of aminoacyl-tRNA synthetases in all three kingdoms of life. The heterogeneity of 16S rRNA is also attributable to horizontal gene transfer in some bacteria, such as *Streptomyces*, *Thermomonospora chromogena* and *Mycobacterium celatum*. In this study, we provide the first example in support of a likely horizontal transfer of the tuf gene encoding the elongation factor Tu. This may be an exception since stringent functional constraints do not allow for frequent horizontal transfer of the tuf gene as with other genes. However, enterococcal tuf genes should not be the only such exception as we have noticed that the phylogeny of *Streptomyces* tuf genes is equally or more complex than that of enterococci. For example, the three tuf-like genes in a high G+C gram-positive bacterium, *S. ramocissimus*, branched with the tuf genes of phylogenetically divergent groups of bacteria (FIG. 5). Another example may be the tuf genes in clostridia, which represent a phylogenetically very broad range of organisms and form a plethora of lines and groups of various complexities and depths. Four species belonging to three different clusters within the genus *Clostridium* have been shown by Southern hybridization to carry two copies of the tuf gene. Further sequence data and phylogenetic analysis may help interpreting the evolution of the elongation factor Tu in these gram-positive bacteria. Since the tuf genes and 16S rRNA genes are often used for phylogenetic study, the existence of duplicate genes originating from horizontal gene transfer may alter the phylogeny of microorganisms when the laterally acquired copy of the gene is used for such analysis. Hence, caution should be taken in interpreting phylogenetic data. In addition, the two tuf genes in enterococci have evolved separately and are distantly related to each other phylogenetically. The enterococcal tufB genes are less conserved and unique to the 11 enterococcal species only. We previously demonstrated that the enterococcal tufA genes could serve as a target to develop a DNA-based assay for

identification of enterococci. The enterococcal tufB genes would also be useful in identification of these 11 enterococcal species.

Example 43

Elongation Factor Tu (Tuf) and the F-ATPase Beta-Subunit (atpD) as Phylogenetic Tools for Species of the Family Enterobacteriaceae

SUMMARY

The phylogeny of enterobacterial species commonly found in clinical samples was analyzed by comparing partial sequences of their elongation factor Tu (tuf) genes and their F-ATPase beta-subunit (atpD) genes. A 884-bp fragment for tuf and a 884- or 871-bp fragment for atpD were sequenced for 88 strains of 72 species from 25 enterobacterial genera. The atpD sequence analysis revealed a specific indel to *Pantoea* and *Tatumella* species showing for the first time a tight phylogenetic affiliation between these two genera. Comprehensive tuf and atpD phylogenetic trees were constructed and are in agreement with each other. Monophyletic genera are *Yersinia*, *Pantoea*, *Edwardsiella*, *Cedecea*, *Salmonella*, *Serratia*, *Proteus*, and *Providencia*. Analogous trees were obtained based on available 16S rDNA sequences from databases. tuf and atpD phylogenies are in agreement with the 16S rDNA analysis despite the smaller resolution power for the latter. In fact, distance comparisons revealed that tuf and atpD genes provide a better resolution for pairs of species belonging to the family Enterobacteriaceae. However, 16S rDNA distances are better resolved for pairs of species belonging to different families. In conclusion, tuf and atpD conserved genes are sufficiently divergent to discriminate different species inside the family Enterobacteriaceae and offer potential for the development of diagnostic tests based on DNA to identify enterobacterial species.

Introduction

Members of the family Enterobacteriaceae are facultatively anaerobic gram-negative rods, catalase-positive and oxydase-positive (Brenner, 1984). They are found in soil, water, plants, and in animals from insects to man. Many enterobacteria are opportunistic pathogens. In fact, members of this family are responsible for about 50% of nosocomial infections in the United States (Brenner, 1984). Therefore, this family is of considerable clinical importance.

Major classification studies on the family Enterobacteriaceae are based on phenotypic traits (Brenner et al., 1999; Brenner et al., 1980; Dickey & Zumoff, 1988; Farmer III et al., 1980; Farmer III et al., 1985b; Farmer III et al., 1985a) such as biochemical reactions and physiological characteristics. However, phenotypically distinct strains may be closely related by genotypic criteria and may belong to the same genospecies (Bercovier et al., 1980; Hartl & Dykhuizen, 1984). Also, phenotypically close strains (biogroups) may belong to different genospecies, like *Klebsiella pneumoniae* and *Enterobacter aerogenes* (Brenner, 1984) for example. Consequently, identification and classification of certain species may be ambiguous with techniques based on phenotypic tests (Janda et al., 1999; Kitch et al., 1994; Sharma et al., 1990).

More advances in the classification of members of the family Enterobacteriaceae have come from DNA-DNA hybridization studies (Brenner et al., 1993; Brenner et al., 1986; Brenner, et al., 1980; Farmer III, et al., 1980; Farmer III, et al., 1985b; Izard et al., 1981; Steigerwalt et al., 1976). Furthermore, the phylogenetic significance of bacterial clas-

sification based on 16S rDNA sequences has been recognized by many workers (Stackebrandt & Goebel, 1994; Wayne et al., 1987). However, members of the family Enterobacteriaceae have not been subjected to extensive phylogenetic analysis of 16S rDNA (Sproer et al., 1999). In fact, this molecule was not thought to solve taxonomic problems concerning closely related species because of its very high degree of conservation (Brenner, 1992; Sproer, et al., 1999). Another drawback of the 16S rDNA gene is that it is found in several copies within the genome (seven in *Escherichia coli* and *Salmonella typhimurium*) (Hill & Harnish, 1981). Due to sequence divergence between the gene copies, direct sequencing of PCR products is often not suitable to achieve a representative sequence (Cilia et al., 1996; Hill & Harnish, 1981). Other genes such as gap and ompA (Lawrence et al., 1991), rpoB (Mollet et al., 1997), and infB (Hedegaard et al., 1999) were used to resolve the phylogeny of enterobacteria. However, none of these studies covered an extensive number of species.

tuf and atpD are the genes encoding the elongation factor Tu (EF-Tu) and the F-ATPase beta-subunit, respectively. EF-Tu is involved in peptide chain formation (Ludwig et al., 1990). The two copies of the tuf gene (tufA and tufB) found in enterobacteria (Sela et al., 1989) share high identity level (99%) in *Salmonella typhimurium* and in *E. coli*. The recombination phenomenon could explain sequence homogenization between the two copies (Abdulkarim & Hughes, 1996; Grunberg-Manago, 1996). F-ATPase is present on the plasma membranes of eubacteria (Nelson & Taiz, 1989). It functions mainly in ATP synthesis (Nelson & Taiz, 1989) and the beta-subunit contains the catalytic site of the enzyme. EF-Tu and F-ATPase are highly conserved throughout evolution and shows functional constancy (Amann et al., 1988; Ludwig, et al., 1990). Recently, phylogenies based on protein sequences from EF-Tu and F-ATPase beta-subunit showed good agreement with each other and with the rDNA data (Ludwig et al., 1993).

We elected to sequence 884-bp fragments of tuf and atpD from 88 clinically relevant enterobacterial strains representing 72 species from 25 genera. These sequences were used to create phylogenetic trees that were compared with 16S rDNA trees. These trees revealed good agreement with each others and demonstrated the high resolution of tuf and atpD phylogenies at the species level.

Materials and Methods

Bacterial strains and genomic material. All bacterial strains used in this study were obtained from the American Type Culture Collection (ATCC) or the Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH (DSMZ). These enterobacteria can all be recovered from clinical specimens, but not all are pathogens. Whenever possible, we choose type strains. Identification of all strains was confirmed by classical biochemical tests using the automated system MicroScan WalkAway-96 system equipped with a Negative BP Combo Panel Type 15 (Dade Behring Canada). Genomic DNA was purified using the G NOME DNA kit (Bio 101). Genomic DNA from *Yersinia pestis* was kindly provided by Dr. Robert R. Brubaker. Strains used in this study and their descriptions are shown in Table 19.

PCR primers. The eubacterial tuf and atpD gene sequences available from public databases were analyzed using the GCG package (version 8.0) (Genetics Computer Group). Based on multiple sequence alignments, two highly conserved regions were chosen for each genes, and PCR primers were derived from these regions with the help of Oligo primer analysis software (version 5.0) (National Biosciences). A second 5' primer was design to amplify the gene atpD for few

enterobacteria difficult to amplify with the first primer set. When required, the primers contained inosines or degeneracies to account for variable positions. Oligonucleotide primers were synthesized with a model 394 DNA/RNA synthesizer (PE Applied Biosystems). PCR primers used in this study are listed in Table 20.

DNA sequencing. An 884-bp portion of the tuf gene and an 884-bp portion (or alternatively an 871-bp portion for a few enterobacterial strains) of the atpD gene were sequenced for all enterobacteria listed in the first strain column of Table 19. Amplification was performed with 4 ng of genomic DNA. The 40- μ l PCR mixtures used to generate PCR products for sequencing contained 1.0 μ M each primer, 200 μ M each deoxyribonucleoside triphosphate (Pharmacia Biotech), 10 mM Tris-HCl (pH 9.0 at 25° C.), 50 mM KCl, 0.1% (w/v) Triton X-100, 2.5 mM MgCl₂, 0.05 mM BSA, 0.3 U of Taq DNA polymerase (Promega) coupled with TaqStart™ antibody (Clontech Laboratories). The TaqStart™ neutralizing monoclonal antibody for Taq DNA polymerase was added to all PCR mixtures to enhance efficiency of amplification (Kellogg et al., 1994). The PCR mixtures were subjected to thermal cycling (3 min at 95° C. and then 35 cycles of 1 min at 95° C., 1 min at 55° C. for tuf or 50° C. for atpD, and 1 min at 72° C., with a 7-min final extension at 72° C.) using a PTC-200 DNA Engine thermocycler (MJ Research). PCR products having the predicted sizes were recovered from an agarose gel stained for 15 min with 0.02% of methylene blue followed by washing in sterile distilled water for 15 min twice (Flores et al., 1992). Subsequently, PCR products having the predicted sizes were recovered from gels using the QIAquick gel extraction kit (QIAGEN).

Both strands of the purified amplicons were sequenced using the ABI Prism BigDye Terminator Cycle Sequencing Ready Reaction Kit (PE Applied Biosystems) on an automated DNA sequencer (Model 377). Amplicons from two independent PCR amplifications were sequenced for each strain to ensure the absence of sequencing errors attributable to nucleotide miscorporations by the Taq DNA polymerase. Sequence assembly was performed with the aid of Sequencher 3.0 software (Gene Codes).

Phylogenetic analysis. Multiple sequence alignments were performed using PileUp from the GCG package (Version 10.0) (Genetics Computer Group) and checked by eye with the editor SeqLab to edit sequences if necessary and to note which regions were to be excluded for phylogenetic analysis. *Vibrio cholerae* and *Shewanella putrefaciens* were used as outgroups. Bootstrap subsets (750 sets) and phylogenetic trees were generated with the Neighbor Joining algorithm from Dr. David Swofford's PAUP (Phylogenetic Analysis Using Parsimony) Software version 4.0b4 (Sinauer Associates) and with tree-bisection branch-swapping. The distance model used was Kimura (1980) two-parameter. Relative rate test was performed with the aid of Phyltest program version 2.0 (c).

Results and Discussion

DNA Amplification, Sequencing And Sequence Alignments

A PCR product of the expected size of 884 bp was obtained for tuf and of 884 or 871 bp for atpD from all bacterial strains tested. After subtracting for biased primer regions and ambiguous single strand data, sequences of at least 721 bp for tuf and 713 bp for atpD were submitted to phylogenetic analyses. These sequences were aligned with tuf and atpD sequences available in databases to verify that the nucleotide sequences indeed encoded a part of tested genes. Gaps were excluded to perform phylogenetic analysis.

Signature Sequences

From the sequence alignments obtained from both tested genes, only one insertion was observed. This five amino acids insertion is located between the positions 325 and 326 of atpD gene of *E. coli* strain K-12 (Saraste et al., 1981) and can be considered a signature sequence of *Tatumella* ptyseos and *Pantoea* species (FIG. 7). The presence of a conserved indel of defined length and sequence and flanked by conserved regions could suggest a common ancestor, particularly when members of a given taxa share this indel (Gupta, 1998). To our knowledge, high relatedness between the genera *Tatumella* and *Pantoea* is demonstrated for the first time.

Enterobacter agglomerans ATCC 27989 sequence does not possess the five amino acid indel (FIG. 7). This indel could represent a useful marker to help resolve the *Enterobacter agglomerans* and *Pantoea* classification. Indeed, the transfer of *Enterobacter agglomerans* to *Pantoea* agglomerans was proposed in 1989 bp Gavini et al. (Gavini et al., 1989). However, some strains are provisionally classified as *Pantoea* sp. until their interrelatedness is elucidated (Gavini, et al., 1989). Since the transfer was proposed, the change of nomenclature has not yet been made for all *Enterobacter agglomerans* in the ATCC database. The absence of the five amino acids indel suggests that some strains of *Enterobacter agglomerans* most likely do not belong to the genus *Pantoea*. Phylogenetic Trees Based On Partial Tuf Sequences, atpD Sequences, and Published 16S Rdna Data of Members of the Enterobacteriaceae.

Representative trees constructed from tuf and atpD sequences with the neighbor-joining method are shown in FIG. 8. The phylogenetic trees generated from partial tuf sequences and atpD sequences are very similar. Nevertheless, atpD tree shows more monophyletic groups corresponding to species that belong to the same genus. These groups are more consistent with the actual taxonomy. For both genes, some genera are not monophyletic. These results support previous phylogenies based on the genes gap and ompA (Lawrence, et al., 1991), rpoB (Mollet, et al., 1997), and infB (Hedegaard, et al., 1999) which all showed that the genera *Escherichia* and *Klebsiella* are polyphyletic. There were few differences in branching between tuf and atpD genes.

Even though *Pantoea agglomerans* and *Pantoea dispersa* indels were excluded for phylogenetic analysis, these two species grouped together and were distant from *Enterobacter agglomerans* ATCC 27989, adding another evidence that the latter species is heterogenous and that not all members of this species belong to the genus *Pantoea*. In fact, the *E. agglomerans* strain ATCC 27989 exhibits branch lengths similar to others *Enterobacter* species with both genes. Therefore, we suggest that this strain belong to the genus *Enterobacter* until further reclassification of that genus.

tuf and atpD trees exhibit very short genetic distances between taxa belonging to the same genetic species including species segregated for clinical considerations. This first concern *E. coli* and *Shigella* species that were confirmed to be the same genetic species by hybridization studies (Brenner et al., 1972; Brenner et al., 1972; Brenner et al., 1982) and phylogenies based on 16S rDNA (Wang et al., 1997) and rpoB genes (Mollet, et al., 1997). Hybridization studies (Bercovier, et al., 1980) and phylogeny based on 16S rDNA genes (Ibrahim et al., 1994) demonstrated also that *Yersinia pestis* and *Y. pseudotuberculosis* are the same genetic species. Among *Yersinia pestis* and *Y. pseudotuberculosis*, the three *Klebsiella pneumoniae* subspecies, *E. coli*-*Shigella* species, and *Salmonella* choleraesuis subspecies, *Salmonella* is a less tightly knit species than the other genetic species. The same is true for *E. coli* and *Shigella* species.

Escherichia fergusonii is very close to *E. coli*-*Shigella* genetic species. This observation is corroborated by 16S rDNA phylogeny (McLaughlin et al., 2000) but not by DNA hybridization values. In fact, *E. fergusonii* is only 49% to 63% related to *E. coli*-*Shigella* (Farmer III, et al., 1985b). It was previously observed that very recently diverged species may not be recognizable based on 16S rDNA sequences although DNA hybridization established them as different species (Fox et al., 1992). Therefore, *E. fergusonii* could be a new “quasi-species”.

atpD phylogeny revealed *Salmonella* subspecies divisions consistent with the actual taxonomy. This result was already observed by Christensen et al. (Christensen & Olsen, 1998). Nevertheless, tuf partial sequences discriminate less than atpD between *Salmonella* subspecies.

Overall, tuf and atpD phylogenies exhibit enough divergence between species to ensure efficient discrimination. Therefore, it could be easy to distinguish phenotypically close enterobacteria belonging to different genetic species such as *Klebsiella pneumoniae* and *Enterobacter aerogenes*.

Phylogenetic relationships between *Salmonella*, *E. coli* and *C. freundii* are not well defined. 16S rDNA and 23S rDNA sequence data reveals a closer relationship between *Salmonella* and *E. coli* than between *Salmonella* and *C. freundii* (Christensen et al., 1998), while DNA homology studies (Selander et al., 1996) and infB phylogeny (Hedegaard, et al., 1999) showed that *Salmonella* is more closely related to *C. freundii* than to *E. coli*. In that regard, tuf and atpD phylogenies are coherent with 16S rDNA and 23S rDNA sequence analysis.

Phylogenetic analyses were also performed using amino acids sequences. tuf tree based on amino acids is characterized by a better resolution between taxa outgroup and taxa ingroup (enterobacteria) than tree based on nucleic acids whereas atpD trees based on amino acids and nucleic acids give almost the same resolution between taxa outgroup and ingroup (data not shown).

Relative rate test (or two cluster test (Takezaki et al., 1995)) evaluates if evolution is constant between two taxa. Before to apply the test, the topology of a tree is determined by tree-building method without the assumption of rate constancy. Therefore, two taxa (or two groups of taxa) are compared with a third taxon that is an outgroup of the first two taxa (Takezaki, et al., 1995). Few pairs of taxa that exhibited a great difference between their branch lengths at particular nodes were chosen to perform the test. This test reveals that tuf and atpD are not constant in their evolution within the family Enterobacteriaceae. For tuf, for example, the hypothesis of rate constancy is rejected (Z value higher than 1.96) between *Yersinia* species. The same is true for *Proteus* species. For atpD, for example, evolution is not constant between *Proteus* species, between *Proteus* species and *Providencia* species, and between *Yersinia* species and *Escherichia coli*. For 16S rDNA, for example, evolution is not constant between two *E. coli*, between *E. coli* and *Enterobacter aerogenes*, and between *E. coli* and *Proteus vulgaris*. These results suggest that tuf, atpD and 16S rDNA could not serve as a molecular clock for the entire family Enterobacteriaceae.

Since the number and the nature of taxa can influence topology of trees, phylogenetic trees from tuf and atpD were reconstructed using sequences corresponding to strains for which 16S rDNA genes were published in GenEMBL. These trees were similar to those generated using 16S rDNA (FIG. 9). Nevertheless, 16S rDNA tree gave poorer resolution power than tuf and atpD gene trees. Indeed, these latter exhibited less multifurcation (polytomy) than the 16S rDNA tree.

Comparison of Distances Based on tuf, atpD, and 16S rDNA Data.

tuf, atpD, and 16S rDNA distances (i.e. the number of differences per nucleotide site) were compared with each other for each pair of strains. We found that the tuf and atpD distances were respectively 2.268 ± 0.965 and 2.927 ± 0.896 times larger than 16S rDNA distances (FIG. 10a and b). atpD distances were 1.445 ± 0.570 times larger than tuf distances (FIG. 10c). FIG. 10 also shows that the tuf, atpD, and 16S rDNA distances between members of different species of the same genus (0.053 ± 0.034 , 0.060 ± 0.020 , and 0.024 ± 0.010 , respectively) were in mean smaller than the distances between members of different genera belonging to the same family (0.103 ± 0.053 , 0.129 ± 0.051 , and 0.044 ± 0.013 , respectively). However, the overlap exhibits with standard deviations add to a focus of evidences that some enterobacterial genera are not well defined (Brenner, 1984). In fact, many distances for pairs of species especially belonging to the genera *Escherichia*, *Shigella*, *Enterobacter*, *Citrobacter*, *Klebsiella*, and *Kluyvera* overlap distances for pairs of species belonging to the same genus (FIG. 10). For example, distances for pairs composed by species of *Citrobacter* and species of *Klebsiella* overlap distances for pairs composed by two *Citrobacter* or by two *Klebsiella*.

Observing the distance distributions, 16S rDNA distances reveal a clear separation between the families Enterobacteriaceae and Vibrionaceae despite the fact that the family Vibrionaceae is genetically very close to the Enterobacteriaceae (FIG. 10a and b). Nevertheless, tuf and atpD show higher discriminating power below the family level (FIG. 10a and b).

There were some discrepancies in the relative distances for the same pairs of taxa between the two genes studied. First, distances between *Yersinia* species are at least two times lower for atpD than for tuf (FIG. 10c). Also, distances at the family level (between Enterobacteriaceae and Vibrionaceae) show that Enterobacteriaceae is a tightlier knit family with atpD gene (*Proteus* genus excepted) than with tuf gene. Both genes well delineate taxa belonging to the same species. There is one exception with atpD: *Klebsiella planticola* and *K. ornithinolithica* belong to the same genus but fit with taxa belonging to the same species (FIG. 10a and c). These two species are also very close genotypically with tuf gene. This suggest that *Klebsiella planticola* and *K. ornithinolithica* could be two newborn species. tuf and atpD genes exhibit little distances between *Escherichia fergusonii* and *E. coli*, *Shigella* species. Unfortunately, comparison with 16S rDNA could not be achieved because the *E. fergusonii* 16S rDNA sequence is not yet accessible in GenEMBL database. Therefore, the majority of phenotypically close enterobacteria could be easily discriminated genotypically using tuf and atpD gene sequences.

In conclusion, tuf and atpD genes exhibit phylogenies consistent with 16S rDNA genes phylogeny. For example, they reveal that the family Enterobacteriaceae is monophyletic. Moreover, tuf and atpD distances provide a higher discriminating power than 16S rDNA distances. In fact, tuf and atpD genes discriminate well between different genospecies and are conserved between strains of the same genetic species in such a way that primers and molecular probes for diagnostic purposes could be designed. Preliminary studies support these observations and diagnostic tests based on tuf and atpD sequence data to identify enterobacteria are currently under development.

Example 44

Testing New Pairs of PCR Primers Selected from Two Species-Specific Genomic DNA Fragments which are Objects of Our Assigned U.S. Pat. No. 6,001,564

Objective. The goal of these experiments is to demonstrate that it is relatively easy for a person skilled in the art to find other PCR primer pairs from the species-specific fragments used as targets for detection and identification of a variety of microorganisms. In fact, we wish to prove that the PCR primers previously tested by our group and which are objects of the present patent application are not the only possible good choices for diagnostic purposes. For this example, we used diagnostic targets described in our assigned U.S. Pat. No. 6,001,564.

Experimental strategy. We have selected randomly two species-specific genomic DNA fragments for this experiment. The first one is the 705-bp fragment specific to *Staphylococcus epidermidis* (SEQ ID NO: 36 from U.S. Pat. No. 6,001,564) while the second one is the 466-bp fragment specific to *Moraxella catarrhalis* (SEQ ID NO: 29 from U.S. Pat. No. 6,001,564). Subsequently, we have selected from these two fragments a number of PCR primer pairs other than those previously tested. We have chosen 5 new primer pairs from each of these two sequences which are well dispersed along the DNA fragment (FIGS. 11 and 12). We have tested these primers for their specificity and compared them with the original primers previously tested. For the specificity tests, we have tested all bacterial species closely related to the target species based on phylogenetic analysis with three conserved genes (rRNA genes, tuf and atpD). The rational for selecting a restricted number of bacterial species to evaluate the specificity of the new primer pairs is based on the fact that the lack of specificity of a DNA-based assay is attributable to the detection of closely related species which are more similar at the nucleotide level. Based on the phylogenetic analysis, we have selected (i) species from the closely related genus *Staphylococcus*, *Enterococcus*, *Streptococcus* and *Listeria* to test the specificity of the *S. epidermidis*-specific PCR assays and (ii) species from the closely related genus *Moraxella*, *Kingella* and *Neisseria* to test the specificity of the *M. catarrhalis*-specific PCR assays.

Materials and Methods

Bacterial strains. All bacterial strains used for these experiments were obtained from the American Type Culture Collection (ATCC, Rockville, Md.).

Genomic DNA isolation. Genomic DNA was purified from the ATCC reference strains by using the G-nome DNA kit (Bio 101 Inc., Vista, Calif.).

Oligonucleotide design and synthesis. PCR primers were designed with the help of the Oligo™ primer analysis software Version 4.0 (National Biosciences Inc., Plymouth, Minn.) and synthesized using a model 391 DNA synthesizer (Applied Biosystems, Foster City, Calif.).

PCR assays. All PCR assays were performed by using genomic DNA purified from reference strains obtained from the ATCC. One μ L of purified DNA preparation (containing 0.01 to 1 ng of DNA per μ L) was added directly into the PCR reaction mixture. The 20 μ L PCR reactions contained final concentrations of 50 mM KCl, 10 mM Tris-HCl (pH 9.0), 0.1% Triton X-100, 2.5 mM MgCl₂, 0.4 μ M of each primer, 200 μ M of each of the four dNTPs and 0.5 unit of Taq DNA polymerase (Promega, Madison, Wis.) combined with the TaqStart™ antibody (Clontech Laboratories Inc., Palo Alto, Calif.). An internal control was integrated into all amplifica-

tion reactions to verify the efficiency of the amplification reaction as well as to ensure that significant PCR inhibition was absent. Primers amplifying a region of 252 bp from a control plasmid added to each amplification reaction were used to provide the internal control. PCR reactions were then subjected to thermal cycling (3 min at 95° C. followed by 30 cycles of 1 second at 95° C. for the denaturation step and 30 seconds at 50 to 65° C. for the annealing-extension step) using a PTC-200 thermal cycler (MJ Research Inc., Watertown, Mass.). PCR amplification products were then analyzed by standard agarose gel (2%) electrophoresis. Amplification products were visualized in agarose gels containing 0.25 µg/mL of ethidium bromide under UV at 254 nm.

Results

Tables 21 and 22 show the results of specificity tests with the 5 new primer pairs selected from SEQ ID NO: 29 (specific to *M. catarrhalis* from U.S. Pat. No. 6,001,564) and SEQ ID NO: 36 (specific to *S. epidermidis* from U.S. Pat. No. 6,001,564), respectively. In order to evaluate the performance of these new primers pairs, we compared them in parallel with the original primer pairs previously tested.

For *M. catarrhalis*, all of the 5 selected PCR primer pairs were specific for the target species because none of the closely related species could be amplified (Table 21). In fact, the comparison with the original primer pair SEQ ID NO: 118+SEQ ID NO: 119 (from U.S. Pat. No. 6,001,564) revealed that all new pairs showed identical results in terms of specificity and sensitivity thereby suggesting their suitability for diagnostic purposes.

For *S. epidermidis*, 4 of the 5 selected PCR primer pairs were specific for the target species (Table 22). It should be noted that for 3 of these four primer pairs the annealing temperature had to be increased from 55° C. to 60 or 65° C. to attain specificity for *S. epidermidis*. Again the comparison with the original primer pair SEQ ID NO: 145+SEQ ID NO: 146 (from U.S. Pat. No. 6,001,564) revealed that these four primer pairs were as good as the original pair. Increasing the annealing temperature for the PCR amplification is well known by persons skilled in the art to be a very effective way to improve the specificity of a PCR assay (Persing et al., 1993, Diagnostic Molecular Microbiology: Principles and Applications, American Society for Microbiology, Washington, D.C.; Ehrlich and Greenberg, 1994, PCR-based Diagnostics in Infectious Disease, Blackwell Scientific Publications, Boston, Mass.). In fact, those skilled in the art are well aware of the fact that the annealing temperature is critical for the optimization of PCR assays. Only the primer pair VBsep3+VBsep4 amplified bacterial species other than *S. epidermidis* including the staphylococcal species *S. capitis*, *S. cohnii*, *S. aureus*, *S. haemolyticus* and *S. hominis* (Table 22). For this non-specific primer pair, increasing the annealing temperature from 55 to 65° C. was not sufficient to attain the desired specificity. One possible explanation for the fact that it appears slightly easier to select species-specific primers for *M. catarrhalis* than for *S. epidermidis* is that *M. catarrhalis* is more isolated in phylogenetic trees than *S. epidermidis*. The large number of coagulase negative staphylococcal species such as *S. epidermidis* is largely responsible for this phylogenetic clustering.

Conclusion

These experiments clearly show that it is relatively easy for a person skilled in the art to select, from the species-specific DNA fragments selected as target for identification, PCR primer pairs suitable for diagnostic purposes other than those previously tested. The amplification conditions can be opti-

mize by modifying critical variables such as the annealing temperature to attain the desired specificity and sensitivity. Consequently, we consider that it is legitimate to claim any possible primer sequences selected from the species-specific fragment and that it would be unfair to grant only the claims dealing with the primer pairs previously tested. By extrapolation, these results strongly suggest that it is also relatively easy for a person skilled in the art to select, from the species-specific DNA fragments, DNA probes suitable for diagnostic purposes other than those previously tested.

Example 45

Testing Modified Versions of PCR Primers Derived from the Sequence of Several Primers which are Objects of U.S. Pat. No. 6,001,564.

Objective. The purpose of this project is to verify the efficiency of amplification by modified PCR primers derived from primers previously tested. The types of primer modifications to be tested include (i) variation of the sequence at one or more nucleotide positions and (ii) increasing or reducing the length of the primers. For this example, we used diagnostic targets described in U.S. Pat. No. 6,001,564.

Experimental Strategy:

Testing Primers with Nucleotide Changes

We have designed 13 new primers which are derived from the *S. epidermidis*-specific SEQ ID NO: 146 from U.S. Pat. No. 6,001,564 (Table 23). These primers have been modified at one or more nucleotide positions. As shown in Table 23, the nucleotide changes were introduced all along the primer sequence. Furthermore, instead of modifying the primer at any nucleotide position, the nucleotide changes were introduced at the third position of each codon to better reflect potential genetic variations in vivo. It should be noted that no nucleotide changes were introduced at the 3' end of the oligonucleotide primers because those skilled in the art are well aware of the fact that mismatches at the 3' end should be avoided (Persing et al., 1993, Diagnostic Molecular Microbiology: Principles and Applications, American Society for Microbiology, Washington, D.C.). All of these modified primers were tested in PCR assays in combination with SEQ ID NO: 145 from U.S. Pat. No. 6,001,564 and the efficiency of the amplification was compared with the original primer pair SEQ ID NO: 145+SEQ ID NO: 146 previously tested in U.S. Pat. No. 6,001,564.

Testing Shorter or Longer Versions of Primers

We have designed shorter and longer versions of the original *S. epidermidis*-specific PCR primer pair SEQ ID NO: 145+146 from U.S. Pat. No. 6,001,564 (Table 24) as well as shorter versions of the original *P. aeruginosa*-specific primer pair SEQ ID NO: 83+84 from U.S. Pat. No. 6,001,564 (Table 25). As shown in Tables 24 and 25, both primers of each pair were shortened or lengthened to the same length. Again, those skilled in the art know that the melting temperature of both primers from a pair should be similar to avoid preferential binding at one primer binding site which is detrimental in PCR (Persing et al., 1993, Diagnostic Molecular Microbiology: Principles and Applications, American Society for Microbiology, Washington, D.C.; Ehrlich and Greenberg, 1994, PCR-based Diagnostics in Infectious Disease, Blackwell Scientific Publications, Boston, Mass.). All of these shorter or longer primer versions were tested in PCR assays and the efficiency of the amplification was compared with the original primer pair SEQ ID NOs 145 and 146.

Materials and Methods

See the Materials and methods section of Example 44.

Results

Testing Primers with Nucleotide Changes

The results of the PCR assays with the 13 modified versions of SEQ ID NO: 146 from U.S. Pat. No. 6,001,564 are shown in Table 23. The 8 modified primers having a single nucleotide variation showed an efficiency of amplification identical to the original primer pair based on testing with 3 different dilutions of genomic DNA. The four primers having two nucleotide variations and primer VBmut12 having 3 nucleotide changes also showed PCR results identical to those obtained with the original pair. Finally, primer VBmut13 with four nucleotide changes showed a reduction in sensitivity by approximately one log as compared with the original primer pair. However, reducing the annealing temperature from 55 to 50° C. gave an efficiency of amplification very similar to that observed with the original primer pair (Table 23). In fact, reducing the annealing temperature of PCR cycles represents an effective way to reduce the stringency of hybridization for the primers and consequently allows the binding of probes with mismatches (Persing et al., 1993, Diagnostic Molecular Microbiology: Principles and Applications, American Society for Microbiology, Washington, D.C.). Subsequently, we have confirmed the specificity of the PCR assays with each of these 13 modified versions of SEQ ID NO: 146 from U.S. Pat. No. 6,001,564 by performing amplifications from all bacterial species closely related to *S. epidermidis* which are listed in Table 22.

Testing Shorter or Longer Versions of Primers

For these experiments, two primer pairs were selected: i) SEQ ID NO: 145+146 from U.S. Pat. No. 6,001,564 (specific to *S. epidermidis*) which are AT rich and ii) SEQ ID NO: 83+84 (specific to *P. aeruginosa*) which are GC rich. For the AT rich sequence, primers of 15 to 30 nucleotide in length were designed (Table 24) while for the GC rich sequences, primers of 13 to 19 nucleotide in length were designed (Table 25).

Table 24 shows that, for an annealing temperature of 55° C., the 30-25-, 20- and 17-nucleotide versions of SEQ ID NO: 145 and 146 from U.S. Pat. No. 6,001,564 all showed identical results as compared with the original primer pair except that the 17-nucleotide version amplified slightly less efficiently the *S. epidermidis* DNA. Reducing the annealing temperature from 55 to 45° C. for the 17-nucleotide version allowed to increase the amplification efficiency to a level very similar to that with the original primer pair (SEQ ID NO: 145+146 from U.S. Pat. No. 6,001,564). Regarding the 15-nucleotide version, there was amplification of *S. epidermidis* DNA only when the annealing temperature was reduced to 45° C. Under those PCR conditions the assay remained *S. epidermidis*-specific but the amplification signal with *S. epidermidis* DNA was slightly lower as compared with the original primer pair. Subsequently, we have further confirmed the specificity of the shorter or longer versions by amplifying DNA from all bacterial species closely related to *S. epidermidis* which are listed in Table 22.

Table 25 shows that, for an annealing temperature of 55° C., all shorter versions of SEQ ID NO: 83 and 84 from U.S. Pat. No. 6,001,564 showed identical PCR results as compared with the original primer pair. As expected, these results show that it is simpler to reduce the length of GC rich as compared with AT rich. This is attributable to the fact that GC binding is more stable than AT binding.

Conclusion

Testing Primers with Nucleotide Changes

The above experiments clearly show that PCR primers may be modified at one or more nucleotide positions without affecting the specificity and the sensitivity of the PCR assay. These results strongly suggest that a given oligonucleotide can detect variant genomic sequences from the target species. In fact, the nucleotide changes in the selected primers were purposely introduced at the third position of each codon to mimic nucleotide variation in genomic DNA. Thus we conclude that it is justified to claim "a variant thereof" for i) the SEQ IDs of the fragments and oligonucleotides which are object of the present patent application and ii) genomic variants of the target species.

Testing Shorter or Longer Versions of Primers

The above experiments clearly show that PCR primers may be shorter or longer without affecting the specificity and the sensitivity of the PCR assay. We have showed that oligonucleotides ranging in sizes from 13 to 30 nucleotides may be as specific and sensitive as the original primer pair from which they were derived. Consequently, these results suggest that it is not exaggerated to claim sequences having at least 12 nucleotide in length.

This invention has been described herein above, and it is readily apparent that modifications can be made thereto without departing from the spirit of this invention. These modifications are under the scope of this invention, as defined in the appended claims.

TABLE 1

Distribution (%) of nosocomial pathogens for various human infections in USA (1990-1992) ¹ .					
Pathogen	UTI ²	SSI ³	BSI ⁴	Pneumonia	CSF ⁵
<i>Escherichia coli</i>	27	9	5	4	2
<i>Staphylococcus aureus</i>	2	21	17	21	2
<i>Staphylococcus epidermidis</i>	2	6	20	0	1
<i>Enterococcus faecalis</i>	16	12	9	2	0
<i>Enterococcus faecium</i>	1	1	0	0	0
<i>Pseudomonas aeruginosa</i>	12	9	3	18	0
<i>Klebsiella pneumoniae</i>	7	3	4	9	0
<i>Proteus mirabilis</i>	5	3	1	2	0
<i>Streptococcus pneumoniae</i>	0	0	3	1	18
Group B <i>Streptococci</i>	1	1	2	1	6
Other <i>streptococci</i>	3	5	2	1	3
<i>Haemophilus influenzae</i>	0	0	0	6	45
<i>Neisseria meningitidis</i>	0	0	0	0	14
<i>Listeria monocytogenes</i>	0	0	0	0	3
Other <i>enterococci</i>	1	1	0	0	0
Other <i>staphylococci</i>	2	8	13	2	0
<i>Candida albicans</i>	9	3	5	5	0
Other <i>Candida</i>	2	1	3	1	0
<i>Enterobacter</i> sp.	5	7	4	12	2
<i>Acinetobacter</i> sp.	1	1	2	4	2
<i>Citrobacter</i> sp.	2	1	1	1	0
<i>Serratia marcescens</i>	1	1	1	3	1
Other <i>Klebsiella</i>	1	1	1	2	1
Others	0	6	4	5	0

¹Data recorded by the National Nosocomial Infections Surveillance (NNIS) from 80 hospitals (Emori and Gaynes, 1993, *Clin. Microbiol. Rev.*, 6:428-442).

²Urinary tract infection.

³Surgical site infection.

⁴Bloodstream infection.

⁵Cerebrospinal fluid.

TABLE 2

Distribution (%) of bloodstream infection pathogens in Quebec (1995), Canada (1992), UK (1969-1988) and USA (1990-1992).

Organism	Quebec ¹	Canada ²	UK ³		USA ⁴	5
			Community-acquired	Hospital-acquired		
<i>E. coli</i>	15.6	53.8	24.8	20.3	5.0	
<i>S. epidermidis</i> and other CoNS ⁵	25.8	—	0.5	7.2	31.0	10
<i>S. aureus</i>	9.6	—	9.7	19.4	16.0	
<i>S. pneumoniae</i>	6.3	—	22.5	2.2	—	
<i>E. faecalis</i>	3.0	—	1.0	4.2	—	
<i>E. faecium</i>	2.6	—	0.2	0.5	—	
<i>Enterococcus</i> sp.	—	—	—	—	9.0	15
<i>H. influenzae</i>	1.5	—	3.4	0.4	—	
<i>P. aeruginosa</i>	1.5	8.2	1.0	8.2	3.0	
<i>K. pneumoniae</i>	3.0	11.2	3.0	9.2	4.0	
<i>P. mirabilis</i>	—	3.9	2.8	5.3	1.0	
<i>S. pyogenes</i>	—	—	1.9	0.9	—	
<i>Enterobacter</i> sp.	4.1	5.5	0.5	2.3	4.0	20
<i>Candida</i> sp.	8.5	—	—	1.0	8.0	
Others	18.5	17.4	28.7	18.9	19.0	

¹Data obtained for 270 isolates collected at the Centre Hospitalier de l'Université Laval (CHUL) during a 5 month period (May to October 1995).

²Data from 10 hospitals throughout Canada representing 941 gram-negative isolates.

(Chamberland et al., 1992, *Clin. Infect. Dis.*, 15:615-628).

³Data from a 20-year study (1969-1988) for nearly 4000 isolates. (Ekyn et al., 41990, *J. Antimicrob. Chemother.*, Suppl. C, 25:41-58).

⁴Data recorded by the National Nosocomial Infections Surveillance (NNIS) from 80 hospitals (Emori and Gaynes, 1993, *Clin. Microbiol. Rev.*, 6:428-442).

⁵Coagulase-negative staphylococci.

TABLE 3

Distribution of positive and negative clinical specimens tested at the microbiology laboratory of the CHUL (February 1994-January 1995).

Clinical specimens and/or sites	No. of samples tested (%)	% of positive specimens	% of negative specimens	35
Urine	17,981 (54.5)	19.4	80.6	
Blood culture/marrow	10,010 (30.4)	6.9	93.1	
Sputum	1,266 (3.8)	68.4	31.6	
Superficial pus	1,136 (3.5)	72.3	27.7	40
Cerebrospinal fluid	553 (1.7)	1.0	99.0	
Synovial fluid	523 (1.6)	2.7	97.3	
Respiratory tract	502 (1.5)	56.6	43.4	
Deep pus	473 (1.4)	56.8	43.2	
Ears	289 (0.9)	47.1	52.9	
Pleural and pericardial fluid	132 (0.4)	1.0	99.0	45
Peritoneal fluid	101(0.3)	28.6	71.4	
Total:	32,966 (100.0)	20.0	80.0	

TABLE 4

Example of microbial species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are used in the present invention.

Bacterial species	55
<i>Abiotrophia adiacens</i>	
<i>Abiotrophia defectiva</i>	
<i>Achromobacter xylosoxidans</i> subsp. <i>denitrificans</i>	
<i>Acetobacterium woodi</i>	
<i>Acetobacter aceti</i>	
<i>Acetobacter altoaceti</i>	60
<i>Acetobacter polyoxogenes</i>	
<i>Acholeplasma laidlawii</i>	
<i>Acidothermus cellulolyticus</i>	
<i>Acidiphilum facilis</i>	
<i>Acinetobacter baumannii</i>	
<i>Acinetobacter calcoaceticus</i>	65
<i>Acinetobacter lwoffii</i>	

TABLE 4-continued

Example of microbial species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are used in the present invention.

<i>Actinomyces meyeri</i>	
<i>Aerococcus viridans</i>	
<i>Aeromonas hydrophila</i>	
<i>Aeromonas salmonicida</i>	
<i>Agrobacterium radiobacter</i>	
<i>Agrobacterium tumefaciens</i>	
<i>Alcaligenes faecalis</i> subsp. <i>faecalis</i>	
<i>Allochromatium vinosum</i>	
<i>Anabaena variabilis</i>	
<i>Anacystis nidulans</i>	
<i>Anaerorhabdus furcosus</i>	
<i>Aquifex aeolicus</i>	
<i>Aquifex pyrophilus</i>	
<i>Arcanobacterium haemolyticum</i>	
<i>Archaeoglobus fulgidus</i>	
<i>Azotobacter vinelandii</i>	
<i>Bacillus anthracis</i>	
<i>Bacillus cereus</i>	
<i>Bacillus firmus</i>	
<i>Bacillus halodurans</i>	
<i>Bacillus megaterium</i>	
<i>Bacillus mycoides</i>	
<i>Bacillus pseudomycoides</i>	
<i>Bacillus stearothermophilus</i>	
<i>Bacillus subtilis</i>	
<i>Bacillus thuringiensis</i>	
<i>Bacillus weihenstephanensis</i>	
<i>Bacteroides distasonis</i>	
<i>Bacteroides fragilis</i>	
<i>Bacteroides forsythus</i>	
<i>Bacteroides ovatus</i>	
<i>Bacteroides vulgatus</i>	
<i>Bartonella henselae</i>	
<i>Bifidobacterium adolescentis</i>	
<i>Bifidobacterium breve</i>	
<i>Bifidobacterium dentium</i>	
<i>Bifidobacterium longum</i>	
<i>Blastochloris viridis</i>	
<i>Borrelia burgdorferi</i>	
<i>Bordetella pertussis</i>	
<i>Bordetella bronchiseptica</i>	
<i>Brucella abortus</i>	
<i>Brevibacterium linens</i>	
<i>Brevibacterium flavum</i>	
<i>Brevundimonas diminuta</i>	
<i>Buchnera aphidicola</i>	
<i>Budvicia aquatica</i>	
<i>Burkholderia cepacia</i>	
<i>Burkholderia mallei</i>	
<i>Burkholderia pseudomallei</i>	
<i>Buttiauxella agrestis</i>	
<i>Butyrivibrio fibrisolvens</i>	
<i>Campylobacter coli</i>	
<i>Campylobacter curvus</i>	
<i>Campylobacter fetus</i> subsp. <i>fetus</i>	
<i>Campylobacter fetus</i> subsp. <i>venerealis</i>	
<i>Campylobacter gracilis</i>	
<i>Campylobacter jejuni</i>	
<i>Campylobacter jejuni</i> subsp. <i>doylei</i>	
<i>Campylobacter jejuni</i> subsp. <i>jejuni</i>	
<i>Campylobacter lari</i>	
<i>Campylobacter rectus</i>	
<i>Campylobacter sputorum</i> subsp. <i>sputorum</i>	
<i>Campylobacter upsaliensis</i>	
<i>Cedecea davisaee</i>	
<i>Cedecea lapagei</i>	
<i>Cedecea neteri</i>	
<i>Chlamydia pneumoniae</i>	
<i>Chlamydia psittaci</i>	
<i>Chlamydia trachomatis</i>	
<i>Chlorobium vibrioforme</i>	
<i>Chloroflexus aurantiacus</i>	
<i>Chryseobacterium meningosepticum</i>	
<i>Citrobacter amalonaticus</i>	
<i>Citrobacter braakii</i>	
<i>Citrobacter farmeri</i>	
<i>Citrobacter freundii</i>	

TABLE 4-continued

Example of microbial species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are used in the present invention.

<i>Citrobacter koseri</i>	5
<i>Citrobacter sedlakii</i>	
<i>Citrobacter werkmanii</i>	
<i>Citrobacter youngae</i>	
<i>Clostridium acetobutylicum</i>	
<i>Clostridium beuerinckii</i>	10
<i>Clostridium bif fermentans</i>	
<i>Clostridium botulinum</i>	
<i>Clostridium difficile</i>	
<i>Clostridium innocuum</i>	
<i>Clostridium histolyticum</i>	
<i>Clostridium novyi</i>	
<i>Clostridium septicum</i>	15
<i>Clostridium perfringens</i>	
<i>Clostridium ramosum</i>	
<i>Clostridium tertium</i>	
<i>Clostridium tetani</i>	
<i>Comamonas acidovorans</i>	
<i>Corynebacterium accolens</i>	20
<i>Corynebacterium bovis</i>	
<i>Corynebacterium cervicis</i>	
<i>Corynebacterium diphtheriae</i>	
<i>Corynebacterium flavescent</i>	
<i>Corynebacterium genitalium</i>	
<i>Corynebacterium glutamicum</i>	25
<i>Corynebacterium jeikeium</i>	
<i>Corynebacterium kutscheri</i>	
<i>Corynebacterium minutissimum</i>	
<i>Corynebacterium mycetoides</i>	
<i>Corynebacterium pseudodiphtheriticum</i>	
<i>Corynebacterium pseudo genitalium</i>	
<i>Corynebacterium pseudotuberculosis</i>	30
<i>Corynebacterium renale</i>	
<i>Corynebacterium striatum</i>	
<i>Corynebacterium ulcerans</i>	
<i>Corynebacterium urealyticum</i>	
<i>Corynebacterium xerosis</i>	
<i>Coxiella burnetii</i>	35
<i>Cytophaga lytica</i>	
<i>Deinococcus radiodurans</i>	
<i>Deinonema sp.</i>	
<i>Edwardsiella hoshinae</i>	
<i>Edwardsiella tarda</i>	
<i>Ehrlichia canis</i>	40
<i>Ehrlichia risticii</i>	
<i>Eikenella corrodens</i>	
<i>Enterobacter aerogenes</i>	
<i>Enterobacter agglomerans</i>	
<i>Enterobacter amnigenus</i>	
<i>Enterobacter asburiae</i>	
<i>Enterobacter cancerogenus</i>	45
<i>Enterobacter cloacae</i>	
<i>Enterobacter gergoviae</i>	
<i>Enterobacter hormaechei</i>	
<i>Enterobacter sakazakii</i>	
<i>Enterococcus avium</i>	
<i>Enterococcus casseliflavus</i>	50
<i>Enterococcus cecorum</i>	
<i>Enterococcus columbae</i>	
<i>Enterococcus dispar</i>	
<i>Enterococcus durans</i>	
<i>Enterococcus faecalis</i>	
<i>Enterococcus faecium</i>	
<i>Enterococcus flavescens</i>	55
<i>Enterococcus gallinarum</i>	
<i>Enterococcus hirae</i>	
<i>Enterococcus malodoratus</i>	
<i>Enterococcus mundtii</i>	
<i>Enterococcus pseudoavium</i>	
<i>Enterococcus raffinosus</i>	60
<i>Enterococcus saccharolyticus</i>	
<i>Enterococcus solitarius</i>	
<i>Enterococcus sulfureus</i>	
<i>Clostridium sordellii</i>	
<i>Erwinia amylovora</i>	
<i>Erwinia carotovora</i>	65
<i>Escherichia coli</i>	

TABLE 4-continued

Example of microbial species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are used in the present invention.

<i>Escherichia fergusonii</i>	
<i>Escherichia hermannii</i>	
<i>Escherichia vulneris</i>	
<i>Eubacterium lenthum</i>	
<i>Eubacterium nodatum</i>	
<i>Ewingella americana</i>	
<i>Francisella tularensis</i>	
<i>Frankia alni</i>	
<i>Fervidobacterium islandicum</i>	
<i>Fibrobacter succinogenes</i>	
<i>Flavobacterium ferrigeneum</i>	
<i>Flexistipes sinusarabici</i>	
<i>Fusobacterium gonitaiformans</i>	
<i>Fusobacterium necrophorum</i> subsp. <i>necrophorum</i>	
<i>Fusobacterium nucleatum</i> subsp. <i>polymorphum</i>	
<i>Gardnerella vaginalis</i>	
<i>Gemella haemolysans</i>	
<i>Gemella morbillorum</i>	
<i>Globicatella sanguis</i>	
<i>Gloeobacter violaceus</i>	
<i>Gloeothece</i> sp.	
<i>Glucorobacter oxydans</i>	
<i>Haemophilus actinomycetemcomitans</i>	
<i>Haemophilus aphrophilus</i>	
<i>Haemophilus ducreyi</i>	
<i>Haemophilus haemolyticus</i>	
<i>Haemophilus influenzae</i>	
<i>Haemophilus parahaemolyticus</i>	
<i>Haemophilus parainfluenzae</i>	
<i>Haemophilus paraphrophilus</i>	
<i>Haemophilus segnis</i>	
<i>Hafnia alvei</i>	
<i>Halobacterium marismortui</i>	
<i>Halobacterium saltinarum</i>	
<i>Haloferax volcanii</i>	
<i>Helicobacter pylori</i>	
<i>Herpetosiphon aurantiacus</i>	
<i>Kingella kingae</i>	
<i>Klebsiella ornithinolytica</i>	
<i>Klebsiella oxytoca</i>	
<i>Klebsiella planticola</i>	
<i>Klebsiella pneumoniae</i> subsp. <i>ozaenae</i>	
<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	
<i>Klebsiella pneumoniae</i> subsp. <i>rhinoscleromatis</i>	
<i>Klebsiella terrigena</i>	
<i>Kluyvera ascorbata</i>	
<i>Kluyvera cryocrescens</i>	
<i>Kluyvera georgiana</i>	
<i>Kocuria kristinae</i>	
<i>Lactobacillus acidophilus</i>	
<i>Lactobacillus garvieae</i>	
<i>Lactobacillus paracasei</i>	
<i>Lactobacillus casei</i> subsp. <i>casei</i>	
<i>Lactococcus garvieae</i>	
<i>Lactococcus lactis</i>	
<i>Lactococcus lactis</i> subsp. <i>lactis</i>	
<i>Legionella micdadei</i>	
<i>Legionella pneumophila</i> subsp. <i>pneumophila</i>	
<i>Leminorella grimontii</i>	
<i>Leminorella richardii</i>	
<i>Leptospira biflexa</i>	
<i>Leptospira interrogans</i>	
<i>Leuconostoc mesenteroides</i> subsp. <i>dextranicum</i>	
<i>Listeria innocua</i>	
<i>Listeria ivanovii</i>	
<i>Listeria monocytogenes</i>	
<i>Listeria seeligeri</i>	
<i>Macrococcus caseolyticus</i>	
<i>Magnetospirillum magnetotacticum</i>	
<i>Megamonas hypermegale</i>	
<i>Methanobacterium thermoautotrophicum</i>	
<i>Methanococcus jannaschii</i>	
<i>Methanococcus vannielii</i>	
<i>Methanosaarcina barkeri</i>	
<i>Methanosaarcina jannaschii</i>	
<i>Methylobacillus flagellatum</i>	
<i>Methylomonas clara</i>	

TABLE 4-continued

Example of microbial species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are used in the present invention.

<i>Micrococcus luteus</i>	5
<i>Micrococcus lylae</i>	
<i>Mitsuokella multacidus</i>	
<i>Mobiluncus curtisi subsp. holmesii</i>	
<i>Moellerella thermoacética</i>	
<i>Moellerella wisconsensis</i>	
<i>Moorella thermoacética</i>	10
<i>Moraxella catarrhalis</i>	
<i>Moraxella osloensis</i>	
<i>Morganella morganii</i> subsp. <i>morganii</i>	
<i>Mycobacterium avium</i>	
<i>Mycobacterium bovis</i>	
<i>Mycobacterium gordonae</i>	15
<i>Mycobacterium kansasi</i>	
<i>Mycobacterium leprae</i>	
<i>Mycobacterium terrae</i>	
<i>Mycobacterium tuberculosis</i>	
<i>Mycoplasma capricolum</i>	
<i>Mycoplasma gallisepticum</i>	20
<i>Mycoplasma genitalium</i>	
<i>Mycoplasma hominis</i>	
<i>Mycoplasma pirum</i>	
<i>Mycoplasma mycoïdes</i>	
<i>Mycoplasma pneumoniae</i>	
<i>Mycoplasma pulmonis</i>	
<i>Mycoplasma salivarium</i>	25
<i>Myxococcus xanthus</i>	
<i>Neisseria animalis</i>	
<i>Neisseria canis</i>	
<i>Neisseria cinerea</i>	
<i>Neisseria cuniculi</i>	
<i>Neisseria elongata</i> subsp. <i>elongata</i>	30
<i>Neisseria elongata</i> subsp. <i>intermedia</i>	
<i>Neisseria flava</i>	
<i>Neisseria flavescens</i>	
<i>Neisseria gonorrhoeae</i>	
<i>Neisseria lactamica</i>	
<i>Leclercia adecarboxylata</i>	35
<i>Neisseria meningitidis</i>	
<i>Neisseria mucosa</i>	
<i>Neisseria perflava</i>	
<i>Neisseria pharyngis</i> var. <i>flava</i>	
<i>Neisseria polysaccarea</i>	
<i>Neisseria sicca</i>	40
<i>Neisseria subflava</i>	
<i>Neisseria weaveri</i>	
<i>Obesumbacterium proteus</i>	
<i>Ochrobactrum anthropi</i>	
<i>Pantoea agglomerans</i>	
<i>Pantoea dispersa</i>	45
<i>Paracoccus denitrificans</i>	
<i>Pasteurella multocida</i>	
<i>Pectinatus frisingensis</i>	
<i>Peptococcus niger</i>	
<i>Peptostreptococcus anaerobius</i>	
<i>Peptostreptococcus asaccharolyticus</i>	
<i>Peptostreptococcus prevotii</i>	50
<i>Phormidium ectocarpri</i>	
<i>Pirellula marina</i>	
<i>Planobispora rosea</i>	
<i>Plesiomonas shigelloides</i>	
<i>Plectonema boryanum</i>	
<i>Porphyromonas asaccharolytica</i>	55
<i>Porphyromonas gingivalis</i>	
<i>Pragia fontium</i>	
<i>Prevotella buccalis</i>	
<i>Prevotella melaninogenica</i>	
<i>Prevotella oralis</i>	
<i>Prevotella ruminocola</i>	60
<i>Prochlorothrix hollandica</i>	
<i>Propionibacterium acnes</i>	
<i>Propionigenium modestum</i>	
<i>Proteus mirabilis</i>	
<i>Proteus penneri</i>	
<i>Proteus vulgaris</i>	
<i>Providencia alcalifaciens</i>	65
<i>Providencia rettgeri</i>	

TABLE 4-continued

Example of microbial species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are used in the present invention.

<i>Providencia rustigianii</i>	
<i>Providencia stuartii</i>	
<i>Pseudomonas aeruginosa</i>	
<i>Pseudomonas fluorescens</i>	
<i>Pseudomonas putida</i>	
<i>Pseudomonas stutzeri</i>	
<i>Psychrobacter phenylpyruvicum</i>	
<i>Pyrococcus abyssi</i>	
<i>Rahnella aquatilis</i>	
<i>Rickettsia prowazekii</i>	
<i>Rhizobium leguminosarum</i>	
<i>Rhizobium phaseoli</i>	
<i>Rhodobacter capsulatus</i>	
<i>Rhodobacter sphaeroides</i>	
<i>Rhodopseudomonas palustris</i>	
<i>Rhodospirillum rubrum</i>	
<i>Ruminococcus albus</i>	
<i>Ruminococcus bromii</i>	
<i>Salmonella bongori</i>	
<i>Salmonella choleraesuis</i> subsp. <i>arizonae</i>	
<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i>	
<i>Salmonella choleraesuis</i> subsp. <i>diarizonae</i>	
<i>Salmonella choleraesuis</i> subsp. <i>houtenae</i>	
<i>Salmonella choleraesuis</i> subsp. <i>indica</i>	
<i>Salmonella choleraesuis</i> subsp. <i>salamae</i>	
<i>Serpulina hyoilectariae</i>	
<i>Serratia ficaria</i>	
<i>Serratia fonticola</i>	
<i>Serratia grimesii</i>	
<i>Serratia liquefaciens</i>	
<i>Serratia marcescens</i>	
<i>Serratia odorifera</i>	
<i>Serratia plymuthica</i>	
<i>Serratia rubidaea</i>	
<i>Shewanella putrefaciens</i>	
<i>Shigella boydii</i>	
<i>Shigella dysenteriae</i>	
<i>Shigella flexneri</i>	
<i>Shigella sonnei</i>	
<i>Sinorhizobium meliloti</i>	
<i>Spirochaeta aurantia</i>	
<i>Staphylococcus aureus</i>	
<i>Staphylococcus aureus</i> subsp. <i>aureus</i>	
<i>Staphylococcus auricularis</i>	
<i>Staphylococcus capitis</i> subsp. <i>capitis</i>	
<i>Staphylococcus cohnii</i> subsp. <i>cohnii</i>	
<i>Staphylococcus epidermidis</i>	
<i>Staphylococcus haemolyticus</i>	
<i>Staphylococcus hominis</i>	
<i>Staphylococcus hominis</i> subsp. <i>hominis</i>	
<i>Staphylococcus lugdunensis</i>	
<i>Staphylococcus saprophyticus</i>	
<i>Staphylococcus sciuri</i> subsp. <i>sciuri</i>	
<i>Staphylococcus simulans</i>	
<i>Staphylococcus warneri</i>	
<i>Stigmatella aurantiaca</i>	
<i>Stenotrophomonas maltophilia</i>	
<i>Streptococcus acidomimicus</i>	
<i>Streptococcus agalactiae</i>	
<i>Streptococcus anginosus</i>	
<i>Streptococcus bovis</i>	
<i>Streptococcus cricetus</i>	
<i>Streptococcus cristatus</i>	
<i>Streptococcus downei</i>	
<i>Streptococcus dysgalactiae</i>	
<i>Streptococcus equi</i> subsp. <i>equi</i>	
<i>Streptococcus ferus</i>	
<i>Streptococcus gordonii</i>	
<i>Streptococcus macacae</i>	
<i>Streptococcus mitis</i>	
<i>Streptococcus mutans</i>	
<i>Streptococcus oralis</i>	
<i>Streptococcus parasanguinis</i>	
<i>Streptococcus pneumoniae</i>	
<i>Streptococcus pyogenes</i>	
<i>Streptococcus ratti</i>	
<i>Streptococcus salivarius</i>	

TABLE 4-continued

Example of microbial species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are used in the present invention.

<i>Streptococcus salivarius</i> subsp. <i>thermophilus</i>	5
<i>Streptococcus sanguinis</i>	
<i>Streptococcus sobrinus</i>	
<i>Streptococcus suis</i>	
<i>Streptococcus uberis</i>	
<i>Streptococcus vestibularis</i>	10
<i>Streptomyces anbofaciens</i>	
<i>Streptomyces aureofaciens</i>	
<i>Streptomyces cinnamoneus</i>	
<i>Streptomyces coelicolor</i>	
<i>Streptomyces collinus</i>	
<i>Streptomyces lividans</i>	
<i>Streptomyces netrospis</i>	15
<i>Streptomyces ramocissimus</i>	
<i>Streptomyces rimosus</i>	
<i>Streptomyces venezuelae</i>	
<i>Succinivibrio dextrinosolvens</i>	
<i>Synechococcus</i> sp.	20
<i>Synechocystis</i> sp.	
<i>Tatumella ptyseos</i>	
<i>Taxeobacter occetus</i>	
<i>Tetragenococcus halophilus</i>	
<i>Thermoplasma acidophilum</i>	
<i>Thermotoga maritima</i>	25
<i>Thermus aquaticus</i>	
<i>Thermus thermophilus</i>	
<i>Thiobacillus ferrooxidans</i>	
<i>Thiomonas cuprina</i>	
<i>Trabulsiella guamensis</i>	
<i>Treponema pallidum</i>	
<i>Ureaplasma urealyticum</i>	30
<i>Veillonella parvula</i>	
<i>Vibrio alginolyticus</i>	
<i>Vibrio anguillarum</i>	
<i>Vibrio cholerae</i>	
<i>Vibrio mimicus</i>	
<i>Wolinella succinogenes</i>	35
<i>Xanthomonas citri</i>	
<i>Xanthomonas oryzae</i>	
<i>Xenorhabdus bovieni</i>	
<i>Xenorhabdus nematophilus</i>	
<i>Yersinia bercovieri</i>	40
<i>Yersinia enterocolitica</i>	
<i>Yersinia frederiksenii</i>	
<i>Yersinia intermedia</i>	
<i>Yersinia pestis</i>	
<i>Yersinia pseudotuberculosis</i>	
<i>Yersinia röhlhei</i>	
<i>Yokenella regensburgei</i>	
<i>Zoogloea ramigera</i>	45
Fungal species	
<i>Absidia corymbifera</i>	
<i>Absidia glauca</i>	
<i>Alternaria alternata</i>	
<i>Arxula adeninivorans</i>	50
<i>Aspergillus flavus</i>	
<i>Aspergillus fumigatus</i>	
<i>Aspergillus nidulans</i>	
<i>Aspergillus niger</i>	
<i>Aspergillus oryzae</i>	
<i>Aspergillus terreus</i>	
<i>Aspergillus versicolor</i>	55
<i>Aureobasidium pullulans</i>	
<i>Basidiobolus ranarum</i>	
<i>Bipolaris hawaiiensis</i>	
<i>Bilophila wadsworthia</i>	
<i>Blastoschizomyces capitatus</i>	
<i>Blastomyces dermatitidis</i>	60
<i>Candida albicans</i>	
<i>Candida catenulata</i>	
<i>Candida dubliniensis</i>	
<i>Candida famata</i>	
<i>Candida glabrata</i>	
<i>Candida guilliermondii</i>	65
<i>Candida haemulonii</i>	
<i>Candida inconspicua</i>	

TABLE 4-continued

Example of microbial species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are used in the present invention.

<i>Candida kefyr</i>	
<i>Candida krusei</i>	
<i>Candida lambica</i>	
<i>Candida lusitaniae</i>	
<i>Candida norvegica</i>	
<i>Candida norvegensis</i>	
<i>Candida parapsilosis</i>	
<i>Candida rugosa</i>	
<i>Candida sphaerica</i>	
<i>Candida tropicalis</i>	
<i>Candida utilis</i>	
<i>Candida viswanathii</i>	
<i>Candida zeylanoides</i>	
<i>Cladophialophora carriornii</i>	
<i>Coccidioides immitis</i>	
<i>Coprinus cinereus</i>	
<i>Cryptococcus albidos</i>	
<i>Cryptococcus humicolus</i>	
<i>Cryptococcus laurentii</i>	
<i>Cryptococcus neoformans</i>	
<i>Cunninghamella bertholletiae</i>	
<i>Curvularia lunata</i>	
<i>Emericella nidulans</i>	
<i>Emmonsia parva</i>	
<i>Eremothecium gossypii</i>	
<i>Exophiala dermatitidis</i>	
<i>Exophiala jeanselmei</i>	
<i>Exophiala moniliae</i>	
<i>Exserohilum rostratum</i>	
<i>Eremothecium gossypii</i>	
<i>Fonsecaea pedrosoi</i>	
<i>Fusarium moniliforme</i>	
<i>Fusarium oxysporum</i>	
<i>Fusarium solani</i>	
<i>Geotrichum</i> sp.	
<i>Histoplasma capsulatum</i>	
<i>Hortaea werneckii</i>	
<i>Issatchenkia orientalis</i> Kudrjanzev	
<i>Kluyveromyces lactic</i>	
<i>Malassezia furfur</i>	
<i>Malassezia pachydermatis</i>	
<i>Malbranchea filamentosa</i>	
<i>Metschnikowia pulcherrima</i>	
<i>Microsporum audouinii</i>	
<i>Microsporum canis</i>	
<i>Mucor circinelloides</i>	
<i>Neurospora crassa</i>	
<i>Paecilomyces lilacinus</i>	
<i>Paracoccidioides brasiliensis</i>	
<i>Penicillium marneffei</i>	
<i>Phialaphora verrucose</i>	
<i>Pichia anomala</i>	
<i>Piedraia hortai</i>	
<i>Podospora anserina</i>	
<i>Podospora curvicerca</i>	
<i>Puccinia graminis</i>	
<i>Pseudallescheria boydii</i>	
<i>Reclimononas americana</i>	
<i>Rhizomucor racemosus</i>	
<i>Rhizopus oryzae</i>	
<i>Rhodotorula minuta</i>	
<i>Rhodotorula mucilaginosa</i>	
<i>Saccharomyces cerevisiae</i>	
<i>Saksenaea vasiformis</i>	
<i>Schizosaccharomyces pombe</i>	
<i>Scopulariopsis kongii</i>	
<i>Sordaria macrospora</i>	
<i>Sporobolomyces salmonicolor</i>	
<i>Sporothrix schenckii</i>	
<i>Stephanosascus ciferrui</i>	
<i>Syncephalastrum racemosum</i>	
<i>Trichoderma reesei</i>	
<i>Trichophyton mentagrophytes</i>	
<i>Trichophyton rubrum</i>	
<i>Trichophyton tonsurans</i>	
<i>Trichosporon cutaneum</i>	
<i>Ustilago maydis</i>	

TABLE 4-continued

Example of microbial species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are used in the present invention.

<i>Wangiella dermatitidis</i>	5
<i>Yarrowia lipolytica</i>	
Parasitical species	
<i>Babesia bigemina</i>	10
<i>Babesia bovis</i>	
<i>Babesia microti</i>	
<i>Blastocystis hominis</i>	
<i>Criithidia fasciculata</i>	
<i>Cryptosporidium parvum</i>	
<i>Entamoeba histolytica</i>	15
<i>Giardia lamblia</i>	
<i>Kentrophoros</i> sp.	
<i>Leishmania aethiopica</i>	
<i>Leishmania amazonensis</i>	
<i>Leishmania braziliensis</i>	
<i>Leishmania donovani</i>	
<i>Leishmania infantum</i>	20
<i>Leishmania enriettii</i>	
<i>Leishmania gerbilli</i>	
<i>Leishmania guyanensis</i>	

TABLE 4-continued

Example of microbial species for which tuf and/or atpD and/or recA nucleic acids and/or sequences are used in the present invention.

<i>Leishmania hertigi</i>
<i>Leishmania major</i>
<i>Leishmania mexicana</i>
<i>Leishmania panamensis</i>
<i>Leishmania tarentolae</i>
<i>Leishmania tropica</i>
<i>Neospora caninum</i>
<i>Onchocerca volvulus</i>
<i>Plasmodium bergerhei</i>
<i>Plasmodium falciparum</i>
<i>Plasmodium knowlesi</i>
<i>Porphyra purpurea</i>
<i>Toxoplasma gondii</i>
<i>Treponema pallidum</i>
<i>Trichomonas tenax</i>
<i>Trichomonas vaginalis</i>
<i>Trypanosoma brucei</i>
<i>Trypanosoma brucei</i> subsp. <i>brucei</i>
<i>Trypanosoma congoense</i>
<i>Trypanosoma cruzi</i>

TABLE 5

Antimicrobial agents resistance genes selected for diagnostic purposes

Gene ID NO.	Antimicrobial agent	Bacteria ¹	ACCESSION NO.	SEQ ID NO.
aac(3)-Ib ²	Aminoglycosides	<i>Enterobacteriaceae</i>	L06157	
aac(3)-IIb ²	Aminoglycosides	<i>Pseudomonads</i>	M97172	
aac(3)-IVa ²	Aminoglycosides	<i>Enterobacteriaceae</i>	X01385	
aac(3)-VIa ²	Aminoglycosides	<i>Enterobacteriaceae</i> , <i>Pseudomonads</i>	M88012	
aac(2')-1a ²	Aminoglycosides	<i>Enterobacteriaceae</i> , <i>Pseudomonads</i>	X04555	
aac(6')-aph(2") ²	Aminoglycosides	<i>Enterococcus</i> sp., <i>Staphylococcus</i> sp.		83-86 ³
aac(6')-Ia, ²	Aminoglycosides	<i>Enterobacteriaceae</i> , <i>Pseudomonads</i>	M18967	
aac(6')-Ic ²	Aminoglycosides	<i>Enterobacteriaceae</i> , <i>Pseudomonads</i>	M94066	
aac(6')-IIa ²	Aminoglycosides	<i>Pseudomonads</i>		112 ⁴
aadB	Aminoglycosides	<i>Enterobacteriaceae</i>		53-54 ³
[ant(2")-Ia ²]				
aacC1	Aminoglycosides	<i>Pseudomonads</i>		55-56 ³
[aac(3)-Ia ²]				
aacC2	Aminoglycosides	<i>Pseudomonads</i>		57-58 ³
[aac(3)-IIa ²]				
aacC3	Aminoglycosides	<i>Pseudomonads</i>		59-60 ³
[aac(3)-III ²]				
aacA4	Aminoglycosides	<i>Pseudomonads</i>		65-66 ³
[aac(6')-Ib ²]				
ant(3")-Ia ²	Aminoglycosides	<i>Enterobacteriaceae</i> , <i>Enterococcus</i> sp., <i>Staphylococcus</i> sp.	X02340 M10241	
ant(4')-Ia ²	Aminoglycosides	<i>Staphylococcus</i> sp.	V01282	
aph(3')-Ia ²	Aminoglycosides	<i>Enterobacteriaceae</i> , <i>Pseudomonads</i>	J01839	
aph(3')-IIa ²	Aminoglycosides	<i>Enterobacteriaceae</i> , <i>Pseudomonads</i>	V00618	
aph(3')-IIIa ²	Aminoglycosides	<i>Enterococcus</i> sp., <i>Staphylococcus</i> sp.	V01547	
aph(3')-VIa ²	Aminoglycosides	<i>Enterobacteriaceae</i> , <i>Pseudomonads</i>	X07753	
rpsL ²	Streptomycin	<i>M. tuberculosis</i> , <i>M. avium</i> complex	X80120 U14749 X70995 L08011	
<i>bla</i> OXA ^{5,6}	β-lactams	<i>Enterobacteriaceae</i> , <i>Pseudomonads</i>	Y10693 AJ238349 AJ009819 X06046	110 ⁴

TABLE 5-continued

Antimicrobial agents resistance genes selected for diagnostic purposes				
Gene ID NO.	Antimicrobial agent	Bacteria ¹	ACCESSION NO.	SEQ ID NO.
			X03037	
			X07260	
			U13880	
			X75562	
			AF034958	
			J03427	
			Z22590	
			U59183	
			L38523	
			U63835	
			AF043100	
			AF060206	
			U85514	
			AF043381	
			AF024602	
			AF064820	
<i>bla</i> ROB ⁵	β-lactams	<i>Haemophilus</i> sp.	45-48 ³	
<i>bla</i> SHV ^{5,6}	β-lactams	<i>Enterobacteriaceae</i> , <i>Pseudomonas aeruginosa</i>	AF124984 AF148850 M59181 X98099 M33655 AF148851 X53433 L47119 AF074954 X53817 AF096930 X55640 Y11069 U20270 U92041 S82452 X98101 X98105 AF164577 AJ011428 AF116855 AB023477 AF293345 AF227204 AF208796 AF132290	41-44 ³
<i>bla</i> TEM ^{5,6}	β-lactams	<i>Enterobacteriaceae</i> , <i>Neisseria</i> sp., <i>Haemophilus</i> sp.	AF012911 U48775 AF093512 AF052748 X64523 Y13612 X57972 AF157413 U31280 U36911 U48775 V00613 X97254 AJ012256 X04515 AF126482 U09188 M88143 Y14574 AF188200 AJ251946 Y17581 Y17582 Y17583 M88143 U37195 Y17584 X64523 U95363 Y10279 Y10280 Y10281	37-40 ³

TABLE 5-continued

Antimicrobial agents resistance genes selected for diagnostic purposes				
Gene ID NO.	Antimicrobial agent	Bacteria ¹	ACCESSION NO.	SEQ ID NO.
			AF027199	
			AF104441	
			AF104442	
			AF062386	
			X57972	
			AF047171	
			AF188199	
			AF157553	
			AF190694	
			AF190695	
			AF190693	
			AF190692	
<i>bla</i> SHV ^{5,6}	β-lactams	<i>Enterobacteriaceae</i> , <i>Pseudomonas aeruginosa</i>	AF124984	41-44 ³
			AF148850	
			M59181	
			X98099	
			M33655	
			AF148851	
			X53433	
			L47119	
			AF074954	
			X53817	
			AF096930	
			X55640	
			Y11069	
			U20270	
			U92041	
			S82452	
			X98101	
			X98105	
			AF164577	
			AJ011428	
			AF116855	
			AB023477	
			AF293345	
			AF227204	
			AF208796	
			AF132290	
<i>bla</i> TEM ^{5,6}	β-lactams	<i>Enterobacteriaceae</i> , <i>Neisseria</i> sp., <i>Haemophilus</i> sp.	AF012911	37-40 ³
			U48775	
			AF093512	
			AF052748	
			X64523	
			Y13612	
			X57972	
			AF157413	
			U31280	
			U36911	
			U48775	
			V00613	
			X97254	
			AJ012256	
			X04515	
			AF126482	
			U09188	
			M88143	
			Y14574	
			AF188200	
			AJ251946	
			Y17581	
			Y17582	
			Y17583	
			M88143	
			U37195	
			Y17584	
			X64523	
			U95363	
			Y10279	
			Y10280	
			Y10281	
			AF027199	
			AF104441	
			AF104442	
			AF062386	
			X57972	

TABLE 5-continued

Antimicrobial agents resistance genes selected for diagnostic purposes				
Gene ID NO.	Antimicrobial agent	Bacteria ¹	ACCESSION NO.	SEQ ID NO.
			AF047171	
			AF188199	
			AF157553	
			AF190694	
			AF190695	
			AF190693	
			AF190692	
<i>bla</i> CARB ⁵	β-lactams	<i>Pseudomonas</i> sp., <i>Enterobacteriaceae</i>	J05162	
			S46063	
			M69058	
			U14749	
			D86225	
			D13210	
			Z18955	
			AF071555	
			AF153200	
			AF030945	
<i>bla</i> CTX-M-1 ⁵	β-lactams	<i>Enterobacteriaceae</i>	X92506	
<i>bla</i> CTX-M-2 ⁵	β-lactams	<i>Enterobacteriaceae</i>	X92507	
<i>bla</i> CMY-2	β-lactams	<i>Enterobacteriaceae</i>	X91840	
			AJ007826	
			AJ011293	
			AJ011291	
			Y17716	
			Y16783	
			Y16781	
			Y15130	
			U77414	
			S83226	
			Y15412	
			X78117	
<i>bla</i> Imp ⁵	β-lactams	<i>Enterobacteriaceae</i> , <i>Pseudomonas</i> <i>aeruginosa</i>	AJ223604	
			S71932	
			D50438	
			D29636	
			X98393	
			AB010417	
			D78375	
<i>bla</i> PER-1 ⁵	β-lactams	<i>Enterobacteriaceae</i> , <i>Pseudomonadaceae</i>	Z21957	
<i>bla</i> PER-2 ⁷	β-lactams	<i>Enterobacteriaceae</i>	X93314	
<i>bla</i> Z ¹²	β-lactams	<i>Enterococcus</i> sp., <i>Staphylococcus</i> sp.		111 ⁴
<i>mecA</i> ¹²	β-lactams	<i>Staphylococcus</i> sp.		97-98 ³
<i>pbp1a</i> ¹³	β-lactams	<i>Streptococcus</i> <i>pneumoniae</i>	M90527	1004-1018,
			X67872	1648,
			AB006868	2056-2064,
			AB006874	2273-2276
			X67873	
			AB006878	
			AB006875	
			AB006877	
			AB006879	
			AF046237	
			AF046235	
			AF026431	
			AF046232	
			AF046233	
			AF046236	
			X67871	
			Z49095	
			AF046234	
			AB006873	
			X67866	
			X67868	
			AB006870	
			AB006869	
			AB006872	
			X67870	
			AB006871	
			X67867	
			X67869	
			AB006876	
			AF046230	

TABLE 5-continued

Antimicrobial agents resistance genes selected for diagnostic purposes				
Gene ID NO.	Antimicrobial agent	Bacteria ¹	ACCESSION NO.	SEQ ID NO.
pbp2b ¹³	β-lactams	<i>Streptococcus pneumoniae</i>	AF046238 Z49094 X16022 M25516 M25518 M25515 U20071 U20084 U20082 U20067 U20079 Z22185 U20072	1019-1033
pbp2b ¹³	β-lactams	<i>Streptococcus pneumoniae</i>	U20083 U20081 M25522 U20075 U20070 U20077 U20068 Z22184 U20069 U20078 M25521 M25525 M25519 Z21981 M25523 M25526 U20076 U20074 M25520 M25517 M25524 Z22230 U20073 U20080	
pbp2x ¹³	β-lactams	<i>Streptococcus pneumoniae</i>	X16367 X65135 AB011204 AB011209 AB011199 AB011200 AB011201 AB011202 AB011198 AB011208 AB011205 AB015852 AB011210 AB015849 AB015850 AB015851 AB015847 AB015846 AB011207 AB015848 Z49096	1034-1048
int	β-lactams, trimethoprim	<i>Enterobacteriaceae</i> ,	99-102 ³	
sul	aminoglycosides, antiseptic,	Pseudomonads	103-106 ³	
ermA ¹⁴	Macrolides, lincosamides, streptogramin B	<i>Staphylococcus</i> sp.	113 ⁴	
ermB ¹⁴	Macrolides, lincosamides, streptogramin B	<i>Enterobacteriaceae</i> , <i>Staphylococcus</i> sp. <i>Enterococcus</i> sp. <i>Streptococcus</i> sp.	114 ⁴	
ermC ¹⁴	Macrolides, lincosamides, streptogramin B	<i>Enterobacteriaceae</i> , <i>Staphylococcus</i> sp.	115 ⁴	

TABLE 5-continued

Antimicrobial agents resistance genes selected for diagnostic purposes				
Gene ID NO.	Antimicrobial agent	Bacteria ¹	ACCESSION NO.	SEQ ID NO.
ereA ¹²	Macrolides	<i>Enterobacteriaceae</i> , <i>Staphylococcus</i> sp.	M11277 E01199 AF099140	
ereB ¹²	Macrolides	<i>Enterobacteriaceae</i> <i>Staphylococcus</i> sp.	A15097 X03988	
msrA ¹² mefA, mefE ⁸	Macrolides Macrolides	<i>Staphylococcus</i> sp. <i>Streptococcus</i> sp.	U70055 U83667 D16251 U34344 U36578	77-80 ³
mphA ⁸	Macrolides	<i>Enterobacteriaceae</i> , <i>Staphylococcus</i> sp.	J03947 M14039 A15070 E01245	
linA/linA ⁹	Lincosamides	<i>Staphylococcus</i> sp.	M14039 A15070 E01245	
linB ¹⁰	Lincosamides	<i>Enterococcus faecium</i>	AF110130 AJ238249	
vga ¹⁵	Streptogramin	<i>Staphylococcus</i> sp.	M90056 U82085	89-90 ³
vgb ¹⁵	Streptogramin	<i>Staphylococcus</i> sp.	M36022 M20219	
vat ¹⁵ vatB ¹⁵	Streptogramin Streptogramin	<i>Staphylococcus</i> sp. <i>Staphylococcus</i> sp.	L07778 U19459 L38809	87-88 ³
satA ¹⁵ mupA ¹²	Streptogramin Mupirocin	<i>Enterococcus faecium</i> <i>Staphylococcus aureus</i>	L12033 X75439 X59478 X59477	81-82 ³
gyrA ¹⁶	Quinolones	Gram-positive and gram-negative bacteria	X95718 X06744 X57174 X16817 X71437 AF065152 AF060881 D32252	1255, 1607-1608, 1764-1776, 2013-2014, 2277-2280
parC/grlA ¹⁶	Quinolones	Gram-positive and gram-negative bacteria	AB005036 AF056287 X95717 AF129764 AB017811 AF065152	1777-1785
parE/grlB ¹⁶	Quinolones	Gram-positive bacteria	X95717 AF065153 AF058920	
norA ¹⁶	Quinolones	<i>Staphylococcus</i> sp.	D90119 M80252 M97169	
mexR(nalB) ¹⁶	Quinolones	<i>Pseudomonas aeruginosa</i>	U23763	
nfxB ¹⁶	Quinolones	<i>Pseudomonas aeruginosa</i>	X65646	
cat ¹²	Chloramphenicol	Gram-positive and gram-negative bacteria	M55620 X15100 A24651 M28717 A00568 A00569 X74948 Y00723 A24362 A00569 M93113 M62822 M58516 V01277 X02166 M77169 X53796 J01841 X07848	
ppflo-like embB ¹⁷	Chloramphenicol Ethambutol	<i>Mycobacterium tuberculosis</i>	AF071555 U68480	

TABLE 5-continued

Antimicrobial agents resistance genes selected for diagnostic purposes				
Gene ID NO.	Antimicrobial agent	Bacteria ¹	ACCESSION NO.	SEQ ID NO.
pncA ¹⁷	Pyrazinamide	<i>Mycobacterium tuberculosis</i>	U59967	
rpoB ¹⁷	Rifampin	<i>Mycobacterium tuberculosis</i>	AF055891 AF055892 S71246 L27989 AF055893	
inhA ¹⁷	Isoniazid	<i>Mycobacterium tuberculosis</i>	AF106077 U02492	
vanA ¹²	Vancomycin	<i>Enterococcus</i> sp.	67-70 ³ 1049-1057	
vanB ¹²	Vancomycin	<i>Enterococcus</i> sp.	116 ⁴	
vanC1 ¹²	Vancomycin	<i>Enterococcus gallinarum</i>	117 ⁴	
vanC2 ¹²	Vancomycin	<i>Enterococcus casseliflavus</i>	1058-1059 U94521 U94522 U94523 U94524 U94525 L29638	1060-1063
vanC3 ¹²	Vancomycin	<i>Enterococcus flavescentis</i>	L29639 U72706	1064-1066
vanD ¹⁸	Vancomycin	<i>Enterococcus faecium</i>	AF130997	
vanE ¹²	Vancomycin	<i>Enterococcus faecium</i>	AF136925	
tetB ¹⁹	Tetracycline	Gram-negative bacteria	J01830 AF162223 AP000342 S83213 U81141 V00611	
tetM ¹⁹	Tetracycline	Gram-negative and Gram-positive bacteria	X52632 AF116348 U50983 X92947 M211136 U08812 X04388	
sul II ²⁰	Sulfonamides	Gram-negative bacteria	M36657 AF017389 AF017391	
dhfrIa ²⁰	Trimethoprim	Gram-negative bacteria	AJ238350 X17477 K00052 U09476 X00926	
dhfrIb ²⁰	Trimethoprim	Gram-negative bacteria	Z50805 Z50804	
dhfrV ²⁰	Trimethoprim	Gram-negative bacteria	X12868	
dhfrVI ²⁰	Trimethoprim	Gram-negative bacteria	Z86002	
dhfrVII ²⁰	Trimethoprim	Gram-negative bacteria	U31119 AF139109 X58425	
dhfrVIII ²⁰	Trimethoprim	Gram-negative bacteria	U10186 U09273	
dhfrIX ²⁰	Trimethoprim	Gram-negative bacteria	X57730	
dhfrXII ²⁰	Trimethoprim	Gram-negative bacteria	Z21672 AF175203 AF180731 M84522	
dhfrXIII ²⁰	Trimethoprim	Gram-negative bacteria	Z50802	
dhfrXV ²⁰	Trimethoprim	Gram-negative bacteria	Z83331	
dhfrXVII ²⁰	Trimethoprim	Gram-negative bacteria	AF170088 AF180469 AF169041	
dfrA ²⁰	Trimethoprim	<i>Staphylococcus</i> sp.	AF045472 U40259 AF051916 X13290	

TABLE 5-continued

Antimicrobial agents resistance genes selected for diagnostic purposes			
Gene ID NO.	Antimicrobial agent	Bacteria ¹	ACCESSION NO. SEQ ID NO.
		Y07536	
		Z16422	
		Z48233	

¹Bacteria having high incidence for the specified antibiotic resistance gene. The presence of the antibiotic resistance genes in other bacteria is not excluded.

²Shaw, K. J., P. N. Rather, R. S. Hare, and G. H. Miller. 1993. Molecular genetics of aminoglycoside resistance genes and familial relationships of the aminoglycoside-modifying enzymes. *Microbiol. Rev.* 57:138-163.

³Antibiotic resistance genes from our assigned U.S. Pat. No. 6,001,564 for which we have selected PCR primer pairs.

⁴These SEQ ID NOS. refer to a previous patent (publication WO98/20157).

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⁶Nucleotide mutations in bla_{SHV}, bla_{TEM}, and bla_{OXA} are associated with extended-spectrum β -lactamase or inhibitor-resistant β -lactamase.

⁷Bauerfeind, A., Y. Chong, and K. Lee. 1998. Plasmid-encoded AmpC beta-lactamases: how far have we gone 10 years after discovery? *Yonsei Med. J.* 39:520-525.

⁸Sutcliffe, J., T. Grebe, A. Tait-Kamradt, and L. Wondrack. 1996. Detection of erythromycin-resistant determinants by PCR. *Antimicrob. Agent. Chemother.* 40:2562-2566.

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¹⁰Bozdogan, B., L. Bererezouga, M.-S. Kuo, D. A. Yurek, K. A. Farley, B. J. Stockman, and R. Leclercq. 1999. A new gene, linB, conferring resistance to lincosamides by nucleotidylation in *Enterococcus faecium* HMI025. *Antimicrob. Agents. Chemother.* 43:925-929.

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¹²Tenover, F. C., T. Popovic, and O. Olsvik. 1996. Genetic methods for detecting antibacterial resistance genes. pp. 1368-1378. In Murray, P. R., E. J. Baron, M. A. Pfaller, F. C. Tenover, R. H. Yolken (eds). *Manual of clinical microbiology* 6th ed., ASM Press, Washington, D.C. USA

¹³Dowson, C. G., T. J. Tracey, and B. G. Spratt. 1994. Origin and molecular epidemiology of penicillin-binding-protein-mediated resistance to β -lactam antibiotics. *Trends Microbiol.* 2: 361-366.

¹⁴Jensen, L. B., N. Frimodt-Møller, F. M. Aarestrup. 1999. Presence of erm gene classes in Gram-positive bacteria of animal and human origin in Denmark. *FEMS Microbiol. Lett.* 170:151-158.

¹⁵Thal, L. A., and M. J. Zervos. 1999. Occurrence and epidemiology of resistance to virginiamycin and streptogramins. *J. Antimicrob. Chemother.* 43:171-176.

¹⁶Martinez J. L., A. Alonso, J. M. Gomez-Gomez, and F. Baquero. 1998. Quinolone resistance by mutations in chromosomal gyrase genes. Just the tip of the iceberg? *J. Antimicrob. Chemother.* 42:683-688.

¹⁷Cockerill III, F.R. 1999. Genetic methods for assessing antimicrobial resistance. *Antimicrob. Agents. Chemother.* 43:199-212.

¹⁸Casadewall, B. and P. Courvalin. 1999. Characterization of the vanD glycopeptide resistance gene cluster from

Enterococcus faecium BM 4339. *J. Bacteriol.* 181:3644-3648.

¹⁹Roberts, M.C. 1999. Genetic mobility and distribution of tetracycline resistance determinants. *Ciba Found. Symp.* 207:206-222.

²⁰Huovinen, P., L. Sundström, G. Swedberg, and O. Sköld. 1995. Trimethoprim and sulfonamide resistance. *Antimicrob. Agent. Chemother.* 39:279-289.

TABLE 6

List of bacterial toxins selected for diagnostic purposes.		
Organism	Toxin	Accession number
<i>Actinobacillus actinomycetemcomitans</i>	Cytolytic distending toxin (cdtA, cdtB, cdtC)	AF006830
	Leukotoxin (ltxA)	M27399
<i>Actinomyces pyogenes</i>	Hemolysin (pyolysin)	U84782
<i>Aeromonas hydrophila</i>	Aerolysin (aerA)	M16495
	Haemolysin (hlyA)	U81555
<i>Bacillus anthracis</i>	Cytotoxic enterotoxin (alt)	L77573
	Anthrax toxin (cya)	M23179
<i>Bacillus cereus</i>	Enterotoxin (bceT)	D17312
		AF192766,
		AF192767
	Enterotoxic hemolysin BL	AJ237785
	Non-haemolytic enterotoxins A, B and C (nhe)	Y19005
<i>Bacillus mycoides</i>	Hemolytic enterotoxin HBL	AJ243150 to AJ243153
		55
<i>Bacillus pseudomycoides</i>	Hemolytic enterotoxin HBL	AJ243154 to AJ243156
<i>Bacteroides fragilis</i>	Enterotoxin (bftP)	U67735
	Matrix metalloprotease/enterotoxin (fragilysin)	S75941,
	Metalloprotease toxin-2	AF038459
		60
		U90931
		AF081785
		Metalloprotease toxin-3
<i>Bordetella bronchiseptica</i>	Adenylate cyclase	AF056297
	hemolysin (cyaA)	Z37112,
	Dermonecrotic toxin (dnt)	U22953
		U59687
		AB020025
		65

TABLE 6-continued

List of bacterial toxins selected for diagnostic purposes.		
Organism	Toxin	Accession number
<i>Bordetella pertussis</i>	Pertussis toxin (S1 subunit, tox)	AJ006151
		AJ006153
		AJ006155
		AJ006157
		AJ006159
		AJ007363
		M14378,
		M16494
		AJ007364
		M13223
		X16347
	Adenyl cyclase (cya)	18323
	Dermonecrotic toxin (dnt)	U10527
<i>Campylobacter jejuni</i>	Cytolytic distending toxin (cdtA, cdtB, cdtC)	U51121
<i>Citrobacter freundii</i>	Shiga-like toxin (slt-IIICa)	X67514,
		S53206
<i>Clostridium botulinum</i>	Botulism toxin (BoNT) (A, B, E and F serotypes)	X52066,
		X52088
		X73423
		M30196
		X70814
		X70819
		X71343
		Z11934
		X70817
		M81186
		X70818
		X70815

TABLE 6-continued

List of bacterial toxins selected for diagnostic purposes.		
Organism	Toxin	Accession number
<i>Clostridium difficile</i>	X62089	
	X62683	
	S76749	
	X81714	
	X70816	10
	X70820	
	X70281	
	L35496	
	M92906	
	A toxin (enterotoxin) (tcdA) (cdtA)	AB012304
<i>Clostridium perfringens</i>	AF053400	15
	Y12616	
	X51797	
	X17194	
	M30307	
	B toxin (cytotoxin) (toxB) (cdtB)	Z23277
	Alpha (phospholipase C) (cpa)	X53138
	L43545	20
	L43546	
	L43547	
<i>Beta (dermonecrotic protein) (cpb)</i>	L43548	
	X13608	
	X17300	
	D10248	25
	L13198	
	X83275	
	L77965	
	Enterotoxin (cpe)	AJ000766
	M98037	
	X81849	30
<i>Enterotoxin pseudogene (not expressed)</i>	X83275	
	L77965	
	Enterotoxin pseudogene (not expressed)	AF037328
	AF037329	
	AF037330	
	Epsilon toxin (etxD)	M80837
	M95206	35
	X60694	
	Iota (Ia and Ib)	X73562
	Lambda (metalloprotease)	D45904
<i>Clostridium sordellii</i>	Theta (perfringolysin O)	M36704
	Cytotoxin L	X82638
	Tetanospasmin	X06214
	X04436	40
	Diphtheriae toxin	X00703
	Phospholipase C	A21336
	lysine decarboxylase (cadA)	U89166
	Shiga-like toxin II	Z50754,
		U33502
	Cytolysin B (cylB)	M38052
<i>Escherichia coli</i> (EHEC)	Hemolysin toxin (hlyA) and ehxA	AF043471
	X94129	45
	X79839	
	X86087	
	AB011549	
	AF074613	
		55

TABLE 7

Origin of the nucleic acids and/or sequences in the sequence listing.			
SEQ ID NO.	Archaeal, bacterial, fungal or parasitical species	Source	Gene*
1	<i>Acinetobacter baumannii</i>	This patent	tuf
2	<i>Actinomyces meyeri</i>	This patent	tuf
3	<i>Aerococcus viridans</i>	This patent	tuf
4	<i>Achromobacter xylosoxidans</i> subsp. <i>denitrificans</i>	This patent	tuf
5	<i>Anaerorhabdus furcosus</i>	This patent	tuf

TABLE 7-continued

Origin of the nucleic acids and/or sequences in the sequence listing.			
SEQ ID NO.	Archaeal, bacterial, fungal or parasitical species	Source	Gene*
6	<i>Bacillus anthracis</i>	This patent	tuf
7	<i>Bacillus cereus</i>	This patent	tuf
8	<i>Bacteroides distasonis</i>	This patent	tuf
9	<i>Enterococcus casseliflavus</i>	This patent	tuf
10	<i>Staphylococcus saprophyticus</i>	This patent	tuf
11	<i>Bacteroides ovatus</i>	This patent	tuf
12	<i>Bartonella henselae</i>	This patent	tuf
13	<i>Bifidobacterium adolescentis</i>	This patent	tuf
14	<i>Bifidobacterium dentium</i>	This patent	tuf
15	<i>Brucella abortus</i>	This patent	tuf
16	<i>Burkholderia cepacia</i>	This patent	tuf
17	<i>Cedecea davisae</i>	This patent	tuf
18	<i>Cedecea neteri</i>	This patent	tuf
19	<i>Cedecea lapagei</i>	This patent	tuf
20	<i>Chlamydia pneumoniae</i>	This patent	tuf
21	<i>Chlamydia psittaci</i>	This patent	tuf
22	<i>Chlamydia trachomatis</i>	This patent	tuf
23	<i>Chryseobacterium meningosepticum</i>	This patent	tuf
24	<i>Citrobacter amalonaticus</i>	This patent	tuf
25	<i>Citrobacter braakii</i>	This patent	tuf
26	<i>Citrobacter koseri</i>	This patent	tuf
27	<i>Citrobacter farmeri</i>	This patent	tuf
28	<i>Citrobacter freundii</i>	This patent	tuf
29	<i>Citrobacter sedlakii</i>	This patent	tuf
30	<i>Citrobacter werkmanii</i>	This patent	tuf
31	<i>Citrobacter youngae</i>	This patent	tuf
32	<i>Clostridium perfringens</i>	This patent	tuf
33	<i>Comamonas acidovorans</i>	This patent	tuf
34	<i>Corynebacterium bovis</i>	This patent	tuf
35	<i>Corynebacterium cervicis</i>	This patent	tuf
36	<i>Corynebacterium flavescent</i>	This patent	tuf
37	<i>Corynebacterium kutscheri</i>	This patent	tuf
38	<i>Corynebacterium minutissimum</i>	This patent	tuf
39	<i>Corynebacterium mycetoides</i>	This patent	tuf
40	<i>Corynebacterium pseudogenitalium</i>	This patent	tuf
41	<i>Corynebacterium renale</i>	This patent	tuf
42	<i>Corynebacterium ulcerans</i>	This patent	tuf
43	<i>Corynebacterium urealyticum</i>	This patent	tuf
44	<i>Corynebacterium xerosis</i>	This patent	tuf
45	<i>Coxiella burnetii</i>	This patent	tuf
46	<i>Edwardsiella hoshinae</i>	This patent	tuf
47	<i>Edwardsiella tarda</i>	This patent	tuf
48	<i>Eikenella corrodens</i>	This patent	tuf
49	<i>Enterobacter aerogenes</i>	This patent	tuf
50	<i>Enterobacter agglomerans</i>	This patent	tuf
51	<i>Enterobacter amnigenus</i>	This patent	tuf
52	<i>Enterobacter asburiae</i>	This patent	tuf
53	<i>Enterobacter cancerogenus</i>	This patent	tuf
54	<i>Enterobacter cloacae</i>	This patent	tuf
55	<i>Enterobacter gergoviae</i>	This patent	tuf
56	<i>Enterobacter hormaechei</i>	This patent	tuf
57	<i>Enterobacter sakazakii</i>	This patent	tuf
58	<i>Enterococcus casseliflavus</i>	This patent	tuf
59	<i>Enterococcus cecorum</i>	This patent	tuf
60	<i>Enterococcus dispar</i>	This patent	tuf
61	<i>Enterococcus durans</i>	This patent	tuf
62	<i>Enterococcus faecalis</i>	This patent	tuf
63	<i>Enterococcus faecalis</i>	This patent	tuf
64	<i>Enterococcus faecium</i>	This patent	tuf
65	<i>Enterococcus flavescent</i>	This patent	tuf
66	<i>Enterococcus gallinarum</i>	This patent	tuf
67	<i>Enterococcus hirae</i>	This patent	tuf
68	<i>Enterococcus mundtii</i>	This patent	tuf
69	<i>Enterococcus pseudoavium</i>	This patent	tuf
70	<i>Enterococcus raffinosus</i>	This patent	tuf
71	<i>Enterococcus saccharolyticus</i>	This patent	tuf
72	<i>Enterococcus solitarius</i>	This patent	tuf
73	<i>Enterococcus casseliflavus</i>	This patent	tuf (C)
74	<i>Staphylococcus saprophyticus</i>	This patent	unknown
75	<i>Enterococcus flavescent</i>	This patent	tuf (C)
76	<i>Enterococcus gallinarum</i>	This patent	tuf (C)
77	<i>Ehrlichia canis</i>	This patent	tuf

TABLE 7-continued

SEQ ID NO.	Archaeal, bacterial, fungal or parasitical species	Source	Gene*	
78	<i>Escherichia coli</i>	This patent	tuf	
79	<i>Escherichia fergusonii</i>	This patent	tuf	
80	<i>Escherichia hermannii</i>	This patent	tuf	
81	<i>Escherichia vulneris</i>	This patent	tuf	
82	<i>Eubacterium lenthum</i>	This patent	tuf	10
83	<i>Eubacterium nodatum</i>	This patent	tuf	
84	<i>Ewingella americana</i>	This patent	tuf	
85	<i>Francisella tularensis</i>	This patent	tuf	
86	<i>Fusobacterium nucleatum</i> subsp. <i>polymorphum</i>	This patent	tuf	
87	<i>Gemella haemolysans</i>	This patent	tuf	15
88	<i>Gemella morbillorum</i>	This patent	tuf	
89	<i>Haemophilus</i> <i>actinomycetemcomitans</i>	This patent	tuf	
90	<i>Haemophilus aphrophilus</i>	This patent	tuf	
91	<i>Haemophilus ducreyi</i>	This patent	tuf	
92	<i>Haemophilus haemolyticus</i>	This patent	tuf	20
93	<i>Haemophilus parahaemolyticus</i>	This patent	tuf	
94	<i>Haemophilus parainfluenzae</i>	This patent	tuf	
95	<i>Haemophilus paraphrophilus</i>	This patent	tuf	
96	<i>Haemophilus segnis</i>	This patent	tuf	
97	<i>Hafnia alvei</i>	This patent	tuf	
98	<i>Kingella kingae</i>	This patent	tuf	25
99	<i>Klebsiella ornithinolytica</i>	This patent	tuf	
100	<i>Klebsiella oxytoca</i>	This patent	tuf	
101	<i>Klebsiella planticola</i>	This patent	tuf	
102	<i>Klebsiella pneumoniae</i> subsp. <i>ozaenae</i>	This patent	tuf	
103	<i>Klebsiella pneumoniae</i> <i>pneumoniae</i>	This patent	tuf	30
104	<i>Klebsiella pneumoniae</i> subsp. <i>rhinoscleromatis</i>	This patent	tuf	
105	<i>Kluyvera ascorbata</i>	This patent	tuf	
106	<i>Kluyvera cryocrescens</i>	This patent	tuf	
107	<i>Kluyvera georgiana</i>	This patent	tuf	
108	<i>Lactobacillus casei</i> subsp. <i>casei</i>	This patent	tuf	35
109	<i>Lactococcus lactis</i> subsp. <i>lactis</i>	This patent	tuf	
110	<i>Leclercia adecarboxylata</i>	This patent	tuf	
111	<i>Legionella miedadei</i>	This patent	tuf	
112	<i>Legionella pneumophila</i> subsp. <i>pneumophila</i>	This patent	tuf	40
113	<i>Leinorella grimontii</i>	This patent	tuf	
114	<i>Leinomorella richardii</i>	This patent	tuf	
115	<i>Leptospira interrogans</i>	This patent	tuf	
116	<i>Megamonas hypermegale</i>	This patent	tuf	
117	<i>Mitsuokella multacidus</i>	This patent	tuf	45
118	<i>Mobiluncus curtisi</i> subsp. <i>holmesii</i>	This patent	tuf	
119	<i>Moellerella wisconsensis</i>	This patent	tuf	
120	<i>Moraxella catarrhalis</i>	This patent	tuf	
121	<i>Morganella morganii</i> subsp. <i>morganii</i>	This patent	tuf	
122	<i>Mycobacterium tuberculosis</i>	This patent	tuf	50
123	<i>Neisseria cinerea</i>	This patent	tuf	
124	<i>Neisseria elongata</i> subsp. <i>elongata</i>	This patent	tuf	
125	<i>Neisseria flavescens</i>	This patent	tuf	
126	<i>Neisseria gonorrhoeae</i>	This patent	tuf	
127	<i>Neisseria lactamica</i>	This patent	tuf	55
128	<i>Neisseria meningitidis</i>	This patent	tuf	
129	<i>Neisseria mucosa</i>	This patent	tuf	
130	<i>Neisseria sicca</i>	This patent	tuf	
131	<i>Neisseria subflava</i>	This patent	tuf	
132	<i>Neisseria weaveri</i>	This patent	tuf	
133	<i>Ochrobactrum anthropi</i>	This patent	tuf	60
134	<i>Pantoea agglomerans</i>	This patent	tuf	
135	<i>Pantoea dispersa</i>	This patent	tuf	
136	<i>Pasteurella multicida</i>	This patent	tuf	
137	<i>Peptostreptococcus anaerobius</i>	This patent	tuf	
138	<i>Peptostreptococcus asaccharolyticus</i>	This patent	tuf	65
139	<i>Peptostreptococcus prevotii</i>	This patent	tuf	

TABLE 7-continued

SEQ ID NO.	Archaeal, bacterial, fungal or parasitical species	Source	Gene*
140	<i>Porphyromonas asaccharolytica</i>	This patent	tuf
141	<i>Porphyromonas gingivalis</i>	This patent	tuf
142	<i>Pragia fontium</i>	This patent	tuf
143	<i>Prevotella melaninogenica</i>	This patent	tuf
144	<i>Prevotella oralis</i>	This patent	tuf
145	<i>Propionibacterium acnes</i>	This patent	tuf
146	<i>Proteus mirabilis</i>	This patent	tuf
147	<i>Proteus penneri</i>	This patent	tuf
148	<i>Proteus vulgaris</i>	This patent	tuf
149	<i>Providencia alcalifaciens</i>	This patent	tuf
150	<i>Providencia rettgeri</i>	This patent	tuf
151	<i>Providencia rustigianii</i>	This patent	tuf
152	<i>Providencia stuartii</i>	This patent	tuf
153	<i>Pseudomonas aeruginosa</i>	This patent	tuf
154	<i>Pseudomonas fluorescens</i>	This patent	tuf
155	<i>Pseudomonas stutzeri</i>	This patent	tuf
156	<i>Psychrobacter phenylpyruvicum</i>	This patent	tuf
157	<i>Rahnella aquatilis</i>	This patent	tuf
158	<i>Salmonella choleraesuis</i> subsp. <i>arizonae</i>	This patent	tuf
159	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype Choleraesuis	This patent	tuf
160	<i>Salmonella choleraesuis</i> subsp. <i>diarizoneae</i>	This patent	tuf
161	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype Heidelberg	This patent	tuf
162	<i>Salmonella choleraesuis</i> subsp. <i>houtouae</i>	This patent	tuf
163	<i>Salmonella choleraesuis</i> subsp. <i>indica</i>	This patent	tuf
164	<i>Salmonella choleraesuis</i> subsp. <i>salamae</i>	This patent	tuf
165	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype Typhi	This patent	tuf
166	<i>Serratia fonticola</i>	This patent	tuf
167	<i>Serratia liquefaciens</i>	This patent	tuf
168	<i>Serratia marcescens</i>	This patent	tuf
169	<i>Serratia odorifera</i>	This patent	tuf
170	<i>Serratia plymuthica</i>	This patent	tuf
171	<i>Serratia rubidaea</i>	This patent	tuf
172	<i>Shigella boydii</i>	This patent	tuf
173	<i>Shigella dysenteriae</i>	This patent	tuf
174	<i>Shigella flexneri</i>	This patent	tuf
175	<i>Shigella sonnei</i>	This patent	tuf
176	<i>Staphylococcus aureus</i>	This patent	tuf
177	<i>Staphylococcus aureus</i>	This patent	tuf
178	<i>Staphylococcus aureus</i>	This patent	tuf
179	<i>Staphylococcus aureus</i>	This patent	tuf
180	<i>Staphylococcus aureus</i> subsp. <i>aureus</i>	This patent	tuf
181	<i>Staphylococcus auricularis</i>	This patent	tuf
182	<i>Staphylococcus capitis</i> subsp. <i>capitis</i>	This patent	tuf
183	<i>Macrococcus caseolyticus</i>	This patent	tuf
184	<i>Staphylococcus cohnii</i> subsp. <i>cohnii</i>	This patent	tuf
185	<i>Staphylococcus epidermidis</i>	This patent	tuf
186	<i>Staphylococcus haemolyticus</i>	This patent	tuf
187	<i>Staphylococcus warneri</i>	This patent	tuf
188	<i>Staphylococcus haemolyticus</i>	This patent	tuf
189	<i>Staphylococcus haemolyticus</i>	This patent	tuf
190	<i>Staphylococcus haemolyticus</i>	This patent	tuf
191	<i>Staphylococcus hominis</i> subsp. <i>hominis</i>	This patent	tuf
192	<i>Staphylococcus warneri</i>	This patent	tuf
193	<i>Staphylococcus hominis</i>	This patent	tuf
194	<i>Staphylococcus hominis</i>	This patent	tuf
195	<i>Staphylococcus hominis</i>	This patent	tuf
196	<i>Staphylococcus hominis</i>	This patent	tuf
197	<i>Staphylococcus lugdunensis</i>	This patent	tuf

TABLE 7-continued

SEQ ID NO.	Archaeal, bacterial, fungal or parasitical species	Source	Gene*	
198	<i>Staphylococcus saprophyticus</i>	This patent	tuf	
199	<i>Staphylococcus saprophyticus</i>	This patent	tuf	
200	<i>Staphylococcus saprophyticus</i>	This patent	tuf	
201	<i>Staphylococcus sciuri</i> subsp. <i>sciuri</i>	This patent	tuf	10
202	<i>Staphylococcus warneri</i>	This patent	tuf	
203	<i>Staphylococcus warneri</i>	This patent	tuf	
204	<i>Bifidobacterium longum</i>	This patent	tuf	
205	<i>Stenotrophomonas maltophilia</i>	This patent	tuf	
206	<i>Streptococcus acidominimus</i>	This patent	tuf	
207	<i>Streptococcus agalactiae</i>	This patent	tuf	15
208	<i>Streptococcus agalactiae</i>	This patent	tuf	
209	<i>Streptococcus agalactiae</i>	This patent	tuf	
210	<i>Streptococcus agalactiae</i>	This patent	tuf	
211	<i>Streptococcus anginosus</i>	This patent	tuf	
212	<i>Streptococcus bovis</i>	This patent	tuf	
213	<i>Streptococcus anginosus</i>	This patent	tuf	20
214	<i>Streptococcus cricetus</i>	This patent	tuf	
215	<i>Streptococcus cristatus</i>	This patent	tuf	
216	<i>Streptococcus downei</i>	This patent	tuf	
217	<i>Streptococcus dysgalactiae</i>	This patent	tuf	
218	<i>Streptococcus equi</i> subsp. <i>equi</i>	This patent	tuf	
219	<i>Streptococcus ferus</i>	This patent	tuf	25
220	<i>Streptococcus gordonii</i>	This patent	tuf	
221	<i>Streptococcus anginosus</i>	This patent	tuf	
222	<i>Streptococcus macacae</i>	This patent	tuf	
223	<i>Streptococcus gordonii</i>	This patent	tuf	
224	<i>Streptococcus mutans</i>	This patent	tuf	
225	<i>Streptococcus parasanguinis</i>	This patent	tuf	30
226	<i>Streptococcus ratti</i>	This patent	tuf	
227	<i>Streptococcus sanguinis</i>	This patent	tuf	
228	<i>Streptococcus sobrinus</i>	This patent	tuf	
229	<i>Streptococcus suis</i>	This patent	tuf	
230	<i>Streptococcus uberis</i>	This patent	tuf	
231	<i>Streptococcus vestibularis</i>	This patent	tuf	35
232	<i>Tatumella pityeos</i>	This patent	tuf	
233	<i>Trabulsiella guamensis</i>	This patent	tuf	
234	<i>Veillonella parvula</i>	This patent	tuf	
235	<i>Yersinia enterocolitica</i>	This patent	tuf	
236	<i>Yersinia frederiksenii</i>	This patent	tuf	40
237	<i>Yersinia intermedia</i>	This patent	tuf	
238	<i>Yersinia pestis</i>	This patent	tuf	
239	<i>Yersinia pseudotuberculosis</i>	This patent	tuf	
240	<i>Yersinia rohdei</i>	This patent	tuf	
241	<i>Yokenella regensburgei</i>	This patent	tuf	
242	<i>Achromobacter xylosoxidans</i> subsp. <i>denitrificans</i>	This patent	atpD	
243	<i>Acinetobacter baumannii</i>	This patent	atpD	45
244	<i>Acinetobacter lwoffii</i>	This patent	atpD	
245	<i>Staphylococcus saprophyticus</i>	This patent	atpD	
246	<i>Alcaligenes faecalis</i> subsp. <i>faecalis</i>	This patent	atpD	
247	<i>Bacillus anthracis</i>	This patent	atpD	
248	<i>Bacillus cereus</i>	This patent	atpD	50
249	<i>Bacteroides distasonis</i>	This patent	atpD	
250	<i>Bacteroides ovatus</i>	This patent	atpD	
251	<i>Leclercia adecarboxylata</i>	This patent	atpD	
252	<i>Stenotrophomonas maltophilia</i>	This patent	atpD	
253	<i>Bartonella henselae</i>	This patent	atpD	
254	<i>Bifidobacterium adolescentis</i>	This patent	atpD	55
255	<i>Brucella abortus</i>	This patent	atpD	
256	<i>Cedecea davisae</i>	This patent	atpD	
257	<i>Cedecea lapagei</i>	This patent	atpD	
258	<i>Cedecea neteri</i>	This patent	atpD	
259	<i>Chryseobacterium meningosepticum</i>	This patent	atpD	60
260	<i>Citrobacter amalonaticus</i>	This patent	atpD	
261	<i>Citrobacter braakii</i>	This patent	atpD	
262	<i>Citrobacter koseri</i>	This patent	atpD	
263	<i>Citrobacter farmeri</i>	This patent	atpD	
264	<i>Citrobacter freundii</i>	This patent	atpD	
265	<i>Citrobacter koseri</i>	This patent	atpD	
266	<i>Citrobacter sedlakii</i>	This patent	atpD	65
267	<i>Citrobacter werkmanii</i>	This patent	atpD	
268	<i>Citrobacter youngae</i>	This patent	atpD	

TABLE 7-continued

SEQ ID NO.	Archaeal, bacterial, fungal or parasitical species	Source	Gene*
269	<i>Clostridium innocuum</i>	This patent	atpD
270	<i>Clostridium perfringens</i>	This patent	atpD
272	<i>Corynebacterium diphtheriae</i>	This patent	atpD
273	<i>Corynebacterium pseudodiphtheriticum</i>	This patent	atpD
274	<i>Corynebacterium ulcerans</i>	This patent	atpD
275	<i>Corynebacterium urealyticum</i>	This patent	atpD
276	<i>Coxiella burnetii</i>	This patent	atpD
277	<i>Edwardsiella hoshiniae</i>	This patent	atpD
278	<i>Edwardsiella tarda</i>	This patent	atpD
279	<i>Eikenella corrodens</i>	This patent	atpD
280	<i>Enterobacter agglomerans</i>	This patent	atpD
281	<i>Enterobacter amnigenus</i>	This patent	atpD
282	<i>Enterobacter asburiae</i>	This patent	atpD
283	<i>Enterobacter cloacae</i>	This patent	atpD
284	<i>Enterobacter cloacae</i>	This patent	atpD
285	<i>Enterobacter gergoviae</i>	This patent	atpD
286	<i>Enterobacter hormaechei</i>	This patent	atpD
287	<i>Enterobacter sakazakii</i>	This patent	atpD
288	<i>Enterococcus avium</i>	This patent	atpD
289	<i>Enterococcus casseliflavus</i>	This patent	atpD
290	<i>Enterococcus durans</i>	This patent	atpD
291	<i>Enterococcus faecalis</i>	This patent	atpD
292	<i>Enterococcus faecium</i>	This patent	atpD
293	<i>Enterococcus gallinarum</i>	This patent	atpD
294	<i>Enterococcus saccharolyticus</i>	This patent	atpD
295	<i>Escherichia fergusonii</i>	This patent	atpD
296	<i>Escherichia hermannii</i>	This patent	atpD
297	<i>Escherichia vulneris</i>	This patent	atpD
298	<i>Eubacterium lenthum</i>	This patent	atpD
299	<i>Ewingella americana</i>	This patent	atpD
300	<i>Francisella tularensis</i>	This patent	atpD
301	<i>Fusobacterium gonadiformans</i>	This patent	atpD
302	<i>Fusobacterium necrophorum</i> subsp. <i>necrophorum</i>	This patent	atpD
303	<i>Fusobacterium nucleatum</i> subsp. <i>polymorphum</i>	This patent	atpD
304	<i>Gardnerella vaginalis</i>	This patent	atpD
305	<i>Gemella haemolysans</i>	This patent	atpD
306	<i>Gemella morbillorum</i>	This patent	atpD
307	<i>Haemophilus ducreyi</i>	This patent	atpD
308	<i>Haemophilus haemolyticus</i>	This patent	atpD
309	<i>Haemophilus parahaemolyticus</i>	This patent	atpD
310	<i>Haemophilus parainfluenzae</i>	This patent	atpD
311	<i>Hafnia alvei</i>	This patent	atpD
312	<i>Kingella kingae</i>	This patent	atpD
313	<i>Klebsiella pneumoniae</i> subsp. <i>ozaenae</i>	This patent	atpD
314	<i>Klebsiella ornithinolytica</i>	This patent	atpD
315	<i>Klebsiella oxytoca</i>	This patent	atpD
316	<i>Klebsiella planticola</i>	This patent	atpD
317	<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	This patent	atpD
318	<i>Kluyvera ascorbata</i>	This patent	atpD
319	<i>Kluyvera cryocrescens</i>	This patent	atpD
320	<i>Kluyvera georgiana</i>	This patent	atpD
321	<i>Lactobacillus acidophilus</i>	This patent	atpD
322	<i>Legionella pneumophila</i> subsp. <i>pneumophila</i>	This patent	atpD
323	<i>Lemirella grimontii</i>	This patent	atpD
324	<i>Listeria monocytogenes</i>	This patent	atpD
325	<i>Micrococcus lylae</i>	This patent	atpD
326	<i>Moellerella wisconsensis</i>	This patent	atpD
327	<i>Moraxella catarrhalis</i>	This patent	atpD
328	<i>Moraxella osloensis</i>	This patent	atpD
329	<i>Morganella morganii</i> subsp. <i>morganii</i>	This patent	atpD
330	<i>Pantoea agglomerans</i>	This patent	atpD
331	<i>Pantoea dispersa</i>	This patent	atpD
332	<i>Pasteurella multocida</i>	This patent	atpD
333	<i>Pragia fontium</i>	This patent	atpD
334	<i>Proteus mirabilis</i>	This patent	atpD
335	<i>Proteus vulgaris</i>	This patent	atpD
336	<i>Providencia alcalifaciens</i>	This patent	atpD
337	<i>Providencia rettgeri</i>	This patent	atpD

TABLE 7-continued

SEQ ID NO.	Archaeal, bacterial, fungal or parasitical species	Source	Gene*	5
338	<i>Providencia rustigianii</i>	This patent	atpD	10
339	<i>Providencia stuartii</i>	This patent	atpD	
340	<i>Psychrobacter phenylpyruvicum</i>	This patent	atpD	
341	<i>Rahnella aquatilis</i>	This patent	atpD	
342	<i>Salmonella choleraesuis</i> subsp. <i>arizonae</i>	This patent	atpD	
343	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype <i>Choleraesuis</i>	This patent	atpD	
344	<i>Salmonella choleraesuis</i> subsp. <i>diarizoneae</i>	This patent	atpD	
345	<i>Salmonella choleraesuis</i> subsp. <i>houtenae</i>	This patent	atpD	
346	<i>Salmonella choleraesuis</i> subsp. <i>indica</i>	This patent	atpD	
347	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype <i>Paratyphi A</i>	This patent	atpD	20
348	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype <i>Paratyphi B</i>	This patent	atpD	
349	<i>Salmonella choleraesuis</i> subsp. <i>salamae</i>	This patent	atpD	
350	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype <i>Typhi</i>	This patent	atpD	
351	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype <i>Typhimurium</i>	This patent	atpD	
352	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype <i>Virchow</i>	This patent	atpD	
353	<i>Serratia ficaria</i>	This patent	atpD	
354	<i>Serratia fonticola</i>	This patent	atpD	
355	<i>Serratia grimesii</i>	This patent	atpD	
356	<i>Serratia liquefaciens</i>	This patent	atpD	
357	<i>Serratia marcescens</i>	This patent	atpD	
358	<i>Serratia odorifera</i>	This patent	atpD	
359	<i>Serratia plymuthica</i>	This patent	atpD	
360	<i>Serratia rubidaea</i>	This patent	atpD	
361	<i>Pseudomonas putida</i>	This patent	atpD	40
362	<i>Shigella boydii</i>	This patent	atpD	
363	<i>Shigella dysenteriae</i>	This patent	atpD	
364	<i>Shigella flexneri</i>	This patent	atpD	
365	<i>Shigella sonnei</i>	This patent	atpD	
366	<i>Staphylococcus aureus</i>	This patent	atpD	
367	<i>Staphylococcus auricularis</i>	This patent	atpD	
368	<i>Staphylococcus capitis</i> subsp. <i>capitis</i>	This patent	atpD	
369	<i>Staphylococcus cohnii</i> subsp. <i>cohnii</i>	This patent	atpD	
370	<i>Staphylococcus epidermidis</i>	This patent	atpD	
371	<i>Staphylococcus haemolyticus</i>	This patent	atpD	
372	<i>Staphylococcus hominis</i> subsp. <i>hominis</i>	This patent	atpD	
373	<i>Staphylococcus hominis</i>	This patent	atpD	55
374	<i>Staphylococcus lugdunensis</i>	This patent	atpD	
375	<i>Staphylococcus saprophyticus</i>	This patent	atpD	
376	<i>Staphylococcus simulans</i>	This patent	atpD	
377	<i>Staphylococcus warneri</i>	This patent	atpD	
378	<i>Streptococcus acidominimus</i>	This patent	atpD	
379	<i>Streptococcus agalactiae</i>	This patent	atpD	
380	<i>Streptococcus agalactiae</i>	This patent	atpD	
381	<i>Streptococcus agalactiae</i>	This patent	atpD	
382	<i>Streptococcus agalactiae</i>	This patent	atpD	
383	<i>Streptococcus agalactiae</i>	This patent	atpD	60
384	<i>Streptococcus dysgalactiae</i>	This patent	atpD	
385	<i>Streptococcus equi</i> subsp. <i>equi</i>	This patent	atpD	
386	<i>Streptococcus anginosus</i>	This patent	atpD	
387	<i>Streptococcus salivarius</i>	This patent	atpD	
388	<i>Streptococcus suis</i>	This patent	atpD	
389	<i>Streptococcus uberis</i>	This patent	atpD	
390	<i>Tatumella ptyseos</i>	This patent	atpD	

TABLE 7-continued

SEQ ID NO.	Archaeal, bacterial, fungal or parasitical species	Source	Gene*
391	<i>Trabulsiella guamensis</i>	This patent	atpD
392	<i>Yersinia bercoieri</i>	This patent	atpD
393	<i>Yersinia enterocolitica</i>	This patent	atpD
394	<i>Yersinia frederiksenii</i>	This patent	atpD
395	<i>Yersinia intermedia</i>	This patent	atpD
396	<i>Yersinia pseudotuberculosis</i>	This patent	atpD
397	<i>Yersinia rohdei</i>	This patent	atpD
398	<i>Yokenella regensburgei</i>	This patent	atpD
399	<i>Yarrowia lipolytica</i>	This patent	tuf (EF-1)
400	<i>Absidia corymbifera</i>	This patent	tuf (EF-1)
401	<i>Alternaria alternata</i>	This patent	tuf (EF-1)
402	<i>Aspergillus flavus</i>	This patent	tuf (EF-1)
403	<i>Aspergillus fumigatus</i>	This patent	tuf (EF-1)
404	<i>Aspergillus fumigatus</i>	This patent	tuf (EF-1)
405	<i>Aspergillus niger</i>	This patent	tuf (EF-1)
406	<i>Blastoschizomyces capitatus</i>	This patent	tuf (EF-1)
407	<i>Candida albicans</i>	This patent	tuf (EF-1)
408	<i>Candida albicans</i>	This patent	tuf (EF-1)
409	<i>Candida albicans</i>	This patent	tuf (EF-1)
410	<i>Candida albicans</i>	This patent	tuf (EF-1)
411	<i>Candida albicans</i>	This patent	tuf (EF-1)
412	<i>Candida dubliniensis</i>	This patent	tuf (EF-1)
413	<i>Candida catenulata</i>	This patent	tuf (EF-1)
414	<i>Candida dubliniensis</i>	This patent	tuf (EF-1)
415	<i>Candida dubliniensis</i>	This patent	tuf (EF-1)
416	<i>Candida famata</i>	This patent	tuf (EF-1)
417	<i>Candida glabrata</i>	WO98/20157	tuf (EF-1)
418	<i>Candida guilliermondii</i>	This patent	tuf (EF-1)
419	<i>Candida haemulonii</i>	This patent	tuf (EF-1)
420	<i>Candida inconspecta</i>	This patent	tuf (EF-1)
421	<i>Candida kefyr</i>	This patent	tuf (EF-1)
422	<i>Candida krusei</i>	WO98/20157	tuf (EF-1)
423	<i>Candida lambica</i>	This patent	tuf (EF-1)
424	<i>Candida lusitaniae</i>	This patent	tuf (EF-1)
425	<i>Candida norvegensis</i>	This patent	tuf (EF-1)
426	<i>Candida parapsilosis</i>	WO98/20157	tuf (EF-1)
427	<i>Candida rugosa</i>	This patent	tuf (EF-1)
428	<i>Candida sphaerica</i>	This patent	tuf (EF-1)
429	<i>Candida tropicalis</i>	WO98/20157	tuf (EF-1)
430	<i>Candida utilis</i>	This patent	tuf (EF-1)
431	<i>Candida viswanathii</i>	This patent	tuf (EF-1)
432	<i>Candida zeylanoides</i>	This patent	tuf (EF-1)
433	<i>Coccidioides immitis</i>	This patent	tuf (EF-1)
434	<i>Cryptococcus albidus</i>	This patent	tuf (EF-1)
435	<i>Exophiala jeanselmei</i>	This patent	tuf (EF-1)
436	<i>Fusarium oxysporum</i>	This patent	tuf (EF-1)
437	<i>Geotrichum sp.</i>	This patent	tuf (EF-1)
438	<i>Histoplasma capsulatum</i>	This patent	tuf (EF-1)
439	<i>Issatchenkia orientalis</i>	This patent	tuf (EF-1)
440	<i>Malassezia furfur</i>	This patent	tuf (EF-1)
441	<i>Malassezia pachydermatis</i>	This patent	tuf (EF-1)
442	<i>Malbranchea filamentosa</i>	This patent	tuf (EF-1)
443	<i>Metschnikowia pulcherrima</i>	This patent	tuf (EF-1)
444	<i>Paecilomyces lilacinus</i>	This patent	tuf (EF-1)
445	<i>Paracoccidioides brasiliensis</i>	This patent	tuf (EF-1)
446	<i>Penicillium marneffei</i>	This patent	tuf (EF-1)
447	<i>Pichia anomala</i>	This patent	tuf (EF-1)
448	<i>Pichia anomala</i>	This patent	tuf (EF-1)
449	<i>Pseudallescheria boydii</i>	This patent	tuf (EF-1)
450	<i>Rhizophorus oryzae</i>	This patent	tuf (EF-1)
451	<i>Rhodotorula minuta</i>	This patent	tuf (EF-1)
452	<i>Sporobolomyces salmonicolor</i>	This patent	tuf (EF-1)
453	<i>Sporothrix schenckii</i>	This patent	tuf (EF-1)
454	<i>Stephanoascus ciferrii</i>	This patent	tuf (EF-1)
455	<i>Trichophyton mentagrophytes</i>	This patent	tuf (EF-1)
456	<i>Trichosporon cutaneum</i>	This patent	tuf (EF-1)
457	<i>Wangiella dermatitidis</i>	This patent	tuf (EF-1)
458	<i>Aspergillus fumigatus</i>	This patent	atpD
459	<i>Blastoschizomyces capitatus</i>	This patent	atpD
460	<i>Candida albicans</i>	This patent	atpD
461	<i>Candida dubliniensis</i>	This patent	atpD
462	<i>Candida famata</i>	This patent	atpD
463	<i>Candida glabrata</i>	This patent	atpD
464	<i>Candida guilliermondii</i>	This patent	atpD

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing.	Source	Gene*	
465	<i>Candida haemulonii</i>	This patent	atpD	
466	<i>Candida inconspicua</i>	This patent	atpD	
467	<i>Candida kefyr</i>	This patent	atpD	
468	<i>Candida krusei</i>	This patent	atpD	
469	<i>Candida lambica</i>	This patent	atpD	10
470	<i>Candida lusitaniae</i>	This patent	atpD	
471	<i>Candida norvegensis</i>	This patent	atpD	
472	<i>Candida parapsilosis</i>	This patent	atpD	
473	<i>Candida rugosa</i>	This patent	atpD	
474	<i>Candida sphaerica</i>	This patent	atpD	
475	<i>Candida tropicalis</i>	This patent	atpD	15
476	<i>Candida utilis</i>	This patent	atpD	
477	<i>Candida viswanathii</i>	This patent	atpD	
478	<i>Candida zeylanoides</i>	This patent	atpD	
479	<i>Coccidioides immitis</i>	This patent	atpD	
480	<i>Cryptococcus albidus</i>	This patent	atpD	
481	<i>Fusarium oxysporum</i>	This patent	atpD	20
482	<i>Geotrichum</i> sp.	This patent	atpD	
483	<i>Histoplasma capsulatum</i>	This patent	atpD	
484	<i>Malassezia furfur</i>	This patent	atpD	
485	<i>Malassezia pachydermatis</i>	This patent	atpD	
486	<i>Metschnikowia pulcherrima</i>	This patent	atpD	
487	<i>Penicillium marneffei</i>	This patent	atpD	25
488	<i>Pichia anomala</i>	This patent	atpD	
489	<i>Pichia anomala</i>	This patent	atpD	
490	<i>Rhodotorula minuta</i>	This patent	atpD	
491	<i>Rhodotorula mucilaginosa</i>	This patent	atpD	
492	<i>Sporobolomyces salmonicolor</i>	This patent	atpD	
493	<i>Sporothrix schenckii</i>	This patent	atpD	
494	<i>Stephanoascus ciferrii</i>	This patent	atpD	30
495	<i>Trichophyton mentagrophytes</i>	This patent	atpD	
496	<i>Wangiella dermatitidis</i>	This patent	atpD	
497	<i>Yarrowia lipolytica</i>	This patent	atpD	
498	<i>Aspergillus fumigatus</i>	This patent	tuf (M)	
499	<i>Blastoschizomyces capitatus</i>	This patent	tuf (M)	
500	<i>Candida rugosa</i>	This patent	tuf (M)	35
501	<i>Coccidioides immitis</i>	This patent	tuf (M)	
502	<i>Fusarium oxysporum</i>	This patent	tuf (M)	
503	<i>Histoplasma capsulatum</i>	This patent	tuf (M)	
504	<i>Paracoccidioides brasiliensis</i>	This patent	tuf (M)	
505	<i>Penicillium marneffei</i>	This patent	tuf (M)	
506	<i>Pichia anomala</i>	This patent	tuf (M)	40
507	<i>Trichophyton mentagrophytes</i>	This patent	tuf (M)	
508	<i>Yarrowia lipolytica</i>	This patent	tuf (M)	
509	<i>Babesia bigemina</i>	This patent	tuf (EF-1)	
510	<i>Babesia bovis</i>	This patent	tuf (EF-1)	
511	<i>Crithidia fasciculata</i>	This patent	tuf (EF-1)	
512	<i>Entamoeba histolytica</i>	This patent	tuf (EF-1)	45
513	<i>Giardia lamblia</i>	This patent	tuf (EF-1)	
514	<i>Leishmania tropica</i>	This patent	tuf (EF-1)	
515	<i>Leishmania aethiopica</i>	This patent	tuf (EF-1)	
516	<i>Leishmania tropica</i>	This patent	tuf (EF-1)	
517	<i>Leishmania donovani</i>	This patent	tuf (EF-1)	
518	<i>Leishmania infantum</i>	This patent	tuf (EF-1)	
519	<i>Leishmania enriettii</i>	This patent	tuf (EF-1)	50
520	<i>Leishmania gerbilli</i>	This patent	tuf (EF-1)	
521	<i>Leishmania hertigi</i>	This patent	tuf (EF-1)	
522	<i>Leishmania major</i>	This patent	tuf (EF-1)	
523	<i>Leishmania amazonensis</i>	This patent	tuf (EF-1)	
524	<i>Leishmania mexicana</i>	This patent	tuf (EF-1)	
525	<i>Leishmania tarentolae</i>	This patent	tuf (EF-1)	55
526	<i>Leishmania tropica</i>	This patent	tuf (EF-1)	
527	<i>Neospora caninum</i>	This patent	tuf (EF-1)	
528	<i>Trichomonas vaginalis</i>	This patent	tuf (EF-1)	
529	<i>Trypanosoma brucei</i>	This patent	tuf (EF-1)	
	subsp. <i>brucei</i>			
530	<i>Critidida fasciculata</i>	This patent	atpD	60
531	<i>Leishmania tropica</i>	This patent	atpD	
532	<i>Leishmania aethiopica</i>	This patent	atpD	
533	<i>Leishmania donovani</i>	This patent	atpD	
534	<i>Leishmania infantum</i>	This patent	atpD	
535	<i>Leishmania gerbilli</i>	This patent	atpD	
536	<i>Leishmania hertigi</i>	This patent	atpD	
537	<i>Leishmania major</i>	This patent	atpD	65
538	<i>Leishmania amazonensis</i>	This patent	atpD	

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing.	Source	Gene*	
607	<i>Enterococcus faecalis</i>	WO98/20157	tuf	
608	<i>Enterococcus faecium</i>	WO98/20157	tuf	
609	<i>Enterococcus gallinarum</i>	WO98/20157	tuf	
610	<i>Haemophilus influenzae</i>	WO98/20157	tuf	
611	<i>Staphylococcus epidermidis</i>	WO98/20157	tuf	
612	<i>Salmonella choleraesuis</i>	This patent	tuf	
	subsp. <i>choleraesuis</i>			
	serotype Paratyphi A			
613	<i>Serratia ficaria</i>	This patent	tuf	
614	<i>Enterococcus malodoratus</i>	This patent	tuf (C)	
615	<i>Enterococcus durans</i>	This patent	tuf (C)	
616	<i>Enterococcus pseudoavium</i>	This patent	tuf (C)	
617	<i>Enterococcus dispar</i>	This patent	tuf (C)	
618	<i>Enterococcus avium</i>	This patent	tuf (C)	
619	<i>Saccharomyces cerevisiae</i>	Database	tuf (M)	
621	<i>Enterococcus faecium</i>	This patent	tuf (C)	
622	<i>Saccharomyces cerevisiae</i>	This patent	tuf (EF-1)	
623	<i>Cryptococcus neoformans</i>	This patent	tuf (EF-1)	
624	<i>Candida albicans</i>	WO98/20157	tuf (EF-1)	
625	<i>Corynebacterium diphtheriae</i>	WO98/20157	tuf	
626	<i>Candida catenulata</i>	This patent	atpD	
627	<i>Saccharomyces cerevisiae</i>	Database	tuf (EF-1)	
628	<i>Trypanosoma cruzi</i>	This patent	atpD	
629	<i>Corynebacterium glutamicum</i>	Database	tuf	
630	<i>Escherichia coli</i>	Database	atpD	
631	<i>Helicobacter pylori</i>	Database	atpD	
632	<i>Clostridium acetobutylicum</i>	Database	atpD	
633	<i>Cytophaga lytica</i>	Database	atpD	
634	<i>Ehrlichia risticii</i>	This patent	atpD	
635	<i>Vibrio cholerae</i>	This patent	atpD	
636	<i>Vibrio cholerae</i>	This patent	tuf	
637	<i>Leishmania enrietti</i>	This patent	atpD	
638	<i>Babesia microti</i>	This patent	tuf (EF-1)	
639	<i>Cryptococcus neoformans</i>	This patent	atpD	
640	<i>Cryptococcus neoformans</i>	This patent	atpD	
641	<i>Cunninghamella bertholletiae</i>	This patent	atpD	
642	<i>Candida tropicalis</i>	Database	atpD (V)	
643	<i>Enterococcus hirae</i>	Database	atpD (V)	
644	<i>Chlamydia pneumoniae</i>	Database	atpD (V)	
645	<i>Halobacterium salinarum</i>	Database	atpD (V)	
646	<i>Homo sapiens</i>	Database	atpD (V)	
647	<i>Plasmodium falciparum</i>	Database	atpD (V)	
648	<i>Saccharomyces cerevisiae</i>	Database	atpD (V)	
649	<i>Trypanosoma congolense</i>	Database	atpD (V)	
650	<i>Thermus thermophilus</i>	Database	atpD (V)	
651	<i>Escherichia coli</i>	WO98/20157	tuf	
652	<i>Borrelia burgdorferi</i>	Database	atpD (V)	
653	<i>Treponema pallidum</i>	Database	atpD (V)	
654	<i>Chlamydia trachomatis</i>	Genome project	atpD (V)	
655	<i>Enterococcus faecalis</i>	Genome project	atpD (V)	
656	<i>Methanosciricia barkeri</i>	Database	atpD (V)	
657	<i>Methanococcus jannaschii</i>	Database	atpD (V)	
658	<i>Porphyromonas gingivalis</i>	Genome project	atpD (V)	
659	<i>Streptococcus pneumoniae</i>	Genome project	atpD (V)	
660	<i>Burkholderia mallei</i>	This patent	tuf	
661	<i>Burkholderia pseudomallei</i>	This patent	tuf	
662	<i>Clostridium beijerinckii</i>	This patent	tuf	
663	<i>Clostridium innocuum</i>	This patent	tuf	
664	<i>Clostridium novyi</i>	This patent	tuf	
665	<i>Clostridium septicum</i>	This patent	tuf	
666	<i>Clostridium tertium</i>	This patent	tuf	
667	<i>Clostridium tetani</i>	This patent	tuf	
668	<i>Enterococcus malodoratus</i>	This patent	tuf	
669	<i>Enterococcus sulfureus</i>	This patent	tuf	
670	<i>Lactococcus garvieae</i>	This patent	tuf	
671	<i>Mycoplasma pirum</i>	This patent	tuf	
672	<i>Mycoplasma salivarium</i>	This patent	tuf	
673	<i>Neisseria polysacccharea</i>	This patent	tuf	
674	<i>Salmonella choleraesuis</i>	This patent	tuf	
675	subsp. <i>choleraesuis</i>			
676	serotype Enteritidis			

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing. Archaeal, bacterial, fungal or parasitical species	Source	Gene*	
732	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype Gallinarum	This patent	tuf	
733	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype Paratyphi B	This patent	tuf	10
734	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype Virchow	This patent	tuf	
735	<i>Serratia grimesii</i>	This patent	tuf	
736	<i>Clostridium difficile</i>	This patent	tuf	15
737	<i>Burkholderia pseudomallei</i>	This patent	atpD	
738	<i>Clostridium bifertamentans</i>	This patent	atpD	
739	<i>Clostridium beijerinckii</i>	This patent	atpD	
740	<i>Clostridium difficile</i>	This patent	atpD	
741	<i>Clostridium ramosum</i>	This patent	atpD	
742	<i>Clostridium septicum</i>	This patent	atpD	20
743	<i>Clostridium tertium</i>	This patent	atpD	
744	<i>Comamonas acidovorans</i>	This patent	atpD	
745	<i>Klebsiella pneumoniae</i> subsp. <i>rhinoscleromatis</i>	This patent	atpD	
746	<i>Neisseria canis</i>	This patent	atpD	
747	<i>Neisseria cinerea</i>	This patent	atpD	25
748	<i>Neisseria cuniculi</i>	This patent	atpD	
749	<i>Neisseria elongata</i> subsp. <i>elongata</i>	This patent	atpD	
750	<i>Neisseria flavescens</i>	This patent	atpD	
751	<i>Neisseria gonorrhoeae</i>	This patent	atpD	
752	<i>Neisseria gonorrhoeae</i>	This patent	atpD	
753	<i>Neisseria lactamica</i>	This patent	atpD	30
754	<i>Neisseria meningitidis</i>	This patent	atpD	
755	<i>Neisseria mucosa</i>	This patent	atpD	
756	<i>Neisseria subflava</i>	This patent	atpD	
757	<i>Neisseria weaveri</i>	This patent	atpD	
758	<i>Neisseria animalis</i>	This patent	atpD	
759	<i>Proteus penneri</i>	This patent	atpD	35
760	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype Enteritidis	This patent	atpD	
761	<i>Yersinia pestis</i>	This patent	atpD	
762	<i>Burkholderia mallei</i>	This patent	atpD	
763	<i>Clostridium sordellii</i>	This patent	atpD	40
764	<i>Clostridium novyi</i>	This patent	atpD	
765	<i>Clostridium botulinum</i>	This patent	atpD	
766	<i>Clostridium histolyticum</i>	This patent	atpD	
767	<i>Peptostreptococcus prevotii</i>	This patent	atpD	
768	<i>Absidia corymbifera</i>	This patent	atpD	45
769	<i>Alternaria alternata</i>	This patent	atpD	
770	<i>Aspergillus flavus</i>	This patent	atpD	
771	<i>Mucor circinelloides</i>	This patent	atpD	
772	<i>Piedraia hortai</i>	This patent	atpD	
773	<i>Pseudallescheria boydii</i>	This patent	atpD	
774	<i>Rhizopus oryzae</i>	This patent	atpD	50
775	<i>Scopulariopsis kongnigii</i>	This patent	atpD	
776	<i>Trichophyton mentagrophytes</i>	This patent	atpD	
777	<i>Trichophyton tonsurans</i>	This patent	atpD	
778	<i>Trichosporon cutaneum</i>	This patent	atpD	
779	<i>Cladophialophora carrionii</i>	This patent	tuf (EF-1)	
780	<i>Cunninghamella bertholletiae</i>	This patent	tuf (EF-1)	
781	<i>Curvularia lunata</i>	This patent	tuf (EF-1)	
782	<i>Fonsecaea pedrosoi</i>	This patent	tuf (EF-1)	55
783	<i>Microsporum audouinii</i>	This patent	tuf (EF-1)	
784	<i>Mucor circinelloides</i>	This patent	tuf (EF-1)	
785	<i>Phialophora verrucosa</i>	This patent	tuf (EF-1)	
786	<i>Saksenaea vasiformis</i>	This patent	tuf (EF-1)	
787	<i>Syncephalastrum racemosum</i>	This patent	tuf (EF-1)	
788	<i>Trichophyton tonsurans</i>	This patent	tuf (EF-1)	60
789	<i>Trichophyton mentagrophytes</i>	This patent	tuf (EF-1)	
790	<i>Bipolaris hawaiiensis</i>	This patent	tuf (EF-1)	
791	<i>Aspergillus fumigatus</i>	This patent	tuf (M)	
792	<i>Trichophyton mentagrophytes</i>	This patent	tuf (M)	
827	<i>Clostridium novyi</i>	This patent	atpD (V)	
828	<i>Clostridium difficile</i>	This patent	atpD (V)	65
829	<i>Clostridium septicum</i>	This patent	atpD (V)	
830	<i>Clostridium botulinum</i>	This patent	atpD (V)	

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing. Archaeal, bacterial, fungal or parasitical species	Source	Gene*
831	<i>Clostridium perfringens</i>	This patent	atpD (V)
832	<i>Clostridium tetani</i>	This patent	atpD (V)
833	<i>Streptococcus pyogenes</i>	Database	atpD (V)
834	<i>Babesia bovis</i>	This patent	atpD (V)
835	<i>Cryptosporidium parvum</i>	This patent	atpD (V)
836	<i>Leishmania infantum</i>	This patent	atpD (V)
837	<i>Leishmania major</i>	This patent	atpD (V)
838	<i>Leishmania tarentolae</i>	This patent	atpD (V)
839	<i>Trypanosoma brucei</i>	This patent	atpD (V)
840	<i>Trypanosoma cruzi</i>	This patent	tuf (EF-1)
841	<i>Trypanosoma cruzi</i>	This patent	tuf (EF-1)
842	<i>Trypanosoma cruzi</i>	This patent	tuf (EF-1)
843	<i>Babesia bovis</i>	This patent	tuf (M)
844	<i>Leishmania aethiopica</i>	This patent	tuf (M)
845	<i>Leishmania amazonensis</i>	This patent	tuf (M)
846	<i>Leishmania donovani</i>	This patent	tuf (M)
847	<i>Leishmania infantum</i>	This patent	tuf (M)
848	<i>Leishmania enriettii</i>	This patent	tuf (M)
849	<i>Leishmania gerbilli</i>	This patent	tuf (M)
850	<i>Leishmania major</i>	This patent	tuf (M)
851	<i>Leishmania mexicana</i>	This patent	tuf (M)
852	<i>Leishmania tarentolae</i>	This patent	tuf (M)
853	<i>Trypanosoma cruzi</i>	This patent	tuf (M)
854	<i>Trypanosoma cruzi</i>	This patent	tuf (M)
855	<i>Trypanosoma cruzi</i>	This patent	tuf (M)
856	<i>Babesia bigemina</i>	This patent	atpD
857	<i>Babesia bovis</i>	This patent	atpD
858	<i>Babesia microti</i>	This patent	atpD
859	<i>Leishmania guyanensis</i>	This patent	atpD
860	<i>Leishmania mexicana</i>	This patent	atpD
861	<i>Leishmania tropica</i>	This patent	atpD
862	<i>Leishmania tropica</i>	This patent	atpD
863	<i>Bordetella pertussis</i>	Database	tuf
864	<i>Trypanosoma brucei brucei</i>	Database	tuf (EF-1)
865	<i>Cryptosporidium parvum</i>	This patent	tuf (EF-1)
866	<i>Staphylococcus saprophyticus</i>	This patent	atpD
867	<i>Zoogloea ramigera</i>	This patent	atpD
868	<i>Staphylococcus saprophyticus</i>	This patent	tuf
869	<i>Enterococcus casseliflavus</i>	This patent	tuf
870	<i>Enterococcus casseliflavus</i>	This patent	tuf
871	<i>Enterococcus flavescent</i>	This patent	tuf
872	<i>Enterococcus gallinarum</i>	This patent	tuf
873	<i>Enterococcus gallinarum</i>	This patent	tuf
874	<i>Staphylococcus haemolyticus</i>	This patent	tuf
875	<i>Staphylococcus epidermidis</i>	This patent	tuf
876	<i>Staphylococcus epidermidis</i>	This patent	tuf
877	<i>Staphylococcus epidermidis</i>	This patent	tuf
878	<i>Staphylococcus epidermidis</i>	This patent	tuf
879	<i>Enterococcus gallinarum</i>	This patent	tuf
880	<i>Pseudomonas aeruginosa</i>	This patent	tuf
881	<i>Enterococcus casseliflavus</i>	This patent	tuf
882	<i>Enterococcus casseliflavus</i>	This patent	tuf
883	<i>Enterococcus faecalis</i>	This patent	tuf
884	<i>Enterococcus faecalis</i>	This patent	tuf
885	<i>Enterococcus faecium</i>	This patent	tuf
886	<i>Enterococcus faecium</i>	This patent	tuf
887	<i>Zoogloea ramigera</i>	This patent	tuf
888	<i>Enterococcus faecalis</i>	This patent	tuf
889	<i>Aspergillus fumigatus</i>	This patent	atpD
890	<i>Penicillium marneffei</i>	This patent	atpD
891	<i>Paecilomyces lilacinus</i>	This patent	atpD
892	<i>Penicillium marneffei</i>	This patent	atpD
893	<i>Sporothrix schenckii</i>	This patent	atpD
894	<i>Malbranchea filamentosa</i>	This patent	atpD
895	<i>Paecilomyces lilacinus</i>	This patent	atpD
896	<i>Aspergillus niger</i>	This patent	atpD
897	<i>Aspergillus fumigatus</i>	This patent	tuf (EF-1)
898	<i>Penicillium marneffei</i>	This patent	tuf (EF-1)
899	<i>Piedraia hortai</i>	This patent	tuf (EF-1)
900	<i>Paecilomyces lilacinus</i>	This patent	tuf (EF-1)
901	<i>Paracoccidioides brasiliensis</i>	This patent	tuf (EF-1)
902	<i>Sporothrix schenckii</i>	This patent	tuf (EF-1)
903	<i>Penicillium marneffei</i>	This patent	tuf (EF-1)
904	<i>Curvularia lunata</i>	This patent	tuf (M)
905	<i>Aspergillus niger</i>	This patent	tuf (M)

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing.	Source	Gene*	
906	<i>Bipolaris hawaiiensis</i>	This patent	tuf (M)	
907	<i>Aspergillus flavus</i>	This patent	tuf (M)	
908	<i>Alternaria alternata</i>	This patent	tuf (M)	
909	<i>Penicillium marneffei</i>	This patent	tuf (M)	
910	<i>Penicillium marneffei</i>	This patent	tuf (M)	10
918	<i>Escherichia coli</i>	Database	recA	
929	<i>Bacteroides fragilis</i>	This patent	atpD (V)	
930	<i>Bacteroides distasonis</i>	This patent	atpD (V)	
931	<i>Porphyromonas asaccharolytica</i>	This patent	atpD (V)	
932	<i>Listeria monocytogenes</i>	This patent	tuf	
939	<i>Saccharomyces cerevisiae</i>	Database	recA (Rad51)	15
940	<i>Saccharomyces cerevisiae</i>	Database	recA (Dmc1)	
941	<i>Cryptococcus humicola</i>	This patent	atpD	
942	<i>Escherichia coli</i>	This patent	atpD	
943	<i>Escherichia coli</i>	This patent	atpD	
944	<i>Escherichia coli</i>	This patent	atpD	
945	<i>Escherichia coli</i>	This patent	atpD	20
946	<i>Neisseria polysaccharea</i>	This patent	atpD	
947	<i>Neisseria sicca</i>	This patent	atpD	
948	<i>Streptococcus mitis</i>	This patent	atpD	
949	<i>Streptococcus mitis</i>	This patent	atpD	
950	<i>Streptococcus mitis</i>	This patent	atpD	25
951	<i>Streptococcus oralis</i>	This patent	atpD	
952	<i>Streptococcus pneumoniae</i>	This patent	atpD	
953	<i>Streptococcus pneumoniae</i>	This patent	atpD	
954	<i>Streptococcus pneumoniae</i>	This patent	atpD	
955	<i>Streptococcus pneumoniae</i>	This patent	atpD	30
956	<i>Babesia microti</i>	This patent	atpD (V)	
957	<i>Entamoeba histolytica</i>	This patent	atpD (V)	
958	<i>Fusobacterium nucleatum</i> subsp. <i>polymorphum</i>	This patent	atpD (V)	35
959	<i>Leishmania aethiopica</i>	This patent	atpD (V)	
960	<i>Leishmania tropica</i>	This patent	atpD (V)	
961	<i>Leishmania guyanensis</i>	This patent	atpD (V)	
962	<i>Leishmania donovani</i>	This patent	atpD (V)	
963	<i>Leishmania hertigi</i>	This patent	atpD (V)	40
964	<i>Leishmania mexicana</i>	This patent	atpD (V)	
965	<i>Leishmania tropica</i>	This patent	atpD (V)	
966	<i>Peptostreptococcus anaerobius</i>	This patent	atpD (V)	
967	<i>Bordetella pertussis</i>	This patent	tuf	
968	<i>Bordetella pertussis</i>	This patent	tuf	
969	<i>Enterococcus columbae</i>	This patent	tuf	45
970	<i>Enterococcus flavescentis</i>	This patent	tuf	
971	<i>Streptococcus pneumoniae</i>	This patent	tuf	
972	<i>Escherichia coli</i>	This patent	tuf	
973	<i>Escherichia coli</i>	This patent	tuf	
974	<i>Escherichia coli</i>	This patent	tuf	50
975	<i>Escherichia coli</i>	This patent	tuf	
976	<i>Mycobacterium avium</i>	This patent	tuf	
977	<i>Streptococcus pneumoniae</i>	This patent	tuf	
978	<i>Mycobacterium gordonae</i>	This patent	tuf	
979	<i>Streptococcus pneumoniae</i>	This patent	tuf	55
980	<i>Mycobacterium tuberculosis</i>	This patent	tuf	
981	<i>Staphylococcus warneri</i>	This patent	tuf	
982	<i>Streptococcus mitis</i>	This patent	tuf	
983	<i>Streptococcus mitis</i>	This patent	tuf	60
984	<i>Streptococcus mitis</i>	This patent	tuf	
985	<i>Streptococcus oralis</i>	This patent	tuf	
986	<i>Streptococcus pneumoniae</i>	This patent	tuf	
987	<i>Enterococcus hirae</i>	This patent	tuf (C)	
988	<i>Enterococcus mundtii</i>	This patent	tuf (C)	65
989	<i>Enterococcus raffinosus</i>	This patent	tuf (C)	
990	<i>Bacillus anthracis</i>	This patent	recA	
991	<i>Prevotella melaninogenica</i>	This patent	recA	
992	<i>Enterococcus casseliflavus</i>	This patent	tuf	
993	<i>Streptococcus pyogenes</i>	Database	speA	
1002	<i>Streptococcus pyogenes</i>	WO98/20157	tuf	
1003	<i>Bacillus cereus</i>	This patent	recA	70
1004	<i>Streptococcus pneumoniae</i>	This patent	pbp1a	
1005	<i>Streptococcus pneumoniae</i>	This patent	pbp1a	
1006	<i>Streptococcus pneumoniae</i>	This patent	pbp1a	
1007	<i>Streptococcus pneumoniae</i>	This patent	pbp1a	
1008	<i>Streptococcus pneumoniae</i>	This patent	pbp1a	75
1009	<i>Streptococcus pneumoniae</i>	This patent	pbp1a	
1010	<i>Streptococcus pneumoniae</i>	This patent	pbp1a	

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing.	Source	Gene*
1011	<i>Streptococcus pneumoniae</i>	This patent	pbp1a
1012	<i>Streptococcus pneumoniae</i>	This patent	pbp1a
1013	<i>Streptococcus pneumoniae</i>	This patent	pbp1a
1014	<i>Streptococcus pneumoniae</i>	This patent	pbp1a
1015	<i>Streptococcus pneumoniae</i>	This patent	pbp1a
1016	<i>Streptococcus pneumoniae</i>	This patent	pbp1a
1017	<i>Streptococcus pneumoniae</i>	This patent	pbp1a
1018	<i>Streptococcus pneumoniae</i>	This patent	pbp1a
1019	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1020	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1021	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1022	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1023	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1024	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1025	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1026	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1027	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1028	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1029	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1030	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1031	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1032	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1033	<i>Streptococcus pneumoniae</i>	This patent	pbp2b
1034	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1035	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1036	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1037	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1038	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1039	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1040	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1041	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1042	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1043	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1044	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1045	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1046	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1047	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1048	<i>Streptococcus pneumoniae</i>	This patent	pbp2x
1049	<i>Enterococcus faecium</i>	This patent	vanA
1050	<i>Enterococcus gallinarum</i>	This patent	vanA
1051	<i>Enterococcus faecium</i>	This patent	vanA
1052	<i>Enterococcus faecium</i>	This patent	vanA
1053	<i>Enterococcus faecium</i>	This patent	vanA
1054	<i>Enterococcus faecalis</i>	This patent	vanA
1055	<i>Enterococcus gallinarum</i>	This patent	vanA
1056	<i>Enterococcus faecium</i>	This patent	vanA
1057	<i>Enterococcus flavescentis</i>	This patent	vanA
1058	<i>Enterococcus gallinarum</i>	This patent	vanC1
1059	<i>Enterococcus gallinarum</i>	This patent	vanC1
1060	<i>Enterococcus casseliflavus</i>	This patent	vanC2
1061	<i>Enterococcus casseliflavus</i>	This patent	vanC2
1062	<i>Enterococcus casseliflavus</i>	This patent	vanC2
1063	<i>Enterococcus casseliflavus</i>	This patent	vanC2
1064	<i>Enterococcus flavescentis</i>	This patent	vanC3
1065	<i>Enterococcus flavescentis</i>	This patent	vanC3
1066	<i>Enterococcus flavescentis</i>	This patent	vanC3
1067	<i>Enterococcus faecium</i>	This patent	vanXY
1068	<i>Enterococcus faecium</i>	This patent	vanXY
1069	<i>Enterococcus faecium</i>	This patent	vanXY
1070	<i>Enterococcus faecalis</i>	This patent	vanXY
1071	<i>Enterococcus gallinarum</i>	This patent	vanXY
1072	<i>Enterococcus faecium</i>	This patent	vanXY
1073	<i>Enterococcus flavescentis</i>	This patent	vanXY
1074	<i>Enterococcus faecium</i>	This patent	vanXY
1075	<i>Enterococcus gallinarum</i>	This patent	vanXY
1076	<i>Escherichia coli</i>	Database	stx ₁
1077	<i>Escherichia coli</i>	Database	stx ₂
1093	<i>Staphylococcus saprophyticus</i>	This patent	unknown
1117	<i>Enterococcus faecium</i>	Database	vanB
1138	<i>Enterococcus gallinarum</i>	Database	vanC1
1139	<i>Enterococcus faecium</i>	Database	vanA
1140	<i>Enterococcus casseliflavus</i>	Database	vanC2
1141	<i>Enterococcus faecium</i>	Database	vanHAXY
1169	<i>Streptococcus pneumoniae</i>	Database	pbp1a
1172	<i>Streptococcus pneumoniae</i>	Database	pbp2b

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing.	Source	Gene*	
1173	<i>Streptococcus pneumoniae</i>	Database	pbp2x	
1178	<i>Staphylococcus aureus</i>	Database	mecA	
1183	<i>Streptococcus pneumoniae</i>	Database	hexA	
1184	<i>Streptococcus pneumoniae</i>	This patent	hexA	
1185	<i>Streptococcus pneumoniae</i>	This patent	hexA	10
1186	<i>Streptococcus pneumoniae</i>	This patent	hexA	
1187	<i>Streptococcus pneumoniae</i>	This patent	hexA	
1188	<i>Streptococcus oralis</i>	This patent	hexA	
1189	<i>Streptococcus mitis</i>	This patent	hexA	
1190	<i>Streptococcus mitis</i>	This patent	hexA	
1191	<i>Streptococcus mitis</i>	This patent	hexA	
1198	<i>Staphylococcus saprophyticus</i>	This patent	unknown	15
1215	<i>Streptococcus pyogenes</i>	Database	pcp	
1230	<i>Escherichia coli</i>	Database	tuf (EF-G)	
1242	<i>Enterococcus faecium</i>	Database	ddl	
1243	<i>Enterococcus faecalis</i>	Database	mtlF, mtlD	
1244	<i>Staphylococcus aureus</i> subsp. <i>aureus</i>	This patent	unknown	20
1245	<i>Bacillus anthracis</i>	This patent	atpD	
1246	<i>Bacillus mycoides</i>	This patent	atpD	
1247	<i>Bacillus thuringiensis</i>	This patent	atpD	
1248	<i>Bacillus thuringiensis</i>	This patent	atpD	
1249	<i>Bacillus thuringiensis</i>	This patent	atpD	
1250	<i>Bacillus weihenstephanensis</i>	This patent	atpD	25
1251	<i>Bacillus thuringiensis</i>	This patent	atpD	
1252	<i>Bacillus thuringiensis</i>	This patent	atpD	
1253	<i>Bacillus cereus</i>	This patent	atpD	
1254	<i>Bacillus cereus</i>	This patent	atpD	
1255	<i>Staphylococcus aureus</i>	This patent	gyrA	
1256	<i>Bacillus weihenstephanensis</i>	This patent	atpD	30
1257	<i>Bacillus anthracis</i>	This patent	atpD	
1258	<i>Bacillus thuringiensis</i>	This patent	atpD	
1259	<i>Bacillus cereus</i>	This patent	atpD	
1260	<i>Bacillus cereus</i>	This patent	atpD	
1261	<i>Bacillus thuringiensis</i>	This patent	atpD	
1262	<i>Bacillus thuringiensis</i>	This patent	atpD	35
1263	<i>Bacillus thuringiensis</i>	This patent	atpD	
1264	<i>Bacillus thuringiensis</i>	This patent	atpD	
1265	<i>Bacillus anthracis</i>	This patent	atpD	
1266	<i>Paracoccidioides brasiliensis</i>	This patent	tuf (EF-1)	
1267	<i>Blastomyces dermatitidis</i>	This patent	tuf (EF-1)	
1268	<i>Histoplasma capsulatum</i>	This patent	tuf (EF-1)	40
1269	<i>Trichophyton rubrum</i>	This patent	tuf (EF-1)	
1270	<i>Microsporum canis</i>	This patent	tuf (EF-1)	
1271	<i>Aspergillus versicolor</i>	This patent	tuf (EF-1)	
1272	<i>Exophiala moniliae</i>	This patent	tuf (EF-1)	
1273	<i>Hortaea werneckii</i>	This patent	tuf (EF-1)	
1274	<i>Fusarium solani</i>	This patent	tuf (EF-1)	
1275	<i>Aureobasidium pullulans</i>	This patent	tuf (EF-1)	45
1276	<i>Blastomyces dermatitidis</i>	This patent	tuf (EF-1)	
1277	<i>Exophiala dermatitidis</i>	This patent	tuf (EF-1)	
1278	<i>Fusarium moniliforme</i>	This patent	tuf (EF-1)	
1279	<i>Aspergillus terreus</i>	This patent	tuf (EF-1)	
1280	<i>Aspergillus fumigatus</i>	This patent	tuf (EF-1)	
1281	<i>Cryptococcus laurentii</i>	This patent	tuf (EF-1)	50
1282	<i>Emmonia parva</i>	This patent	tuf (EF-1)	
1283	<i>Fusarium solani</i>	This patent	tuf (EF-1)	
1284	<i>Sporothrix schenckii</i>	This patent	tuf (EF-1)	
1285	<i>Aspergillus nidulans</i>	This patent	tuf (EF-1)	
1286	<i>Cladophialophora carrionii</i>	This patent	tuf (EF-1)	55
1287	<i>Exserohilum rostratum</i>	This patent	tuf (EF-1)	
1288	<i>Bacillus thuringiensis</i>	This patent	recA	
1289	<i>Bacillus thuringiensis</i>	This patent	recA	
1299	<i>Staphylococcus aureus</i>	Database	gyrA	
1300	<i>Escherichia coli</i>	Database	gyrA	
1307	<i>Staphylococcus aureus</i>	Database	gyrB	
1320	<i>Escherichia coli</i>	Database	parC (grlA)	60
1321	<i>Staphylococcus aureus</i>	Database	parC (grlA)	
1328	<i>Staphylococcus aureus</i>	Database	parE (grlB)	
1348	unidentified bacterium	Database	aac2Ia	
1351	<i>Pseudomonas aeruginosa</i>	Database	aac3Ib	
1356	<i>Serratia marcescens</i>	Database	aac3Iib	
1361	<i>Escherichia coli</i>	Database	aac3IVa	65
1366	<i>Enterobacter cloacae</i>	Database	aac3VIa	
1371	<i>Citrobacter koseri</i>	Database	aac6Ia	

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing.	Source	Gene*	
1376	<i>Serratia marcescens</i>	Database	aac6Ic	
1381	<i>Escherichia coli</i>	Database	ant3Ia	
1386	<i>Staphylococcus aureus</i>	Database	ant4Ia	
1391	<i>Escherichia coli</i>	Database	aph3Ia	
1396	<i>Escherichia coli</i>	Database	aph3IIa	
1401	<i>Enterococcus faecalis</i>	Database	aph3IIIa	
1406	<i>Acinetobacter baumannii</i>	Database	aph3V1a	
1411	<i>Pseudomonas aeruginosa</i>	Database	blaCARB	
1416	<i>Klebsiella pneumoniae</i>	Database	blaCMY-2	
1423	<i>Escherichia coli</i>	Database	blaCTX-M-1	
1428	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype	Database	blaCTX-M-2	
	Typhimurium			
1433	<i>Pseudomonas aeruginosa</i>	Database	blaIMP	
1438	<i>Escherichia coli</i>	Database	blaOXA2	
1439	<i>Pseudomonas aeruginosa</i>	Database	blaOXA10	
1442	<i>Pseudomonas aeruginosa</i>	Database	blaPER1	
1445	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype	Database	blaPER2	
	Typhimurium			
1452	<i>Staphylococcus epidermidis</i>	Database	dfrA	
1461	<i>Escherichia coli</i>	Database	dhfRIa	
1470	<i>Escherichia coli</i>	Database	dhfRIb	
1475	<i>Escherichia coli</i>	Database	dhfRV	
1480	<i>Proteus mirabilis</i>	Database	dhfVI	
1489	<i>Escherichia coli</i>	Database	dhfVII	
1494	<i>Escherichia coli</i>	Database	dhfVIII	
1499	<i>Escherichia coli</i>	Database	dhfIX	
1504	<i>Escherichia coli</i>	Database	dhfXII	
1507	<i>Escherichia coli</i>	Database	dhfXIII	
1512	<i>Escherichia coli</i>	Database	dhfXV	
1517	<i>Escherichia coli</i>	Database	dhfXVII	
1518	<i>Acinetobacter lwoffii</i>	This patent	fusA	
1519	<i>Acinetobacter lwoffii</i>	This patent	fusA-tuf	
	spacer			
1520	<i>Acinetobacter lwoffii</i>	This patent	tuf	
1521	<i>Haemophilus influenzae</i>	This patent	fusA	
1522	<i>Haemophilus influenzae</i>	This patent	fusA-tuf	
	spacer			
1523	<i>Haemophilus influenzae</i>	This patent	tuf	
1524	<i>Proteus mirabilis</i>	This patent	fusA	
1525	<i>Proteus mirabilis</i>	This patent	fusA-tuf	
	spacer			
1526	<i>Proteus mirabilis</i>	This patent	tuf	
1527	<i>Campylobacter curvus</i>	This patent	atpD	
1530	<i>Escherichia coli</i>	Database	ereA	
1535	<i>Escherichia coli</i>	Database	ereB	
1540	<i>Staphylococcus haemolyticus</i>	Database	linA	
1545	<i>Enterococcus faecium</i>	Database	linB	
1548	<i>Streptococcus pyogenes</i>	Database	mefA	
1551	<i>Streptococcus pneumoniae</i>	Database	mefE	
1560	<i>Escherichia coli</i>	Database	mphA	
1561	<i>Candida albicans</i>	This patent	tuf (EF-1)	
1562	<i>Candida dubliniensis</i>	This patent	tuf (EF-1)	
1563	<i>Candida famata</i>	This patent	tuf (EF-1)	
1564	<i>Candida glabrata</i>	This patent	tuf (EF-1)	
1565	<i>Candida guilliermondii</i>	This patent	tuf (EF-1)	
1566	<i>Candida haemulonii</i>	This patent	tuf (EF-1)	
1567	<i>Candida kefyr</i>	This patent	tuf (EF-1)	
1568	<i>Candida lusitaniae</i>	This patent	tuf (EF-1)	
1569	<i>Candida sphaerica</i>	This patent	tuf (EF-1)	
1570	<i>Candida tropicalis</i>	This patent	tuf (EF-1)	
1571	<i>Candida viswanathii</i>	This patent	tuf (EF-1)	
1572	<i>Alcaligenes faecalis</i> subsp. <i>faecalis</i>	This patent	tuf	
1573	<i>Prevotella buccalis</i>	This patent	tuf	
1574	<i>Succinivibrio dextrinosolvens</i>	This patent	tuf	
1575	<i>Tetragenococcus halophilus</i>	This patent	tuf	
1576	<i>Campylobacter jejuni</i> subsp. <i>jejuni</i>	This patent	atpD	
1577	<i>Campylobacter rectus</i>	This patent	atpD	
1578	<i>Enterococcus casseliflavus</i>	This patent	fusA	
1579	<i>Enterococcus gallinarum</i>	This patent	fusA	
1580	<i>Streptococcus mitis</i>	This patent	fusA	
1585	<i>Enterococcus faecium</i>	Database	satG	

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing.	Source	Gene*	
1590	Cloning vector pFW16	Database	tetM	
1594	<i>Enterococcus faecium</i>	Database	vanD	
1599	<i>Enterococcus faecalis</i>	Database	vanE	
1600	<i>Campylobacter jejuni</i> subsp. <i>doylei</i>	This patent	atpD	5
1601	<i>Enterococcus sulfureus</i>	This patent	atpD	10
1602	<i>Enterococcus solitarius</i>	This patent	atpD	
1603	<i>Campylobacter sputorum</i> subsp. <i>sputorum</i>	This patent	atpD	
1604	<i>Enterococcus pseudoavium</i>	This patent	atpD	
1607	<i>Klebsiella ornithinolytica</i>	This patent	gyrA	15
1608	<i>Klebsiella oxytoca</i>	This patent	gyrA	
1613	<i>Staphylococcus aureus</i>	Database	vatB	
1618	<i>Staphylococcus cohnii</i>	Database	vatC	
1623	<i>Staphylococcus aureus</i>	Database	vga	
1628	<i>Staphylococcus aureus</i>	Database	vgaB	20
1633	<i>Staphylococcus aureus</i>	Database	vgb	
1638	<i>Aspergillus fumigatus</i>	This patent	atpD	
1639	<i>Aspergillus fumigatus</i>	This patent	atpD	
1640	<i>Bacillus mycoides</i>	This patent	atpD	
1641	<i>Bacillus mycoides</i>	This patent	atpD	
1642	<i>Bacillus mycoides</i>	This patent	atpD	
1643	<i>Bacillus pseudomycoides</i>	This patent	atpD	25
1644	<i>Bacillus pseudomycoides</i>	This patent	atpD	
1645	<i>Budvicia aquatica</i>	This patent	atpD	
1646	<i>Buttauxella agrestis</i>	This patent	atpD	
1647	<i>Candida norvegica</i>	This patent	atpD	
1648	<i>Streptococcus pneumoniae</i>	This patent	pbp1a	
1649	<i>Campylobacter lad</i>	This patent	atpD	
1650	<i>Coccidioides immitis</i>	This patent	atpD	30
1651	<i>Emmonsia parva</i>	This patent	atpD	
1652	<i>Erwinia amylovora</i>	This patent	atpD	
1653	<i>Fonsecaea pedrosoi</i>	This patent	atpD	
1654	<i>Fusarium moniliforme</i>	This patent	atpD	
1655	<i>Klebsiella oxytoca</i>	This patent	atpD	
1656	<i>Microsporum audouinii</i>	This patent	atpD	35
1657	<i>Obesumbacterium proteus</i>	This patent	atpD	
1658	<i>Paracoccidioides brasiliensis</i>	This patent	atpD	
1659	<i>Plesiomonas shigelloides</i>	This patent	atpD	
1660	<i>Shewanella putrefaciens</i>	This patent	atpD	
1662	<i>Campylobacter curvus</i>	This patent	tuf	
1663	<i>Campylobacter rectus</i>	This patent	tuf	40
1664	<i>Fonsecaea pedrosoi</i>	This patent	tuf	
1666	<i>Microsporum audouinii</i>	This patent	tuf	
1667	<i>Piedraia hortai</i>	This patent	tuf	
1668	<i>Escherichia coli</i>	Database	tuf	
1669	<i>Saksenaea vasiformis</i>	This patent	tuf	
1670	<i>Trichophyton tonsurans</i>	This patent	tuf	
1671	<i>Enterobacter aerogenes</i>	This patent	atpD	45
1672	<i>Bordetella pertussis</i>	Database	atpD	
1673	<i>Arcanobacterium haemolyticum</i>	This patent	tuf	
1674	<i>Butyrivibrio fibrisolvens</i>	This patent	tuf	
1675	<i>Campylobacter jejuni</i> subsp. <i>doylei</i>	This patent	tuf	50
1676	<i>Campylobacter lari</i>	This patent	tuf	
1677	<i>Campylobacter sputorum</i> subsp. <i>sputorum</i>	This patent	tuf	
1678	<i>Campylobacter upsaliensis</i>	This patent	tuf	
1679	<i>Globicatella sanguis</i>	This patent	tuf	
1680	<i>Lactobacillus acidophilus</i>	This patent	tuf	55
1681	<i>Leuconostoc mesenteroides</i> subsp. <i>dextranicum</i>	This patent	tuf	
1682	<i>Prevotella buccalis</i>	This patent	tuf	
1683	<i>Ruminococcus bromii</i>	This patent	tuf	
1684	<i>Paracoccidioides brasiliensis</i>	This patent	atpD	
1685	<i>Candida norvegica</i>	This patent	tuf (EF-1)	60
1686	<i>Aspergillus nidulans</i>	This patent	tuf	
1687	<i>Aspergillus terreus</i>	This patent	tuf	
1688	<i>Candida norvegica</i>	This patent	tuf	
1689	<i>Candida parapsilosis</i>	This patent	tuf	
1702	<i>Streptococcus gordonii</i>	WO98/20157	recA	
1703	<i>Streptococcus mutans</i>	WO98/20157	recA	65
1704	<i>Streptococcus pneumoniae</i>	WO98/20157	recA	
1705	<i>Streptococcus pyogenes</i>	WO98/20157	recA	

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing.	Source	Gene*	
1706	<i>Streptococcus salivarius</i> subsp. <i>thermophilus</i>	WO98/20157	recA	
1707	<i>Escherichia coli</i>	WO98/20157	oxa	
1708	<i>Enterococcus faecalis</i>	WO98/20157	blaZ	
1709	<i>Pseudomonas aeruginosa</i>	WO98/20157	aac6'-IIa	5
1710	<i>Staphylococcus aureus</i>	WO98/20157	ermA	
1711	<i>Escherichia coli</i>	WO98/20157	ermB	
1712	<i>Staphylococcus aureus</i>	WO98/20157	ermC	
1713	<i>Enterococcus faecalis</i>	WO98/20157	vanB	
1714	<i>Campylobacter jejuni</i> subsp. <i>jejuni</i>	This patent	recA	
1715	<i>Abiotrophia adiacens</i>	WO98/20157	tuf	15
1716	<i>Abiotrophia defectiva</i>	WO98/20157	tuf	
1717	<i>Corynebacterium accolens</i>	WO98/20157	tuf	
1718	<i>Corynebacterium genitalium</i>	WO98/20157	tuf	
1719	<i>Corynebacterium jeikeium</i>	WO98/20157	tuf	
1720	<i>Corynebacterium</i> <i>pseudodiphtheriticum</i>	WO98/20157	tuf	
1721	<i>Corynebacterium striatum</i>	WO98/20157	tuf	
1722	<i>Enterococcus avium</i>	WO98/20157	tuf	
1723	<i>Gardnerella vaginalis</i>	WO98/20157	tuf	
1724	<i>Listeria innocua</i>	WO98/20157	tuf	
1725	<i>Listeria ivanovii</i>	WO98/20157	tuf	
1726	<i>Listeria monocytogenes</i>	WO98/20157	tuf	20
1727	<i>Listeria seeligeri</i>	WO98/20157	tuf	
1728	<i>Staphylococcus aureus</i>	WO98/20157	tuf	
1729	<i>Staphylococcus saprophyticus</i>	WO98/20157	tuf	
1730	<i>Staphylococcus simulans</i>	WO98/20157	tuf	
1731	<i>Streptococcus agalactiae</i>	WO98/20157	tuf	
1732	<i>Streptococcus pneumoniae</i>	WO98/20157	tuf	30
1733	<i>Streptococcus salivarius</i>	WO98/20157	tuf	
1734	<i>Agrobacterium radiobacter</i>	WO98/20157	tuf	
1735	<i>Bacillus subtilis</i>	WO98/20157	tuf	
1736	<i>Bacteroides fragilis</i>	WO98/20157	tuf	
1737	<i>Borrelia burgdorferi</i>	WO98/20157	tuf	
1738	<i>Brevibacterium linens</i>	WO98/20157	tuf	35
1739	<i>Chlamydia trachomatis</i>	WO98/20157	tuf	
1740	<i>Fibrobacter succinogenes</i>	WO98/20157	tuf	
1741	<i>Flavobacterium ferrugineum</i>	WO98/20157	tuf	
1742	<i>Helicobacter pylori</i>	WO98/20157	tuf	
1743	<i>Micrococcus luteus</i>	WO98/20157	tuf	
1744	<i>Mycobacterium tuberculosis</i>	WO98/20157	tuf	40
1745	<i>Mycoplasma genitalium</i>	WO98/20157	tuf	
1746	<i>Neisseria gonorrhoeae</i>	WO98/20157	tuf	
1747	<i>Rickettsia prowazekii</i>	WO98/20157	tuf	
1748	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i>	WO98/20157	tuf	
1749	<i>Shewanella putrefaciens</i>	WO98/20157	tuf	45
1750	<i>Stigmatella aurantia</i>	WO98/20157	tuf	
1751	<i>Thiomanos cuprina</i>	WO98/20157	tuf	
1752	<i>Treponema pallidum</i>	WO98/20157	tuf	
1753	<i>Ureaplasma urealyticum</i>	WO98/20157	tuf	
1754	<i>Wolinella succinogenes</i>	WO98/20157	tuf	
1755	<i>Burkholderia cepacia</i>	WO98/20157	tuf	
1756	<i>Bacillus anthracis</i>	This patent	recA	50
1757	<i>Bacillus anthracis</i>	This patent	recA	
1758	<i>Bacillus cereus</i>	This patent	recA	
1759	<i>Bacillus cereus</i>	This patent	recA	
1760	<i>Bacillus mycoides</i>	This patent	recA	
1761	<i>Bacillus pseudomycoides</i>	This patent	recA	55
1762	<i>Bacillus thuringiensis</i>	This patent	recA	
1763	<i>Bacillus thuringiensis</i>	This patent	recA	
1764	<i>Klebsiella oxytoca</i>	This patent	gyrA	
1765	<i>Klebsiella pneumoniae</i> subsp. <i>ozanae</i>	This patent	gyrA	
1766	<i>Klebsiella planticola</i>	This patent	gyrA	60
1767	<i>Klebsiella pneumoniae</i>	This patent	gyrA	
1768	<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	This patent	gyrA	
1769	<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	This patent	gyrA	
1770	<i>Klebsiella pneumoniae</i> subsp. <i>rhinoscleromatis</i>	This patent	gyrA	65
1771	<i>Klebsiella terrigena</i>	This patent	gyrA	

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing. Archaeal, bacterial, fungal or parasitical species	Source	Gene*	
1772	<i>Legionella pneumophila</i> subsp. <i>pneumophila</i>	This patent	gyrA	
1773	<i>Proteus mirabilis</i>	This patent	gyrA	
1774	<i>Providencia rettgeri</i>	This patent	gyrA	
1775	<i>Proteus vulgaris</i>	This patent	gyrA	10
1776	<i>Yersinia enterocolitica</i>	This patent	gyrA	
1777	<i>Klebsiella oxytoca</i>	This patent	parC (grlA)	
1778	<i>Klebsiella oxytoca</i>	This patent	parC (grlA)	
1779	<i>Klebsiella pneumoniae</i> subsp. <i>ozaenae</i>	This patent	parC (grlA)	
1780	<i>Klebsiella planticola</i>	This patent	parC (grlA)	15
1781	<i>Klebsiella pneumoniae</i>	This patent	parC (grlA)	
1782	<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	This patent	parC (grlA)	
1783	<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	This patent	parC (grlA)	
1784	<i>Klebsiella pneumoniae</i> subsp. <i>rhinoscleromatis</i>	This patent	parC (grlA)	20
1785	<i>Klebsiella terrigena</i>	This patent	parC (grlA)	
1786	<i>Bacillus cereus</i>	This patent	fusA	
1787	<i>Bacillus cereus</i>	This patent	fusA	
1788	<i>Bacillus anthracis</i>	This patent	fusA	
1789	<i>Bacillus cereus</i>	This patent	fusA	
1790	<i>Bacillus anthracis</i>	This patent	fusA	25
1791	<i>Bacillus pseudomycoides</i>	This patent	fusA	
1792	<i>Bacillus cereus</i>	This patent	fusA	
1793	<i>Bacillus anthracis</i>	This patent	fusA	
1794	<i>Bacillus cereus</i>	This patent	fusA	
1795	<i>Bacillus weihenstephanensis</i>	This patent	fusA	
1796	<i>Bacillus mycoides</i>	This patent	fusA	30
1797	<i>Bacillus thuringiensis</i>	This patent	fusA	
1798	<i>Bacillus weihenstephanensis</i>	This patent	fusA-tuf	
1799	<i>Bacillus thuringiensis</i>	This patent	spacer	
1800	<i>Bacillus anthracis</i>	This patent	fusA-tuf	
1801	<i>Bacillus pseudomycoides</i>	This patent	spacer	35
1802	<i>Bacillus anthracis</i>	This patent	fusA-tuf	
1803	<i>Bacillus cereus</i>	This patent	spacer	
1804	<i>Bacillus cereus</i>	This patent	fusA-tuf	40
1805	<i>Bacillus mycoides</i>	This patent	spacer	
1806	<i>Bacillus cereus</i>	This patent	fusA-tuf	
1807	<i>Bacillus cereus</i>	This patent	spacer	
1808	<i>Bacillus cereus</i>	This patent	fusA-tuf	45
1809	<i>Bacillus anthracis</i>	This patent	spacer	
1810	<i>Bacillus mycoides</i>	This patent	tuf	
1811	<i>Bacillus thuringiensis</i>	This patent	tuf	50
1812	<i>Bacillus cereus</i>	This patent	tuf	
1813	<i>Bacillus weihenstephanensis</i>	This patent	tuf	
1814	<i>Bacillus anthracis</i>	This patent	tuf	
1815	<i>Bacillus cereus</i>	This patent	tuf	
1816	<i>Bacillus cereus</i>	This patent	tuf	
1817	<i>Bacillus anthracis</i>	This patent	tuf	55
1818	<i>Bacillus cereus</i>	This patent	tuf	
1819	<i>Bacillus anthracis</i>	This patent	tuf	
1820	<i>Bacillus pseudomycoides</i>	This patent	tuf	
1821	<i>Bacillus cereus</i>	This patent	tuf	
1822	<i>Streptococcus oralis</i>	This patent	fusA	60
1823	<i>Budvicia aquatica</i>	This patent	fusA	
1824	<i>Buttiauxella agrestis</i>	This patent	fusA	
1825	<i>Klebsiella oxytoca</i>	This patent	fusA	
1826	<i>Plesiomonas shigelloides</i>	This patent	fusA	
1827	<i>Shewanella putrefaciens</i>	This patent	fusA	
1828	<i>Obesumbacterium proteus</i>	This patent	fusA	65
1829	<i>Klebsiella oxytoca</i>	This patent	fusA-tuf	
		spacer		

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing. Archaeal, bacterial, fungal or parasitical species	Source	Gene*	
1830	<i>Budvicia aquatica</i>	This patent	fusA-tuf	
1831	<i>Plesiomonas shigelloides</i>	This patent	spacer	
1832	<i>Obesumbacterium proteus</i>	This patent	fusA-tuf	
1833	<i>Shewanella putrefaciens</i>	This patent	spacer	
1834	<i>Buttiauxella agrestis</i>	This patent	fusA-tuf	
1835	<i>Campylobacter coli</i>	This patent	spacer	
1836	<i>Campylobacter fetus</i> subsp. <i>fetus</i>	This patent	fusA-tuf	
1837	<i>Campylobacter fetus</i> subsp. <i>venerealis</i>	This patent	tuf	
1838	<i>Buttiauxella agrestis</i>	This patent	tuf	
1839	<i>Klebsiella oxytoca</i>	This patent	tuf	
1840	<i>Plesiomonas shigelloides</i>	This patent	tuf	
1841	<i>Shewanella putrefaciens</i>	This patent	tuf	
1842	<i>Obesumbacterium proteus</i>	This patent	tuf	
1843	<i>Budvicia aquatica</i>	This patent	tuf	
1844	<i>Abiotrophia adiacens</i>	This patent	atpD	
1845	<i>Arcanobacterium haemolyticum</i>	This patent	atpD	
1846	<i>Basidiobolus ranarum</i>	This patent	atpD	
1847	<i>Blastomyces dermatitidis</i>	This patent	atpD	
1848	<i>Blastomyces dermatitidis</i>	This patent	atpD	
1849	<i>Campylobacter coli</i>	This patent	atpD	
1850	<i>Campylobacter fetus</i> subsp. <i>fetus</i>	This patent	atpD	
1851	<i>Campylobacter fetus</i> subsp. <i>venerealis</i>	This patent	atpD	
1852	<i>Campylobacter gracilis</i>	This patent	atpD	
1853	<i>Campylobacter jejuni</i> subsp. <i>jejuni</i>	This patent	atpD	
1854	<i>Enterococcus cecorum</i>	This patent	atpD	
1855	<i>Enterococcus columbae</i>	This patent	atpD	
1856	<i>Enterococcus dispar</i>	This patent	atpD	
1857	<i>Enterococcus malodoratus</i>	This patent	atpD	
1858	<i>Enterococcus mundtii</i>	This patent	atpD	
1859	<i>Enterococcus raffinosus</i>	This patent	atpD	
1860	<i>Globicatella sanguis</i>	This patent	atpD	
1861	<i>Lactococcus garvieae</i>	This patent	atpD	
1862	<i>Lactococcus lactis</i>	This patent	atpD	
1863	<i>Listeria ivanovii</i>	This patent	atpD	
1864	<i>Succinivibrio dextrinosolvens</i>	This patent	atpD	
1865	<i>Tetragenococcus halophilus</i>	This patent	atpD	
1866	<i>Campylobacter fetus</i> subsp. <i>fetus</i>	This patent	recA	
1867	<i>Campylobacter fetus</i> subsp. <i>venerealis</i>	This patent	recA	
1868	<i>Campylobacter jejuni</i> subsp. <i>jejuni</i>	This patent	recA	
1869	<i>Enterococcus avium</i>	This patent	recA	
1870	<i>Enterococcus faecium</i>	This patent	recA	
1871	<i>Listeria monocytogenes</i>	This patent	recA	
1872	<i>Streptococcus mitis</i>	This patent	recA	
1873	<i>Streptococcus oralis</i>	This patent	recA	
1874	<i>Aspergillus fumigatus</i>	This patent	tuf (M)	
1875	<i>Aspergillus versicolor</i>	This patent	tuf (M)	
1876	<i>Basidiobolus ranarum</i>	This patent	tuf (M)	
1877	<i>Campylobacter gracilis</i>	This patent	tuf	
1878	<i>Campylobacter jejuni</i> subsp. <i>jejuni</i>	This patent	tuf	
1879	<i>Coccidioides immitis</i>	This patent	tuf (M)	
1880	<i>Erwinia amylovora</i>	This patent	tuf	
1881	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype <i>Typhimurium</i>	This patent	tuf	
1899	<i>Klebsiella pneumoniae</i>	Database	blaSHV	
1900	<i>Klebsiella pneumoniae</i>	Database	blaSHV	
1901	<i>Escherichia coli</i>	Database	blaSHV	
1902	<i>Klebsiella pneumoniae</i>	Database	blaSHV	
1903	<i>Klebsiella pneumoniae</i>	Database	blaSHV	

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing. Archaeal, bacterial, fungal or parasitical species	Source	Gene*
1904	<i>Escherichia coli</i>	Database	blaSHV
1905	<i>Pseudomonas aeruginosa</i>	Database	blaSHV
1927	<i>Neisseria meningitidis</i>	Database	blaTEM
1928	<i>Escherichia coli</i>	Database	blaTEM
1929	<i>Klebsiella oxytoca</i>	Database	blaTEM
1930	<i>Escherichia coli</i>	Database	blaTEM
1931	<i>Escherichia coli</i>	Database	blaTEM
1932	<i>Escherichia coli</i>	Database	blaTEM
1933	<i>Escherichia coli</i>	Database	blaTEM
1954	<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	Database	gyrA
1956	<i>Candida inconspicua</i>	This patent	tuf (M)
1957	<i>Candida utilis</i>	This patent	tuf (M)
1958	<i>Candida zeylanoides</i>	This patent	tuf (M)
1959	<i>Candida catenulata</i>	This patent	tuf (M)
1960	<i>Candida krusei</i>	This patent	tuf (M)
1965	Plasmid pGS05	Database	sullI
1970	Transposon Tn10	Database	tetB
1985	<i>Cryptococcus neoformans</i>	Database	tuf (EF-1)
1986	<i>Cryptococcus neoformans</i>	Database	tuf (EF-1)
1987	<i>Saccharomyces cerevisiae</i>	Database	tuf (EF-1)
1988	<i>Saccharomyces cerevisiae</i>	Database	tuf (EF-1)
1989	<i>Eremothecium gossypii</i>	Database	tuf (EF-1)
1990	<i>Eremothecium gossypii</i>	Database	tuf (EF-1)
1991	<i>Aspergillus oryzae</i>	Database	tuf (EF-1)
1992	<i>Aureobasidium pullulans</i>	Database	tuf (EF-1)
1993	<i>Histoplasma capsulatum</i>	Database	tuf (EF-1)
1994	<i>Neurospora crassa</i>	Database	tuf (EF-1)
1995	<i>Podospora anserina</i>	Database	tuf (EF-1)
1996	<i>Podospora curvicerca</i>	Database	tuf (EF-1)
1997	<i>Sordaria macrospora</i>	Database	tuf (EF-1)
1998	<i>Trichoderma reesei</i>	Database	tuf (EF-1)
2004	<i>Candida albicans</i>	Database	tuf (M)
2005	<i>Schizosaccharomyces pombe</i>	Database	tuf (M)
2010	<i>Klebsiella pneumoniae</i>	Database	blaTEM
2011	<i>Klebsiella pneumoniae</i>	Database	blaTEM
2013	<i>Kluyvera ascorbata</i>	This patent	gyrA
2014	<i>Kluyvera georgiana</i>	This patent	gyrA
2047	<i>Streptococcus pneumoniae</i>	Database	pbp1A
2048	<i>Streptococcus pneumoniae</i>	Database	pbp1A
2049	<i>Streptococcus pneumoniae</i>	Database	pbp1A
2050	<i>Streptococcus pneumoniae</i>	Database	pbp1A
2051	<i>Streptococcus pneumoniae</i>	Database	pbp1A
2052	<i>Streptococcus pneumoniae</i>	Database	pbp1A
2053	<i>Streptococcus pneumoniae</i>	Database	pbp1A
2054	<i>Streptococcus pneumoniae</i>	Database	gyrA
2055	<i>Streptococcus pneumoniae</i>	Database	parC
2056	<i>Streptococcus pneumoniae</i>	This patent	pbp1A
2057	<i>Streptococcus pneumoniae</i>	This patent	pbp1A
2058	<i>Streptococcus pneumoniae</i>	This patent	pbp1A
2059	<i>Streptococcus pneumoniae</i>	This patent	pbp1A
2060	<i>Streptococcus pneumoniae</i>	This patent	pbp1A
2061	<i>Streptococcus pneumoniae</i>	This patent	pbp1A
2062	<i>Streptococcus pneumoniae</i>	This patent	pbp1A
2063	<i>Streptococcus pneumoniae</i>	This patent	pbp1A
2064	<i>Streptococcus pneumoniae</i>	This patent	pbp1A
2072	<i>Mycobacterium tuberculosis</i>	Database	rpoB
2097	<i>Mycoplasma pneumoniae</i>	Database	tuf
2101	<i>Mycobacterium tuberculosis</i>	Database	inhA
2105	<i>Mycobacterium tuberculosis</i>	Database	embB
2129	<i>Clostridium difficile</i>	Database	cdtA
2130	<i>Clostridium difficile</i>	Database	cdtB
2137	<i>Pseudomonas putida</i>	Genome project	tuf
2138	<i>Pseudomonas aeruginosa</i>	Genome project	tuf
2139	<i>Campylobacter jejuni</i>	Database	atpD
2140	<i>Streptococcus pneumoniae</i>	Database	pbp1a
2144	<i>Staphylococcus aureus</i>	Database	mupA
2147	<i>Escherichia coli</i>	Database	catI
2150	<i>Escherichia coli</i>	Database	catII
2153	<i>Shigella flexneri</i>	Database	catIII
2156	<i>Clostridium perfringens</i>	Database	catP
2159	<i>Staphylococcus aureus</i>	Database	cat
2162	<i>Staphylococcus aureus</i>	Database	cat
2165	<i>Salmonella typhimurium</i>	Database	ppf1o-like

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing. Archaeal, bacterial, fungal or parasitical species	Source	Gene*
5			
2183	<i>Alcaligenes faecalis</i> subsp. <i>faecalis</i>	This patent	tuf
2184	<i>Campylobacter coli</i>	This patent	fusA
2185	<i>Succinivibrio dextrinosolvens</i>	This patent	tuf
2186	<i>Tetragenococcus halophilus</i>	This patent	tuf
2187	<i>Campylobacter jejuni</i> subsp. <i>jejuni</i>	This patent	fusA
2188	<i>Campylobacter jejuni</i> subsp. <i>jejuni</i>	This patent	fusA
2189	<i>Leishmania guyanensis</i>	This patent	atpD
2190	<i>Trypanosoma brucei brucei</i>	This patent	atpD
2191	<i>Aspergillus nidulans</i>	This patent	atpD
2192	<i>Leishmania panamensis</i>	This patent	atpD
2193	<i>Aspergillus nidulans</i>	This patent	tuf (M)
2194	<i>Aureobasidium pullulans</i>	This patent	tuf (M)
2195	<i>Emmonia parva</i>	This patent	tuf (M)
2196	<i>Escherichium rostratum</i>	This patent	tuf (M)
2197	<i>Fusarium moniliforme</i>	This patent	tuf (M)
2198	<i>Fusarium solani</i>	This patent	tuf (M)
2199	<i>Histoplasma capsulatum</i>	This patent	tuf (M)
2200	<i>Kocuria kristinae</i>	This patent	tuf
2201	<i>Vibrio mimicus</i>	This patent	tuf
2202	<i>Citrobacter freundii</i>	This patent	recA
2203	<i>Clostridium botulinum</i>	This patent	recA
2204	<i>Francisella tularensis</i>	This patent	recA
2205	<i>Peptostreptococcus anaerobius</i>	This patent	recA
2206	<i>Peptostreptococcus asaccharolyticus</i>	This patent	recA
2207	<i>Providencia stuartii</i>	This patent	recA
2208	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype Paratyphi A	This patent	recA
2209	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype Typhimurium	This patent	recA
35			
2210	<i>Staphylococcus saprophyticus</i>	This patent	recA
2211	<i>Yersinia pseudotuberculosis</i>	This patent	recA
2212	<i>Zoogloea ramigera</i>	This patent	recA
2214	<i>Abiotrophia adiacens</i>	This patent	fusA
2215	<i>Acinetobacter baumannii</i>	This patent	fusA
2216	<i>Actinomyces meyeri</i>	This patent	fusA
2217	<i>Clostridium difficile</i>	This patent	fusA
40			
2218	<i>Corynebacterium diphtheriae</i>	This patent	fusA
2219	<i>Enterobacter cloacae</i>	This patent	fusA
2220	<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	This patent	fusA
2221	<i>Listeria monocytogenes</i>	This patent	fusA
2222	<i>Mycobacterium avium</i>	This patent	fusA
2223	<i>Mycobacterium gordonae</i>	This patent	fusA
2224	<i>Mycobacterium kansasii</i>	This patent	fusA
2225	<i>Mycobacterium terrae</i>	This patent	fusA
2226	<i>Neisseria polysaccharea</i>	This patent	fusA
2227	<i>Staphylococcus epidermidis</i>	This patent	fusA
2228	<i>Staphylococcus haemolyticus</i>	This patent	fusA
2229	<i>Succinivibrio dextrinosolvens</i>	This patent	fusA
2230	<i>Tetragenococcus halophilus</i>	This patent	fusA
2231	<i>Veillonella parvula</i>	This patent	fusA
2232	<i>Yersinia pseudotuberculosis</i>	This patent	fusA
2233	<i>Zoogloea ramigera</i>	This patent	fusA
2234	<i>Aeromonas hydrophila</i>	This patent	fusA
55			
2235	<i>Abiotrophia adiacens</i>	This patent	fusA-tuf spacer
2236	<i>Acinetobacter baumannii</i>	This patent	fusA-tuf spacer
2237	<i>Actinomyces meyeri</i>	This patent	fusA-tuf spacer
60			
2238	<i>Clostridium difficile</i>	This patent	fusA-tuf spacer
2239	<i>Corynebacterium diphtheriae</i>	This patent	fusA-tuf spacer
2240	<i>Enterobacter cloacae</i>	This patent	fusA-tuf spacer
65			
2241	<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	This patent	fusA-tuf spacer

TABLE 7-continued

SEQ ID NO.	Origin of the nucleic acids and/or sequences in the sequence listing. Archaeal, bacterial, fungal or parasitical species	Source	Gene*	
2242	<i>Listeria monocytogenes</i>	This patent	fusA-tuf	
2243	<i>Mycobacterium avium</i>	This patent	spacer	
2244	<i>Mycobacterium gordonae</i>	This patent	fusA-tuf	10
2245	<i>Mycobacterium kansasii</i>	This patent	spacer	
2246	<i>Mycobacterium terrae</i>	This patent	fusA-tuf	
2247	<i>Neisseria polysaccharea</i>	This patent	spacer	
2248	<i>Staphylococcus epidermidis</i>	This patent	fusA-tuf	15
2249	<i>Staphylococcus haemolyticus</i>	This patent	spacer	
2255	<i>Abiotrophia adiacens</i>	This patent	tuf	
2256	<i>Acinetobacter baumannii</i>	This patent	tuf	
2257	<i>Actinomyces meyeri</i>	This patent	tuf	20
2258	<i>Clostridium difficile</i>	This patent	tuf	
2259	<i>Corynebacterium diphtheriae</i>	This patent	tuf	
2260	<i>Enterobacter cloacae</i>	This patent	tuf	
2261	<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	This patent	tuf	
2262	<i>Listeria monocytogenes</i>	This patent	tuf	25
2263	<i>Mycobacterium avium</i>	This patent	tuf	
2264	<i>Mycobacterium gordonae</i>	This patent	tuf	
2265	<i>Mycobacterium kansasii</i>	This patent	tuf	
2266	<i>Mycobacterium terrae</i>	This patent	tuf	
2267	<i>Neisseria polysaccharea</i>	This patent	tuf	30
2268	<i>Staphylococcus epidermidis</i>	This patent	tuf	
2269	<i>Staphylococcus haemolyticus</i>	This patent	tuf	
2270	<i>Aeromonas hydrophila</i>	This patent	tuf	
2271	<i>Bilophila wadsworthia</i>	This patent	tuf	
2272	<i>Brevundimonas diminuta</i>	This patent	tuf	
2273	<i>Streptococcus mitis</i>	This patent	pbp1a	35
2274	<i>Streptococcus mitis</i>	This patent	pbp1a	
2275	<i>Streptococcus mitis</i>	This patent	pbp1a	
2276	<i>Streptococcus oralis</i>	This patent	pbp1a	
2277	<i>Escherichia coli</i>	This patent	gyrA	
2278	<i>Escherichia coli</i>	This patent	gyrA	40
2279	<i>Escherichia coli</i>	This patent	gyrA	
2280	<i>Escherichia coli</i>	This patent	gyrA	
2288	<i>Enterococcus faecium</i>	Database	ddl	
2293	<i>Enterococcus faecium</i>	Database	vanA	
2296	<i>Enterococcus faecalis</i>	Database	vanB	

*tuf indicates tuf sequences, tuf (C) indicates tuf sequences divergent from main (usually A and B) copies of the elongation factor-Tu, tuf (EF-1) indicates tuf sequences of the eukaryotic type (elongation factor 1α), tuf (M) indicates tuf sequences from organellar (mostly mitochondrial) origin.

fusA indicates fusA sequences; fusA-tuf spacer indicates the intergenic region between fusA and tuf.

atpD indicates atpD sequences of the F-type, atpD (V) indicates atpD sequences of the V-type.

recA indicates recA sequences, recA(Rad51) indicates rad51 sequences or homologs and recA(Dmc1) indicates dmc1 sequences or homologs.

TABLE 8-continued

Bacterial species used to test the specificity of the <i>Streptococcus agalactiae</i> -specific amplification primers derived from tuf sequences.		
5	Strain	Reference number
	<i>Streptococcus downei</i>	ATCC 33748
	<i>Streptococcus dysgalactiae</i>	ATCC 43078
	<i>Streptococcus equi</i> subsp. <i>equi</i>	ATCC 9528
	<i>Streptococcus ferus</i>	ATCC 33477
	<i>Streptococcus gordonii</i>	ATCC 10558
	<i>Streptococcus macacae</i>	ATCC 35911
	<i>Streptococcus mitis</i>	ATCC 49456
	<i>Streptococcus mutans</i>	ATCC 25175
	<i>Streptococcus oralis</i>	ATCC 35037
	<i>Streptococcus parasanguinis</i>	ATCC 15912
	<i>Streptococcus paruberis</i>	DSM 6631
	<i>Streptococcus pneumoniae</i>	ATCC 27336
	<i>Streptococcus pyogenes</i>	ATCC 19615
	<i>Streptococcus ratti</i>	ATCC 19645
	<i>Streptococcus salivarius</i>	ATCC 7073
	<i>Streptococcus sanguinis</i>	ATCC 10556
	<i>Streptococcus sobrinus</i>	ATCC 27352
	<i>Streptococcus suis</i>	ATCC 43765
	<i>Streptococcus uberis</i>	ATCC 19436
	<i>Streptococcus vestibularis</i>	ATCC 49124
	<i>Bacteroides caccae</i>	ATCC 43185
	<i>Bacteroides vulgatus</i>	ATCC 8482
	<i>Bacteroides fragilis</i>	ATCC 25285
	<i>Candida albicans</i>	ATCC 11006
	<i>Clostridium innoculum</i>	ATCC 14501
	<i>Clostridium ramosum</i>	ATCC 25582
	<i>Lactobacillus casei</i> subsp. <i>casei</i>	ATCC 393
	<i>Clostridium septicum</i>	ATCC 12464
	<i>Corynebacterium cervicis</i>	NCTC 10604
	<i>Corynebacterium genitalium</i>	ATCC 33031
	<i>Corynebacterium urealyticum</i>	ATCC 43042
	<i>Enterococcus faecalis</i>	ATCC 29212
	<i>Enterococcus faecium</i>	ATCC 19434
	<i>Eubacterium lentum</i>	ATCC 43055
	<i>Eubacterium nodatum</i>	ATCC 33099
	<i>Gardnerella vaginalis</i>	ATCC 14018
	<i>Lactobacillus acidophilus</i>	ATCC 4356
	<i>Lactobacillus crispatus</i>	ATCC 33820
	<i>Lactobacillus gasseri</i>	ATCC 33323
	<i>Lactobacillus johnsonii</i>	ATCC 33200
	<i>Lactococcus lactis</i> subsp. <i>lactis</i>	ATCC 19435
	<i>Lactococcus lactis</i> subsp. <i>lactis</i>	ATCC 11454
	<i>Listeria innocua</i>	ATCC 33090
	<i>Micrococcus luteus</i>	ATCC 9341
	<i>Escherichia coli</i>	ATCC 25922
	<i>Micrococcus lylae</i>	ATCC 27566
	<i>Porphyromonas asaccharolytica</i>	ATCC 25260
	<i>Prevotella corporis</i>	ATCC 33547
	<i>Prevotella melanogenica</i>	ATCC 25845
	<i>Staphylococcus aureus</i>	ATCC 13301
	<i>Staphylococcus epidermidis</i>	ATCC 14990
	<i>Staphylococcus saprophyticus</i>	ATCC 15305

TABLE 8

Strain	Reference number
<i>Streptococcus acidominimus</i>	ATCC 51726
<i>Streptococcus agalactiae</i>	ATCC 12403
<i>Streptococcus agalactiae</i>	ATCC 12973
<i>Streptococcus agalactiae</i>	ATCC 13813
<i>Streptococcus agalactiae</i>	ATCC 27591
<i>Streptococcus agalactiae</i>	CDCs 1073
<i>Streptococcus anginosus</i>	ATCC 27335
<i>Streptococcus anginosus</i>	ATCC 33397
<i>Streptococcus bovis</i>	ATCC 33317
<i>Streptococcus anginosus</i>	ATCC 27823
<i>Streptococcus cricetus</i>	ATCC 19642
<i>Streptococcus cristatus</i>	ATCC 51100

TABLE 9

Bacterial species used to test the specificity of the <i>Streptococcus agalactiae</i> -specific amplification primers derived from atpD sequences.		
60	Strain	Reference number
	<i>Streptococcus acidominimus</i>	ATCC 51726
	<i>Streptococcus agalactiae</i>	ATCC 12400
	<i>Streptococcus agalactiae</i>	ATCC 12403
	<i>Streptococcus agalactiae</i>	ATCC 12973
	<i>Streptococcus agalactiae</i>	ATCC 13813
	<i>Streptococcus agalactiae</i>	ATCC 27591
	<i>Streptococcus agalactiae</i>	CDCs-1073
	<i>Streptococcus anginosus</i>	ATCC 27335
	<i>Streptococcus anginosus</i>	ATCC 27823
	<i>Streptococcus bovis</i>	ATCC 33317
	<i>Streptococcus cricetus</i>	ATCC 19642
	<i>Streptococcus cristatus</i>	ATCC 51100

TABLE 9-continued

Bacterial species used to test the specificity of the *Streptococcus agalactiae*-specific amplification primers derived from *atpD* sequences.

Strain	Reference number
<i>Streptococcus downei</i>	ATCC 33748
<i>Streptococcus dysgalactiae</i>	ATCC 43078
<i>Streptococcus equi</i> subsp. <i>equi</i>	ATCC 9528
<i>Streptococcus ferus</i>	ATCC 33477
<i>Streptococcus gordonii</i>	ATCC 10558
<i>Streptococcus macacae</i>	ATCC 35911
<i>Streptococcus mitis</i>	ATCC 49456
<i>Streptococcus mutans</i>	ATCC 25175
<i>Streptococcus oralis</i>	ATCC 35037
<i>Streptococcus parasanguinis</i>	ATCC 15912
<i>Streptococcus parauberis</i>	DSM 6631
<i>Streptococcus pneumoniae</i>	ATCC 27336
<i>Streptococcus pyogenes</i>	ATCC 19615
<i>Streptococcus ratti</i>	ATCC 19645
<i>Streptococcus salivarius</i>	ATCC 7073
<i>Streptococcus sanguinis</i>	ATCC 10556
<i>Streptococcus sobrinus</i>	ATCC 27352
<i>Streptococcus suis</i>	ATCC 43765
<i>Streptococcus uberis</i>	ATCC 19436
<i>Streptococcus vestibularis</i>	ATCC 49124

TABLE 10

Bacterial species used to test the specificity of the *Enterococcus*-specific amplification primers derived from *tuf* sequences.

Strain	Reference number
Gram-positive species (n = 74)	
<i>Abiotrophia adiacens</i>	ATCC 49176
<i>Abiotrophia defectiva</i>	ATCC 49175
<i>Bacillus cereus</i>	ATCC 14579
<i>Bacillus subtilis</i>	ATCC 27370
<i>Bifidobacterium adolescentis</i>	ATCC 27534
<i>Bifidobacterium breve</i>	ATCC 15700
<i>Bifidobacterium dentium</i>	ATCC 27534
<i>Bifidobacterium longum</i>	ATCC 15707
<i>Clostridium perfringens</i>	ATCC 3124
<i>Clostridium septicum</i>	ATCC 12464
<i>Corynebacterium aquaticus</i>	ATCC 14665
<i>Corynebacterium pseudodiphtheriticum</i>	ATCC 10700
<i>Enterococcus avium</i>	ATCC 14025
<i>Enterococcus casseliflavus</i>	ATCC 25788
<i>Enterococcus cecorum</i>	ATCC 43199
<i>Enterococcus columbae</i>	ATCC 51263
<i>Enterococcus dispar</i>	ATCC 51266
<i>Enterococcus durans</i>	ATCC 19432
<i>Enterococcus faecalis</i>	ATCC 29212
<i>Enterococcus faecium</i>	ATCC 19434
<i>Enterococcus flavescens</i>	ATCC 49996
<i>Enterococcus gallinarum</i>	ATCC 49573
<i>Enterococcus hirae</i>	ATCC 8044
<i>Enterococcus malodoratus</i>	ATCC 43197
<i>Enterococcus mundtii</i>	ATCC 43186
<i>Enterococcus pseudoavium</i>	ATCC 49372
<i>Enterococcus raffinosus</i>	ATCC 49427
<i>Enterococcus saccharolyticus</i>	ATCC 43076
<i>Enterococcus solitarius</i>	ATCC 49428
<i>Enterococcus sulfureus</i>	ATCC 49903
<i>Eubacterium lentum</i>	ATCC 49903
<i>Gemella haemolysans</i>	ATCC 10379
<i>Gemella morbillorum</i>	ATCC 27842
<i>Lactobacillus acidophilus</i>	ATCC 4356
<i>Leuconostoc mesenteroides</i>	ATCC 19225
<i>Listeria grayi</i>	ATCC 19120
<i>Listeria grayi</i>	ATCC 19123
<i>Listeria innocua</i>	ATCC 33090
<i>Listeria ivanovii</i>	ATCC 19119
<i>Listeria monocytogenes</i>	ATCC 15313
<i>Listeria seeligeri</i>	ATCC 35967
<i>Micrococcus luteus</i>	ATCC 9341

TABLE 10-continued

Bacterial species used to test the specificity of the *Enterococcus*-specific amplification primers derived from *tuf* sequences.

Strain	Reference number
<i>Pediococcus acidilacti</i>	ATCC 33314
<i>Pediococcus pentosaceus</i>	ATCC 33316
<i>Peptococcus niger</i>	ATCC 27731
<i>Peptostreptococcus anaerobius</i>	ATCC 27337
<i>Peptostreptococcus indolicus</i>	ATCC 29247
<i>Peptostreptococcus micros</i>	ATCC 33270
<i>Propionibacterium acnes</i>	ATCC 6919
<i>Staphylococcus aureus</i>	ATCC 43300
<i>Staphylococcus capitis</i>	ATCC 27840
<i>Staphylococcus epidermidis</i>	ATCC 14990
<i>Staphylococcus haemolyticus</i>	ATCC 29970
<i>Staphylococcus hominis</i>	ATCC 27844
<i>Staphylococcus lugdunensis</i>	ATCC 43809
<i>Staphylococcus saprophyticus</i>	ATCC 15305
<i>Staphylococcus simulans</i>	ATCC 27848
<i>Staphylococcus warneri</i>	ATCC 27836
<i>Streptococcus agalactiae</i>	ATCC 13813
<i>Streptococcus anginosus</i>	ATCC 33397
<i>Streptococcus bovis</i>	ATCC 33317
<i>Streptococcus constellatus</i>	ATCC 27823
<i>Streptococcus cristatus</i>	ATCC 51100
<i>Streptococcus intermedius</i>	ATCC 27335
<i>Streptococcus mitis</i>	ATCC 49456
<i>Streptococcus mitis</i>	ATCC 3639
<i>Streptococcus mutans</i>	ATCC 27175
<i>Streptococcus parasanguinis</i>	ATCC 15912
<i>Streptococcus pneumoniae</i>	ATCC 27736
<i>Streptococcus pneumoniae</i>	ATCC 6303
<i>Streptococcus pyogenes</i>	ATCC 19615
<i>Streptococcus salivarius</i>	ATCC 7073
<i>Streptococcus sanguinis</i>	ATCC 10556
<i>Streptococcus suis</i>	ATCC 43765
Gram-negative species (n = 39)	
<i>Acidominococcus fermentans</i>	ATCC 2508
<i>Acinetobacter baumannii</i>	ATCC 19606
<i>Alcaligenes faecalis</i>	ATCC 8750
<i>Anaerobiospirillum</i>	ATCC 29305
<i>succiniproducens</i>	
<i>Anaerorhabdus furcosus</i>	ATCC 25662
<i>Bacteroides distasonis</i>	ATCC 8503
<i>Bacteroides thetaiaomicron</i>	ATCC 29741
<i>Bacteroides vulgatus</i>	ATCC 8482
<i>Bordetella pertussis</i>	LSPQ 3702
<i>Bulkholderia cepacia</i>	LSPQ 2217
<i>Butyrivibrio fibrisolvens</i>	ATCC 19171
<i>Cardiobacterium hominis</i>	ATCC 15826
<i>Citrobacter freundii</i>	ATCC 8090
<i>Desulfovibrio vulgaris</i>	ATCC 29579
<i>Edwardsiella tarda</i>	ATCC 15947
<i>Enterobacter cloacae</i>	ATCC 13047
<i>Escherichia coli</i>	ATCC 25922
<i>Fusobacterium russii</i>	ATCC 25533
<i>Haemophilus influenzae</i>	ATCC 9007
<i>Hafnia alvei</i>	ATCC 13337
<i>Klebsiella oxytoca</i>	ATCC 13182
<i>Meganomonas hypermegas</i>	ATCC 25560
<i>Mitsukella multicidus</i>	ATCC 27723
<i>Moraxella catarrhalis</i>	ATCC 43628
<i>Morganella morganii</i>	ATCC 25830
<i>Neisseria meningitidis</i>	ATCC 13077
<i>Pasteurella aerogenes</i>	ATCC 27883
<i>Proteus vulgaris</i>	ATCC 13315
<i>Providencia alcalifaciens</i>	ATCC 9886
<i>Providencia rettgeri</i>	ATCC 9250
<i>Pseudomonas aeruginosa</i>	ATCC 27853
<i>Salmonella typhimurium</i>	ATCC 14028
<i>Serratia marcescens</i>	ATCC 13880
<i>Shigella flexneri</i>	ATCC 12022
<i>Shigella sonnei</i>	ATCC 29930
<i>Succinivibrio dextrinosolvens</i>	ATCC 19716
<i>Tissierella praeacuta</i>	ATCC 25539
<i>Veillonella parvula</i>	ATCC 10790
<i>Yersinia enterocolitica</i>	ATCC 9610

TABLE 11

Microbial species for which tuf and/or atpD and/or recA sequences are available in public databases.			
Species	Strain	Accession number	Coding gene*
tuf sequences			
Bacteria			
<i>Actinobacillus actinomycetemcomitans</i>	HK1651	Genome project ²	tuf
<i>Actinobacillus actinomycetemcomitans</i>	HK1651	Genome project ²	tuf (EF-G)
<i>Agrobacterium tumefaciens</i>		X99673	tuf
<i>Agrobacterium tumefaciens</i>		X99673	tuf (EF-G)
<i>Agrobacterium tumefaciens</i>		X99674	tuf
<i>Anacystis nidulans</i>	PCC 6301	X17442	tuf
<i>Aquifex aeolicus</i>	VF5	AE000669	tuf
<i>Aquifex aeolicus</i>	VF5	AE000669	tuf (EF-G)
<i>Aquifex pyrophilus</i>		Genome project ²	tuf (EF-G)
<i>Aquifex pyrophilus</i>		Y15787	tuf
<i>Bacillus anthracis</i>	Ames	Genome project ²	tuf
<i>Bacillus anthracis</i>	Ames	Genome project ²	tuf (EF-G)
<i>Bacillus halodurans</i>	C-125	AB017508	tuf
<i>Bacillus halodurans</i>	C-125	AB017508	tuf (EF-G)
<i>Bacillus stearothermophilus</i>	CCM 2184	AJ000260	tuf
<i>Bacillus subtilis</i>	168	D64127	tuf
<i>Bacillus subtilis</i>	168	D64127	tuf (EF-G)
<i>Bacillus subtilis</i>	DSM 10	Z99104	tuf
<i>Bacillus subtilis</i>	DSM 10	Z99104	tuf (EF-G)
<i>Bacteroides forsythus</i>	ATCC 43037	AB035466	tuf
<i>Bacteroides fragilis</i>	DSM 1151	— ¹	tuf
<i>Bordetella bronchiseptica</i>	RB50	Genome project ²	tuf
<i>Bordetella pertussis</i>	Tohama 1	Genome project ²	tuf
<i>Bordetella pertussis</i>	Tohama 1	Genome project ²	tuf (EF-G)
<i>Borrelia burgdorferi</i>	B31	U78193	tuf
<i>Borrelia burgdorferi</i>		AE001155	tuf (EF-G)
<i>Brevibacterium linens</i>	DSM 20425	X76863	tuf
<i>Buchnera aphidicola</i>	Ap	Y12307	tuf
<i>Burkholderia pseudomallei</i>	K96243	Genome project ²	tuf (EF-G)
<i>Campylobacter jejuni</i>	NCTC 11168	Y17167	tuf
<i>Campylobacter jejuni</i>	NCTC 11168	CJ11168X2	tuf (EF-G)
<i>Chlamydia pneumoniae</i>	CWL029	AE001592	tuf
<i>Chlamydia pneumoniae</i>	CWL029	AE001639	tuf (EF-G)
<i>Chlamydia trachomatis</i>		M74221	tuf
<i>Chlamydia trachomatis</i>	D/UW-3/CX	AE001317	tuf (EF-G)
<i>Chlamydia trachomatis</i>	D/UW-3/CX	AE001305	tuf
<i>Chlamydia trachomatis</i>	F/IC-Cal-13	L22216	tuf
<i>Chlorobium vibrioforme</i>	DSM 263	X77033	tuf
<i>Chloroflexus aurantiacus</i>	DSM 636	X76865	tuf
<i>Clostridium acetobutylicum</i>	Clostridium 824	Genome project ²	tuf
<i>Clostridium difficile</i>	630	Genome project ²	tuf
<i>Clostridium difficile</i>	630	Genome project ²	tuf (EF-G)
<i>Corynebacterium diphtheriae</i>	NCTC 13129	Genome project ²	tuf
<i>Corynebacterium diphtheriae</i>	NCTC 13129	Genome project ²	tuf (EF-G)
<i>Corynebacterium glutamicum</i>	ASO 19	X77034	tuf
<i>Corynebacterium glutamicum</i>	MJ-233	E09634	tuf
<i>Coxiella burnetii</i>	Nine Mile phase I	AF136604	tuf
<i>Cytophaga lytica</i>	DSM 2039	X77035	tuf
<i>Deinococcus radiodurans</i>	R1	AE001891	tuf (EF-G)
<i>Deinococcus radiodurans</i>	R1	AE180092	tuf
<i>Deinococcus radiodurans</i>	R1	AE002041	tuf
<i>Deinonema</i> sp.		— ¹	tuf
<i>Eikenella corrodens</i>	ATCC 23834	Z12610	tuf
<i>Eikenella corrodens</i>	ATCC 23834	Z12610	tuf (EF-G)
<i>Enterococcus faecalis</i>		Genome project ²	tuf (EF-G)
<i>Escherichia coli</i>		J01690	tuf
<i>Escherichia coli</i>		J01717	tuf
<i>Escherichia coli</i>		X00415	tuf (EF-G)
<i>Escherichia coli</i>		X57091	tuf
<i>Escherichia coli</i>	K-12 MG1655	U000006	tuf
<i>Escherichia coli</i>	K-12 MG1655	U000096	tuf
<i>Escherichia coli</i>	K-12 MG1655	AE000410	tuf (EF-G)
<i>Fervidobacterium islandicum</i>	DSM 5733	Y15788	tuf
<i>Fibrobacter succinogenes</i>	S85	X76866	tuf
<i>Flavobacterium ferrigeneum</i>	DSM 13524	X76867	tuf
<i>Flexistipes sinusarabici</i>	X59461	tuf	
<i>Gloeobacter violaceus</i>	PCC 7421	U09433	tuf
<i>Gloeothece</i> sp.	PCC 6501	U09434	tuf
<i>Haemophilus actinomycetemcomitans</i>	HK1651	Genome project ²	tuf
<i>Haemophilus ducreyi</i>	35000	AF087414	tuf (EF-G)
<i>Haemophilus influenzae</i>	Rd	U32739	tuf

TABLE 11-continued

Microbial species for which tuf and/or atpD and/or recA sequences are available in public databases.

Species	Strain	Accession number	Coding gene*
<i>Haemophilus influenzae</i>	Rd	U32746	tuf
<i>Haemophilus influenzae</i>	Rd	U32739	tuf (EF-G)
<i>Helicobacter pylori</i>	26695	AE000511	tuf
<i>Helicobacter pylori</i>	J99	AE001539	tuf (EF-G)
<i>Helicobacter pylori</i>	J99	AE001541	tuf
<i>Herpetosiphon aurantiacus</i>	Hpga1	X76868	tuf
<i>Klebsiella pneumoniae</i>	M6H 78578	Genome project ²	tuf
<i>Klebsiella pneumoniae</i>	M6H 78578	Genome project ²	tuf (EF-G)
<i>Lactobacillus paracasei</i>		E13922	tuf
<i>Legionella pneumophila</i>	Philadelphia-1	Genome project ²	tuf
<i>Leptospira interrogans</i>		AF115283	tuf
<i>Leptospira interrogans</i>		AF115283	tuf (EF-G)
<i>Micrococcus luteus</i>	IFO 3333	M17788	tuf (EF-G)
<i>Micrococcus luteus</i>	IFO 3333	M17788	tuf
<i>Moraxella</i> sp.	TAC II 25	AJ249258	tuf
<i>Mycobacterium avium</i>	104	Genome project ²	tuf
<i>Mycobacterium avium</i>	104	Genome project ²	tuf (EF-G)
<i>Mycobacterium bovis</i>	AF2122/97	Genome project ²	tuf
<i>Mycobacterium bovis</i>	AF2122/97	Genome project ²	tuf (EF-G)
<i>Mycobacterium leprae</i>		L13276	tuf
<i>Mycobacterium leprae</i>		Z14314	tuf
<i>Mycobacterium leprae</i>		Z14314	tuf (EF-G)
<i>Mycobacterium leprae</i>	Thai 53	D13869	tuf
<i>Mycobacterium tuberculosis</i>	Erdmann	S40925	tuf
<i>Mycobacterium tuberculosis</i>	H37Rv	AL021943	tuf (EF-G)
<i>Mycobacterium tuberculosis</i>	H37Rv	Z84395	tuf
<i>Mycobacterium tuberculosis</i>	y42	AD000005	tuf
<i>Mycobacterium tuberculosis</i>	CSU#93	Genome project ²	tuf
<i>Mycobacterium tuberculosis</i>	CSU#93	Genome project ²	tuf (EF-G)
<i>Mycoplasma capricolum</i>	PG-31	X16462	tuf
<i>Mycoplasma genitalium</i>	G37	U39732	tuf
<i>Mycoplasma genitalium</i>	G37	U39689	tuf (EF-G)
<i>Mycoplasma hominis</i>		X57136	tuf
<i>Mycoplasma hominis</i>	PG21	M57675	tuf
<i>Mycoplasma pneumoniae</i>	M129	AE000019	tuf
<i>Mycoplasma pneumoniae</i>	M129	AE000058	tuf (EF-G)
<i>Neisseria gonorrhoeae</i>	MS11	L36380	tuf
<i>Neisseria gonorrhoeae</i>	MS11	L36380	tuf (EF-G)
<i>Neisseria meningitidis</i>	Z2491	Genome project ²	tuf (EF-G)
<i>Neisseria meningitidis</i>	Z2491	Genome project ²	tuf
<i>Pasteurella multocida</i>	Pm70	Genome project ²	tuf
<i>Peptococcus niger</i>	DSM 20745	X76869	tuf
<i>Phormidium ectocarpi</i>	PCC 7375	U09443	tuf
<i>Planobispora rosea</i>	ATCC 53773	U67308	tuf
<i>Planobispora rosea</i>	ATCC 53773	X98830	tuf
<i>Planobispora rosea</i>	ATCC 53773	X98830	tuf (EF-G)
<i>Plectonema boryanum</i>	PCC 73110	U09444	tuf
<i>Porphyromonas gingivalis</i>	W83	Genome project ²	tuf
<i>Porphyromonas gingivalis</i>	W83	Genome project ²	tuf (EF-G)
<i>Porphyromonas gingivalis</i>	FDC 381	AB035461	tuf
<i>Porphyromonas gingivalis</i>	W83	AB035462	tuf
<i>Porphyromonas gingivalis</i>	SUNY 1021	AB035463	tuf
<i>Porphyromonas gingivalis</i>	A7A1-28	AB035464	tuf
<i>Porphyromonas gingivalis</i>	ATCC 33277	AB035465	tuf
<i>Porphyromonas gingivalis</i>	ATCC 33277	AB035471	tuf (EF-G)
<i>Prochlorothrix hollandica</i>		U09445	tuf
<i>Pseudomonas aeruginosa</i>	PAO-1	Genome project ²	tuf
<i>Pseudomonas putida</i>		Genome project ²	tuf
<i>Rickettsia prowazekii</i>	Madrid E	AJ235272	tuf
<i>Rickettsia prowazekii</i>	Madrid E	AJ235270	tuf (EF-G)
<i>Rickettsia prowazekii</i>	Madrid E	Z54171	tuf (EF-G)
<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype <i>Typhimurium</i>		X64591	tuf (EF-G)
<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype <i>Typhimurium</i>	LT2 trpE91	X55116	tuf
<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i> serotype <i>Typhimurium</i>	LT2 trpE91	X55117	tuf
<i>Serpulina hyodysenteriae</i>	B204	U51635	tuf
<i>Serratia marcescens</i>		AF058451	tuf
<i>Shewanella putrefaciens</i>	DSM 50426	— ¹	tuf
<i>Shewanella putrefaciens</i>	MR-1	Genome project ²	tuf
<i>Spirochaeta aurantia</i>	DSM 1902	X76874	tuf
<i>Staphylococcus aureus</i>		AJ237696	tuf (EF-G)
<i>Staphylococcus aureus</i>	EMRSA-16	Genome project ²	tuf
<i>Staphylococcus aureus</i>	NCTC 8325	Genome project ²	tuf

TABLE 11-continued

Microbial species for which tuf and/or atpD and/or recA sequences are available in public databases.			
Species	Strain	Accession number	Coding gene*
<i>Staphylococcus aureus</i>	COL	Genome project ²	tuf
<i>Staphylococcus aureus</i>	EMRSA-16	Genome project ²	tuf (EF-G)
<i>Stigmatella aurantiaca</i>	DW4	X82820	tuf
<i>Stigmatella aurantiaca</i>	Sg a1	X76870	tuf
<i>Streptococcus mutans</i>	GS-5 Kuramitsu	U75481	tuf
<i>Streptococcus mutans</i>	UAB159	Genome project ²	tuf
<i>Streptococcus oralis</i>	NTCC 11427	P331701	tuf
<i>Streptococcus pyogenes</i>		Genome project ²	tuf (EF-G)
<i>Streptococcus pyogenes</i>	M1-GAS	Genome project ²	tuf
<i>Streptomyces aureofaciens</i>	ATCC 10762	AF007125	tuf
<i>Streptomyces cinnamoneus</i>	Tue89	X98831	tuf
<i>Streptomyces coelicolor</i>	A3(2)	AI031013	tuf (EF-G)
<i>Streptomyces coelicolor</i>	A3(2)	X77039	tuf (EF-G)
<i>Streptomyces colinii</i>	M145	X77039	tuf
<i>Streptomyces colinii</i>	BSM 40733	S79408	tuf
<i>Streptomyces netropsis</i>	Tu1063	AF153618	tuf
<i>Streptomyces netropsis</i>		X67057	tuf
<i>Streptomyces ramocissimus</i>		X67058	tuf
<i>Streptomyces ramocissimus</i>		X67057	tuf (EF-G)
<i>Synechococcus</i> sp.	PCC 6301	X17442	tuf (EF-G)
<i>Synechococcus</i> sp.	PCC 6301	X17442	tuf
<i>Synechocystis</i> sp.	PCC 6803	D90913	tuf (EF-G)
<i>Synechocystis</i> sp.	PCC 6803	D90913	tuf
<i>Synechocystis</i> sp.	PCC 6803	X65159	tuf (EF-G)
<i>Taxeobacter occetus</i>	Myx 2105	X77036	tuf
<i>Thermotoga maritima</i>		Genome project ²	tuf (EF-G)
<i>Thermotoga maritima</i>		M27479	tuf
<i>Thermus aquaticus</i>	EP 00276	X66322	tuf
<i>Thermus thermophilus</i>	HB8	X16278	tuf (EF-G)
<i>Thermus thermophilus</i>	HB8	X05977	tuf
<i>Thermus thermophilus</i>	HB8	X06657	tuf
<i>Thiomonas cuprina</i>	DSM 5495	U78300	tuf
<i>Thiomonas cuprina</i>	DSM 5495	U78300	tuf (EF-G)
<i>Thiomonas cuprina</i>	Hoe5	X76871	tuf
<i>Treponema denticola</i>		Genome project ²	tuf
<i>Treponema denticola</i>		Genome project ²	tuf (EF-G)
<i>Treponema pallidum</i>		AE001202	tuf
<i>Treponema pallidum</i>		AE001222	tuf (EF-G)
<i>Treponema pallidum</i>		AE001248	tuf (EF-G)
<i>Ureaplasma urealyticum</i>	ATCC 33697	Z34275	tuf
<i>Ureaplasma urealyticum</i>	serovar 3 biovar 1	AE002151	tuf
<i>Ureaplasma urealyticum</i>	serovar 3 biovar 1	AE002151	tuf (EF-G)
<i>Vibrio cholerae</i>	N16961	Genome project ²	tuf
<i>Wolinella succinogenes</i>	DSM 1740	X76872	tuf
<i>Yersinia pestis</i>	CO-92	Genome project ²	tuf
<i>Yersinia pestis</i>	CO-92	Genome project ²	tuf (EF-G)
Archaeabacteria			
<i>Archaeoglobus fulgidus</i>		Genome project ²	tuf (EF-G)
<i>Halobacterium marismortui</i>		X16677	tuf
<i>Methanobacterium thermoautotrophicum</i> delta H		AE000877	tuf
<i>Methanococcus jannaschii</i>	ATCC 43067	U67486	tuf
<i>Methanococcus vannielii</i>		X05698	tuf
<i>Pyrococcus abyssi</i>	Orsay	AJ248285	tuf
<i>Thermoplasma acidophilum</i>	DSM 1728	X53866	tuf
Fungi			
<i>Absidia glauca</i>	CBS 101.48	X54730	tuf (EF-1)
<i>Arxula adeninivorans</i>	Ls3	Z47379	tuf (EF-1)
<i>Aspergillus oryzae</i>	KBN616	AB007770	tuf (EF-1)
<i>Aureobasidium pullulans</i>	R106	U19723	tuf (EF-1)
<i>Candida albicans</i>	SC5314	Genome project ²	tuf (M)
<i>Candida albicans</i>	SC5314	M29934	tuf (EF-1)
<i>Candida albicans</i>	SC5314	M29935	tuf (EF-1)
<i>Cryptococcus neoformans</i>	B3501	U81803	tuf (EF-1)
<i>Cryptococcus neoformans</i>	M1-106	U81804	tuf (EF-1)
<i>Eremothecium gossypii</i>	ATCC 10895	X73978	tuf (EF-1)
<i>Eremothecium gossypii</i>		A29820	tuf (EF-1)
<i>Fusarium oxysporum</i>	NRRL 26037	AF008498	tuf (EF-1)
<i>Histoplasma capsulatum</i>	186AS	U14100	tuf (EF-1)
<i>Podospora anserina</i>		X74799	tuf (EF-1)
<i>Podospora curvicerca</i>	VLV	X96614	tuf (EF-1)
<i>Prototheca wickerhamii</i>	263-11	AJ245645	tuf (EF-1)
<i>Puccinia graminis</i>	race 32	X73529	tuf (EF-1)
<i>Reclinomonas americana</i>	ATCC 50394	AF007261	tuf (M)

TABLE 11-continued

Microbial species for which tuf and/or atpD and/or recA sequences are available in public databases.			
Species	Strain	Accession number	Coding gene*
<i>Rhizomucor racemosus</i>	ATCC 1216B	X17475	tuf (EF-1)
<i>Rhizomucor racemosus</i>	ATCC 1216B	J02605	tuf (EF-1)
<i>Rhizomucor racemosus</i>	ATCC 1216B	X17476	tuf (EF-1)
<i>Rhodotorula mucilaginosa</i>		AF016239	tuf (EF-1)
<i>Saccharomyces cerevisiae</i>		K00428	tuf (M)
<i>Saccharomyces cerevisiae</i>		M59369	tuf (EF-G)
<i>Saccharomyces cerevisiae</i>		X00779	tuf (EF-1)
<i>Saccharomyces cerevisiae</i>		X01638	tuf (EF-1)
<i>Saccharomyces cerevisiae</i>		M10992	tuf (EF-1)
<i>Saccharomyces cerevisiae</i>	Alpha S288	X78993	tuf (EF-1)
<i>Saccharomyces cerevisiae</i>		M15666	tuf (EF-1)
<i>Saccharomyces cerevisiae</i>		Z35987	tuf (EF-1)
<i>Saccharomyces cerevisiae</i>	S288C (AB972)	U51033	tuf (EF-1)
<i>Schizophyllum commune</i>	1-40	X94913	tuf (EF-1)
<i>Schizosaccharomyces pombe</i>	972h-	AL021816	tuf (EF-1)
<i>Schizosaccharomyces pombe</i>	972h-	AL021813	tuf (EF-1)
<i>Schizosaccharomyces pombe</i>	972h-	D82571	tuf (EF-1)
<i>Schizosaccharomyces pombe</i>	U42189		tuf (EF-1)
<i>Schizosaccharomyces pombe</i>	PR745	D89112	tuf (EF-1)
<i>Sordaria macrospora</i>	OOO	X96615	tuf (EF-1)
<i>Trichoderma reesei</i>	QM9414	Z23012	tuf (EF-1)
<i>Yarrowia lipolytica</i>		AF054510	tuf (EF-1)
Parasites			
<i>Blastocystis hominis</i>	HE87-1	D64080	tuf (EF-1)
<i>Cryptosporidium parvum</i>		U69697	tuf (EF-1)
<i>Eimeria tenella</i>	LS18	A1755521	tuf (EF-1)
<i>Entamoeba histolytica</i>	HM1:IMSS	X83565	tuf (EF-1)
<i>Entamoeba histolytica</i>	NIH 200	M92073	tuf (EF-1)
<i>Giardia lamblia</i>		D14342	tuf (EF-1)
<i>Kentrophoros</i> sp.		AF056101	tuf (EF-1)
<i>Leishmania amazonensis</i>	IFLA/BR/67/PH8	M92653	tuf (EF-1)
<i>Leishmania braziliensis</i>		U72244	tuf (EF-1)
<i>Onchocerca volvulus</i>		M64333	tuf (EF-1)
<i>Porphyra purpurea</i>	Avonport	U08844	tuf (EF-1)
<i>Plasmodium berghei</i>	ANKA	AJ224150	tuf (EF-1)
<i>Plasmodium falciparum</i>	K1	X60488	tuf (EF-1)
<i>Plasmodium knowlesi</i>	line H	AJ224153	tuf (EF-1)
<i>Toxoplasma gondii</i>	RH	Y11431	tuf (EF-1)
<i>Trichomonas tenax</i>	ATCC 30207	D78479	tuf (EF-1)
<i>Trypanosoma brucei</i>	LVH/75/	U10562	tuf (EF-1)
<i>Trypanosoma cruzi</i>	Y	L76077	tuf (EF-1)
Human and plants			
<i>Arabidopsis thaliana</i>	Columbia	X89227	tuf (EF-1)
<i>Glycine max</i>	Ceresia	X89058	tuf (EF-1)
<i>Glycine max</i>	Ceresia	Y15107	tuf (EF-1)
<i>Glycine max</i>	Ceresia	Y15108	tuf (EF-1)
<i>Glycine max</i>	Maple Arrow	X66062	tuf (EF-1)
<i>Homo sapiens</i>		X03558	tuf (EF-1)
<i>Pyramimonas disomata</i>		AB008010	tuf
atpD sequences			
Bacteria			
<i>Acetobacterium woodi</i>	DSM 1030	U10505	atpD
<i>Actinobacillus actinomycetemcomitans</i>	HK1651	Genome project ²	atpD
<i>Bacillus anthracis</i>	Ames	Genome project ²	atpD
<i>Bacillus firmus</i>	OF4	M60117	atpD
<i>Bacillus megaterium</i>	QM B1551	M20255	atpD
<i>Bacillus stearothermophilus</i>		D38058	atpD
<i>Bacillus stearothermophilus</i>	IFO1035	D38060	atpD
<i>Bacillus subtilis</i>	168	Z28592	atpD
<i>Bacteroides fragilis</i>	DSM 2151	M22247	atpD
<i>Bordetella bronchiseptica</i>	RB50	Genome project ²	atpD
<i>Bordetella pertussis</i>	Tohama 1	Genome project ²	atpD
<i>Borrelia burgdorferi</i>	B31	AE001122	atpD (V)
<i>Burkholderia cepacia</i>	DSM50181	X76877	atpD
<i>Burkholderia pseudomallei</i>	K96243	Genome project ²	atpD
<i>Campylobacter jejuni</i>	NCTC 11168	CJ11168X1	atpD
<i>Chlamydia pneumoniae</i>		Genome project ²	atpD (V)
<i>Chlamydia trachomatis</i>	MoPn	Genome project ²	atpD (V)
<i>Chlorobium vibrioforme</i>	DSM 263	X76873	atpD
<i>Citrobacter freundii</i>	JEO503	AF037156	atpD

TABLE 11-continued

Microbial species for which tuf and/or atpD and/or recA sequences are available in public databases.			
Species	Strain	Accession number	Coding gene*
<i>Clostridium acetobutylicum</i>	ATCC 824	Genome project ²	atpD
<i>Clostridium acetobutylicum</i>	DSM 792	AF101055	atpD
<i>Clostridium difficile</i>	630	Genome project ²	atpD
<i>Corynebacterium diphtheriae</i>	NCTC13129	Genome project ²	atpD
<i>Corynebacterium glutamicum</i>	ASO 19	X76875	atpD
<i>Corynebacterium glutamicum</i>	MJ-233	E09634	atpD
<i>Cytophaga lytica</i>	DSM 2039	M22535	atpD
<i>Enterobacter aerogenes</i>	DSM 30053	— ³	atpD
<i>Enterococcus faecalis</i>	V583	Genome project ²	atpD (V)
<i>Enterococcus hirae</i>		M90060	atpD
<i>Enterococcus hirae</i>	ATCC 9790	D17462	atpD (V)
<i>Escherichia coli</i>		J01594	atpD
<i>Escherichia coli</i>		M25464	atpD
<i>Escherichia coli</i>		V00267	atpD
<i>Escherichia coli</i>		V00311	atpD
<i>Escherichia coli</i>	K12 MG1655	L10328	atpD
<i>Flavobacterium ferrugineum</i>	DSM 13524	— ³	atpD
<i>Haemophilus actinomycetemcomitans</i>		Genome project ²	atpD
<i>Haemophilus influenzae</i>	Rd	U32730	atpD
<i>Helicobacter pylori</i>	NCTC 11638	AF004014	atpD
<i>Helicobacter pylori</i>	26695	Genome project ²	atpD
<i>Helicobacter pylori</i>	J99	Genome project ²	atpD
<i>Klebsiella pneumoniae</i>	M6H 78578	Genome project ²	atpD
<i>Lactobacillus casei</i>	DSM 20021	X64542	atpD
<i>Legionella pneumophila</i>	Philadelphia-1	Genome project ²	atpD
<i>Moorella thermoacetica</i>	ATCC 39073	U64318	atpD
<i>Mycobacterium avium</i>	104	Genome project ²	atpD
<i>Mycobacterium bovis</i>	AF2122/97	Genome project ²	atpD
<i>Mycobacterium leprae</i>		U15186	atpD
<i>Mycobacterium leprae</i>		Genome project ²	atpD
<i>Mycobacterium tuberculosis</i>	H37Rv	Z73419	atpD
<i>Mycobacterium tuberculosis</i>	CSU#93	Genome project ²	atpD
<i>Mycoplasma gallisepticum</i>		X64256	atpD
<i>Mycoplasma genitalium</i>	G37	U39725	atpD
<i>Mycoplasma pneumoniae</i>	M129	U43738	atpD
<i>Neisseria gonorrhoeae</i>	FA 1090	Genome project ²	atpD
<i>Neisseria meningitidis</i>	Z2491	Genome project ²	atpD
<i>Pasteurella multocida</i>	Pm70	Genome project ²	atpD
<i>Pectinatus frisingensis</i>	DSM 20465	X64543	atpD
<i>Peptococcus niger</i>	DSM 20475	X76878	atpD
<i>Pirellula marina</i>	IFAM 1313	X57204	atpD
<i>Porphyromonas gingivalis</i>	W83	Genome project ²	atpD (V)
<i>Propionigenium modestum</i>	DSM 2376	X58461	atpD
<i>Pseudomonas aeruginosa</i>	PAO1	Genome project ²	atpD
<i>Pseudomonas putida</i>		Genome project ²	atpD
<i>Rhodobacter capsulatus</i>	B100	X99599	atpD
<i>Rhodospirillum rubrum</i>		X02499	atpD
<i>Rickettsia prowazekii</i>	F-12	AF036246	atpD
<i>Rickettsia prowazekii</i>	Madrid	Genome project ²	atpD
<i>Ruminococcus albus</i>	7ATCC	AB006151	atpD
<i>Salmonella bongori</i>	JEO4162	AF037155	atpD
<i>Salmonella bongori</i>	BR1859	AF037154	atpD
<i>Salmonella choleraesuis</i> subsp. <i>arizona</i>	S83769	AF037146	atpD
<i>Salmonella choleraesuis</i> subsp. <i>arizonae</i>	u24	AF037147	atpD
<i>Salmonella choleraesuis</i> subsp.	K228	AF037140	atpD
<i>choleraesuis</i> serotype Dublin			
<i>Salmonella choleraesuis</i> subsp.	K771	AF037139	atpD
<i>choleraesuis</i> serotype Dublin			
<i>Salmonella choleraesuis</i> subsp.	Div36-86	AF037142	atpD
<i>choleraesuis</i> serotype Infantis			
<i>Salmonella choleraesuis</i> subsp.	Div95-86	AF037143	atpD
<i>choleraesuis</i> serotype Tennessee			
<i>Salmonella choleraesuis</i> subsp.	LT2	AF037141	atpD
<i>choleraesuis</i> serotype Typhimurium			
<i>Salmonella choleraesuis</i> subsp. <i>diarizoneae</i>	DS210/89	AF037149	atpD
<i>Salmonella choleraesuis</i> subsp. <i>diarizoneae</i>	JEO307	AF037148	atpD
<i>Salmonella choleraesuis</i> subsp. <i>diarizoneae</i>	S109671	AF037150	atpD
<i>Salmonella choleraesuis</i> subsp. <i>houtenae</i>	S84366	AF037151	atpD

TABLE 11-continued

Microbial species for which tuf and/or atpD and/or recA sequences are available in public databases.			
Species	Strain	Accession number	Coding gene*
<i>Salmonella choleraesuis</i>	S84098	AF037152	atpD
subsp. <i>houtenae</i>			
<i>Salmonella choleraesuis</i>	BR2047	AF037153	atpD
subsp. <i>indica</i>			
<i>Salmonella choleraesuis</i>	NSC72	AF037144	atpD
subsp. <i>salamae</i>			
<i>Salmonella choleraesuis</i>	S114655	AF037145	atpD
subsp. <i>salamae</i>			
<i>Shewanella putrefaciens</i>	MR-1	Genome project ²	atpD
<i>Staphylococcus aureus</i>	COL	Genome project ²	atpD
<i>Stigmatella aurantia</i>	Sgal	X76879	atpD
<i>Streptococcus bovis</i>	JB-1	AB009314	atpD
<i>Streptococcus mutans</i>	GS-5	U31170	atpD
<i>Streptococcus mutans</i>	UAB159	Genome project ²	atpD
<i>Streptococcus pneumoniae</i>	Type 4	Genome project ²	atpD (V)
<i>Streptococcus pneumoniae</i>	Type 4	Genome project ²	atpD
<i>Streptococcus pyogenes</i>	M1-GAS	Genome project ²	atpD (V)
<i>Streptococcus pyogenes</i>	M1-GAS	Genome project ²	atpD
<i>Streptococcus sanguinis</i>	10904	AF001955	atpD
<i>Streptomyces lividans</i>	1326	Z22606	atpD
<i>Thermus thermophilus</i>	HB8	D63799	atpD (V)
<i>Thiobacillus ferrooxidans</i>	ATCC 33020	M81087	atpD
<i>Treponema pallidum</i>	Nichols	AE001228	atpD (V)
<i>Vibrio alginolyticus</i>		X16050	atpD
<i>Vibrio cholerae</i>	N16961	Genome project ²	atpD
<i>Wolinella succinogenes</i>	DSM 1470	X76880	atpD
<i>Yersinia enterocolitica</i>	NCTC 10460	AF037157	atpD
<i>Yersinia pestis</i>	CO-92	Genome project ²	atpD
Archaeabacteria			
<i>Archaeoglobus fulgidus</i>	DSM 4304	AE001023	atpD (V)
<i>Halobacterium salinarum</i>		S56356	atpD (V)
<i>Haloferax volcanii</i>	WR 340	X79516	atpD
<i>Methanococcus jannaschii</i>	DSM 2661	U67477	atpD (V)
<i>Methanosarcina barkeri</i>	DSM 800	J04836	atpD (V)
Fungi			
<i>Candida albicans</i>	SC5314	Genome project ²	atpD
<i>Candida tropicalis</i>		M64984	atpD (V)
<i>Kluyveromyces lactis</i>	2359/152	U37764	atpD
<i>Neurospora crassa</i>		X53720	atpD
<i>Saccharomyces cerevisiae</i>		M12082	atpD
<i>Saccharomyces cerevisiae</i>	X2180-1A	J05409	atpD (V)
<i>Schizosaccharomyces pombe</i>	972 h-	S47814	atpD (V)
<i>Schizosaccharomyces pombe</i>	972 h-	M57956	atpD
Parasites			
<i>Giardia lamblia</i>	WB	U18938	atpD
<i>Plasmodium falciparum</i>	3D7	L08200	atpD (V)
<i>Trypanosoma congolense</i>	IL3000	Z25814	atpD (V)
Human and plants			
<i>Homo sapiens</i>		L09234	atpD (V)
<i>Homo sapiens</i>		M27132	atpD
recA sequences			
Bacteria			
<i>Acetobacter aceti</i>	no. 1023	S60630	recA
<i>Acetobacter altoacetigenes</i>	MH-24	E05290	recA
<i>Acetobacter polyoxogenes</i>	NBI 1028	D13183	recA
<i>Acholeplasma laidlawii</i>	8195	M81465	recA
<i>Acidiphilum facilis</i>	ATCC 35904	D16538	recA
<i>Acidothermus cellulolyticus</i>	ATCC 43068	AJ006705	recA
<i>Acinetobacter calcoaceticus</i>	BD413/ADP1	L26100	recA
<i>Actinobacillus actinomycetemcomitans</i>	HK1651	Genome project ²	recA
<i>Aeromonas salmonicida</i>	A449	U83688	recA
<i>Agrobacterium tumefaciens</i>	C58	L07902	recA
<i>Allochromatium vinosum</i>		AJ000677	recA
<i>Aquifex aeolicus</i>	VF5	AE000775	recA
<i>Aquifex pyrophilus</i>	Kol5a	L23135	recA
<i>Azotobacter vinelandii</i>		S96898	recA
<i>Bacillus stearothermophilus</i>	10	Genome project ²	recA
<i>Bacillus subtilis</i>	PB1831	U87792	recA
<i>Bacillus subtilis</i>	168	Z99112	recA

TABLE 11-continued

Microbial species for which tuf and/or atpD and/or recA sequences are available in public databases.			
Species	Strain	Accession number	Coding gene*
<i>Bacteroides fragilis</i>		M63029	recA
<i>Bifidobacterium breve</i>	NCFB 2258	AF094756	recA
<i>Blastochloris viridis</i>	DSM 133	AF022175	recA
<i>Bordetella pertussis</i>	165	X53457	recA
<i>Bordetella pertussis</i>	Tohama I	Genome project ²	recA
<i>Borrelia burgdorferi</i>	Sh-2-82	U23457	recA
<i>Borrelia burgdorferi</i>	B31	AE001124	recA
<i>Brevibacterium flavum</i>	MJ-233	E10390	recA
<i>Brucella abortus</i>	2308	L00679	recA
<i>Burkholderia cepacia</i>	ATCC 17616	U70431	recA
<i>Burkholderia cepacia</i>		D90120	recA
<i>Burkholderia pseudomallei</i>	K96243	Genome project ²	recA
<i>Campylobacter fetus subsp. fetus</i>	23D	AF020677	recA
<i>Campylobacter jejuni</i>	81-176	U03121	recA
<i>Campylobacter jejuni</i>	NCTC 11168	AL139079	recA
<i>Chlamydia trachomatis</i>	L2	U16739	recA
<i>Chlamydia trachomatis</i>	D/UW-3/CX	AE001335	recA
<i>Chlamydophila pneumoniae</i>	CWL029	AE001658	recA
<i>Chloroflexus aurantiacus</i>	J-10-fl	AF037259	recA
<i>Clostridium acetobutylicum</i>		M94057	recA
<i>Clostridium perfringens</i>	13	U61497	recA
<i>Corynebacterium diphtheriae</i>	NCTC13129	Genome project ²	recA
<i>Corynebacterium glutamicum</i>	AS019	U14965	recA
<i>Corynebacterium pseudotuberculosis</i>	C231	U30387	recA
<i>Deinococcus radiodurans</i>	KD8301	AB005471	recA
<i>Deinococcus radiodurans</i>	R1	U01876	recA
<i>Enterobacter agglomerans</i>	339	L03291	recA
<i>Enterococcus faecalis</i>	OGIX	M81466	recA
<i>Erwinia carotovora</i>		X55554	recA
<i>Escherichia coli</i>		J01672	recA
<i>Escherichia coli</i>		X55552	recA
<i>Escherichia coli</i>	K-12	AE000354	recA
<i>Frankia alni</i>	Arl3	AJ006707	recA
<i>Gluconobacter oxydans</i>		U21001	recA
<i>Haemophilus influenzae</i>	Rd	U32687	recA
<i>Haemophilus influenzae</i>	Rd	U32741	recA
<i>Haemophilus influenzae</i>	Rd	L07529	recA
<i>Helicobacter pylori</i>	69A	Z35478	recA
<i>Helicobacter pylori</i>	26695	AE000536	recA
<i>Helicobacter pylori</i>	J99	AE001453	recA
<i>Klebsiella pneumoniae</i>	M6H 78578	Genome project ²	recA
<i>Lactococcus lactis</i>	ML3	M88106	recA
<i>Legionella pneumophila</i>		X55453	recA
<i>Leptospira biflexa</i>	serovar patoc	U32625	recA
<i>Leptospira interrogans</i>	serovar pomona	U29169	recA
<i>Magnetospirillum magnetotacticum</i>	MS-1	X17371	recA
<i>Methylobacillus flagellatus</i>	MFK1	M35325	recA
<i>Methylomonas clara</i>	ATCC 31226	X59514	recA
<i>Mycobacterium avium</i>	104	Genome project ²	recA
<i>Mycobacterium bovis</i>	AF122/97	Genome project ²	recA
<i>Mycobacterium leprae</i>		X73822	recA
<i>Mycobacterium tuberculosis</i>	H37Rv	X58485	recA
<i>Mycobacterium tuberculosis</i>	CSU#93	Genome project ²	recA
<i>Mycoplasma genitalium</i>	G37	U39717	recA
<i>Mycoplasma mycoides</i>	GM9	L22073	recA
<i>Mycoplasma pneumoniae</i>	ATCC 29342	MPAE000033	recA
<i>Mycoplasma pulmonis</i>	KD735	L22074	recA
<i>Myxococcus xanthus</i>		L40368	recA
<i>Myxococcus xanthus</i>		L40367	recA
<i>Neisseria animalis</i>	NCTC 10212	U57910	recA
<i>Neisseria cinerea</i>	LCDC 81-176	AJ223869	recA
<i>Neisseria cinerea</i>	LNP 1646	U57906	recA
<i>Neisseria cinerea</i>	NCTC 10294	AJ223871	recA
<i>Neisseria cinerea</i>	Vedros M601	AJ223870	recA
<i>Neisseria elongate</i>	CCUG 2131	AJ223882	recA
<i>Neisseria elongate</i>	CCUG 4165A	AJ223880	recA
<i>Neisseria elongate</i>	NCTC 10660	AJ223881	recA
<i>Neisseria elongate</i>	NCTC 11050	AJ223878	recA
<i>Neisseria elongate</i>	NHITCC 2376	AJ223877	recA
<i>Neisseria elongate</i> subsp. <i>intermedia</i>	CCUG 4557	AJ223879	recA
<i>Neisseria flava</i>	Bangor 9	AJ223873	recA
<i>Neisseria flavescens</i>	LNP 444	U57907	recA
<i>Neisseria gonorrhoeae</i>	CH95	U57902	recA
<i>Neisseria gonorrhoeae</i>	FA19	X64842	recA

TABLE 11-continued

Microbial species for which tuf and/or atpD and/or recA sequences are available in public databases.			
Species	Strain	Accession number	Coding gene*
<i>Neisseria gonorrhoeae</i>	MS11	X17374	recA
<i>Neisseria gonorrhoeae</i>		Genome project ²	recA
<i>Neisseria lactamica</i>	CCUC 7757	AJ223866	recA
<i>Neisseria lactamica</i>	CCUG 7852	Y11819	recA
<i>Neisseria lactamica</i>	LCDC 77-143	Y11818	recA
<i>Neisseria lactamica</i>	LCDC 80-111	AJ223864	recA
<i>Neisseria lactamica</i>	LCDC 845	AJ223865	recA
<i>Neisseria lactamica</i>	NCTC 10617	U57905	recA
<i>Neisseria lactamica</i>	NCTC 10618	AJ223863	recA
<i>Neisseria meningitidis</i>	44/46	X64849	recA
<i>Neisseria meningitidis</i>	Bangor 13	AJ223868	recA
<i>Neisseria meningitidis</i>	HF116	X64848	recA
<i>Neisseria meningitidis</i>	HF130	X64844	recA
<i>Neisseria meningitidis</i>	HF46	X64847	recA
<i>Neisseria meningitidis</i>	M470	X64850	recA
<i>Neisseria meningitidis</i>	N94II	X64846	recA
<i>Neisseria meningitidis</i>	NCTC 8249	AJ223867	recA
<i>Neisseria meningitidis</i>	P63	X64845	recA
<i>Neisseria meningitidis</i>	S3446	U57903	recA
<i>Neisseria meningitidis</i>	FAM18	Genome project ²	recA
<i>Neisseria mucosa</i>	LNP 405	U57908	recA
<i>Neisseria mucosa</i>	Vedros M1801	AJ223875	recA
<i>Neisseria perflava</i>	CCUG 17915	AJ223876	recA
<i>Neisseria perflava</i>	LCDC 85402	AJ223862	recA
<i>Neisseria pharyngis</i> var. <i>flava</i>	NCTC 4590	U57909	recA
<i>Neisseria polysaccharea</i>	CCUG 18031	Y11815	recA
<i>Neisseria polysaccharea</i>	CCUG 24845	Y11816	recA
<i>Neisseria polysaccharea</i>	CCUG 24846	Y11814	recA
<i>Neisseria polysaccharea</i>	INS MA 3008	Y11817	recA
<i>Neisseria polysaccharea</i>	NCTC 11858	U57904	recA
<i>Neisseria sicca</i>	NRL 30016	AJ223872	recA
<i>Neisseria subflava</i>	NRL 30017	AJ223874	recA
<i>Paracoccus denitrificans</i>	DSM 413	U59631	recA
<i>Pasteurella multocida</i>		X99324	recA
<i>Porphyromonas gingivalis</i>	W83	U70054	recA
<i>Prevotella ruminicola</i>	JCM 8958	U61227	recA
<i>Proteus mirabilis</i>	pG1300	X14870	recA
<i>Proteus vulgaris</i>		X55555	recA
<i>Pseudomonas aeruginosa</i>		X05691	recA
<i>Pseudomonas aeruginosa</i>	PAM 7	X52261	recA
<i>Pseudomonas aeruginosa</i>	PAO12	D13090	recA
<i>Pseudomonas fluorescens</i>	OE 28.3	M96558	recA
<i>Pseudomonas putida</i>		L12684	recA
<i>Pseudomonas putida</i>	PpS145	U70864	recA
<i>Rhizobium leguminosarum</i>	VF39	X59956	recA
<i>biovar viciae</i>			
<i>Rhizobium phaseoli</i>	CNPAF512	X62479	recA
<i>Rhodobacter capsulatus</i>	J50	X82183	recA
<i>Rhodobacter sphaeroides</i>	2.4.1	X72705	recA
<i>Rhodopseudomonas palustris</i>	N 7	D84467	recA
<i>Rickettsia prowazekii</i>	Madrid E	AJ235273	recA
<i>Rickettsia prowazekii</i>	Madrid E	U01959	recA
<i>Serratia marcescens</i>		M22935	recA
<i>Shigella flexneri</i>		X55553	recA
<i>Shigella sonnei</i>	KNIH104S	AF101227	recA
<i>Sinorhizobium meliloti</i>	2011	X59957	recA
<i>Staphylococcus aureus</i>		L25893	recA
<i>Streptococcus gordoni</i>	Challis V288	L20574	recA
<i>Streptococcus mutans</i>	UA96	M81468	recA
<i>Streptococcus mutans</i>	GS-5	M61897	recA
<i>Streptococcus pneumoniae</i>		Z17307	recA
<i>Streptococcus pneumoniae</i>	R800	Z34303	recA
<i>Streptococcus pyogenes</i>	NZ131	U21934	recA
<i>Streptococcus pyogenes</i>	D471	M81469	recA
<i>Streptococcus salivarius</i>		M94062	recA
<i>subsp. <i>thermophilus</i></i>			
<i>Streptomyces ambofaciens</i>	DSM 40697	Z30324	recA
<i>Streptomyces coelicolor</i>	A3(2)	AL020958	recA
<i>Streptomyces lividans</i>	TK24	X76076	recA
<i>Streptomyces rimosus</i>	R6	X94233	recA
<i>Streptomyces venezuelae</i>	ATCC10712	U04837	recA
<i>Synechococcus</i> sp.	PR6	M29495	recA
<i>Synechocystis</i> sp.	PCC6803	D90917	recA
<i>Thermotoga maritima</i>		L23425	recA
<i>Thermotoga maritima</i>		AE001823	recA

TABLE 11-continued

Microbial species for which tuf and/or atpD and/or recA sequences are available in public databases.			
Species	Strain	Accession number	Coding gene*
<i>Thermus aquaticus</i>		L20095	recA
<i>Thermus thermophilus</i>	HB8	D17392	recA
<i>Thiobacillus ferrooxidans</i>		M26933	recA
<i>Treponema denticola</i>		Genome project ²	recA
<i>Treponema pallidum</i>	Nichols	AE001243	recA
<i>Vibrio anguillarum</i>		M80525	recA
<i>Vibrio cholerae</i>	017	X71969	recA
<i>Vibrio cholerae</i>	2740-80	U10162	recA
<i>Vibrio cholerae</i>	569B	LA42384	recA
<i>Vibrio cholerae</i>	M549	AF117881	recA
<i>Vibrio cholerae</i>	M553	AF117882	recA
<i>Vibrio cholerae</i>	M645	AF117883	recA
<i>Vibrio cholerae</i>	M793	AF117878	recA
<i>Vibrio cholerae</i>	M794	AF117880	recA
<i>Vibrio cholerae</i>	M967	AF117879	recA
<i>Xanthomonas citri</i>	XW47	AF006590	recA
<i>Xanthomonas oryzae</i>		AF013600	recA
<i>Xenorhabdus bovinii</i>	T228/1	U87924	recA
<i>Xenorhabdus nematophilus</i>	AN6	AF127333	recA
<i>Yersinia pestis</i>	231	X75336	recA
<i>Yersinia pestis</i>	CO-92	Genome project ²	recA
Fungi, parasites, human and plants			
<i>Anabaena variabilis</i>	ATCC 29413	M29680	recA
<i>Arabidopsis thaliana</i>		U43652	recA (Rad51)
<i>Candida albicans</i>		U39808	recA (Dmc1)
<i>Coprinus cinereus</i>	Okayama-7	U21905	recA (Rad51)
<i>Emericella nidulans</i>		Z80341	recA (Rad51)
<i>Gallus gallus</i>		L09655	recA (Rad51)
<i>Homo sapiens</i>		D13804	recA (Rad51)
<i>Homo sapiens</i>		D63882	recA (Dmc1)
<i>Leishmania major</i>	Friedlin	AF062379	recA (Rad51)
<i>Leishmania major</i>	Friedlin	AF062380	recA (Dmc1)
<i>Mus musculus</i>		D58419	recA (Dmc1)
<i>Neurospora crassa</i>	74-OR23-1A	D29638	recA (Rad51)
<i>Saccharomyces cerevisiae</i>		D10023	recA (Rad51)
<i>Schizosaccharomyces pombe</i>		Z22691	recA (Rad51)
<i>Schizosaccharomyces pombe</i>	972h-	AL021817	recA (Dmc1)
<i>Tetrahymena thermophila</i>	PB9R	AF064516	recA (Rad51)
<i>Trypanosoma brucei</i>	stock 427	Y13144	recA (Rad51)
<i>Ustilago maydis</i>		U62484	recA (Rad51)
<i>Xenopus laevis</i>		D38488	recA (Rad51)
<i>Xenopus laevis</i>		D38489	recA (Rad51)

*tuf indicates tuf sequences, including tuf genes, fusA genes and fusA-tuf intergenic spacers.

tuf (C) indicates tuf sequences divergent from main (usually A and B) copies of the elongation factor-Tu

tuf (EF-1) indicates tuf sequences of the eukaryotic type (elongation factor 1α)

tuf (M) indicates tuf sequences from organellar (mostly mitochondrial) origin

atpD indicates atpD sequences of the F-type

atpD (V) indicates atpD sequences of the V-type

recA indicates recA sequences

recA (Rad51) indicates rad51 sequences or homologs

recA (Dmc1) indicates dmc1 sequences or homologs

¹Nucleotides sequences published in Arch. Microbiol. 1990 153:241-247²These sequences are from the TIGR database (<http://www.tigr.org/tdb/tdb.html>)³Nucleotides sequences published in FEMS Microbiology Letters 1988 50:101-106

TABLE 12

Bacterial species used to test the specificity of the <i>Staphylococcus</i> -specific amplification primers derived from tuf sequences.	
Strain	Reference number
Staphylococcal species (n = 27)	
<i>Staphylococcus arlettae</i>	ATCC 43957
<i>Staphylococcus aureus</i>	ATCC 35844
subsp. <i>anaerobius</i>	
<i>Staphylococcus aureus</i>	ATCC 43300
subsp. <i>aureus</i>	
<i>Staphylococcus auricularis</i>	ATCC 33753

55

Bacterial species used to test the specificity of the *Staphylococcus*-specific amplification primers derived from tuf sequences.

Strain	Reference number
<i>Staphylococcus capitis</i> subsp. <i>capitis</i>	ATCC 27840
<i>Staphylococcus caprae</i>	ATCC 35538
<i>Staphylococcus carnosus</i>	ATCC 51365
<i>Staphylococcus chromogenes</i>	ATCC 43764
<i>Staphylococcus cohnii</i> subsp. <i>urealyticum</i>	DSM 20260
<i>Staphylococcus delphini</i>	ATCC 49171
<i>Staphylococcus epidermidis</i>	ATCC 14990

TABLE 12-continued

TABLE 12-continued

Bacterial species used to test the specificity of the <i>Staphylococcus</i> -specific amplification primers derived from tuf sequences.	
Strain	Reference number
<i>Staphylococcus equorum</i>	ATCC 43958
<i>Staphylococcus felis</i>	ATCC 49168
<i>Staphylococcus gallinarum</i>	ATCC 35539
<i>Staphylococcus haemolyticus</i>	ATCC 29970
<i>Staphylococcus hominis</i>	ATCC 27844
<i>Staphylococcus hyicus</i>	ATCC 11249
<i>Staphylococcus intermedius</i>	ATCC 29663
<i>Staphylococcus kloosii</i>	ATCC 43959
<i>Staphylococcus lentus</i>	ATCC 29070
<i>Staphylococcus lugdunensis</i>	ATCC 43809
<i>Staphylococcus saprophyticus</i>	ATCC 15305
<i>Staphylococcus schleiferi</i> subsp. <i>coagulans</i>	ATCC 49545
<i>Staphylococcus sciuri</i> subsp. <i>sciuri</i>	ATCC 29060
<i>Staphylococcus simulans</i>	ATCC 27848
<i>Staphylococcus warneri</i>	ATCC 27836
<i>Staphylococcus xylosus</i>	ATCC 29971
Gram-negative bacteria (n = 33)	
<i>Acinetobacter baumannii</i>	ATCC 19606
<i>Bacteroides distasonis</i>	ATCC 8503
<i>Bacteroides fragilis</i>	ATCC 25285
<i>Bulkholderia cepacia</i>	ATCC 25416
<i>Bordetella pertussis</i>	ATCC 9797
<i>Citrobacter freundii</i>	ATCC 8090
<i>Enterobacter aerogenes</i>	ATCC 13048
<i>Enterobacter cloacae</i>	ATCC 13047
<i>Escherichia coli</i>	ATCC 25922
<i>Haemophilus influenzae</i>	ATCC 8907
<i>Haemophilus parahaemolyticus</i>	ATCC 10014
<i>Haemophilus parainfluenzae</i>	ATCC 7901
<i>Hafnia alvei</i>	ATCC 13337
<i>Kingella indologenes</i>	ATCC 25869
<i>Klebsiella oxytoca</i>	ATCC 13182
<i>Klebsiella pneumoniae</i>	ATCC 13883
<i>Moraxella catarrhalis</i>	ATCC 25240
<i>Morganella morganii</i>	ATCC 25830
<i>Neisseria gonorrhoeae</i>	ATCC 35201
<i>Neisseria meningitidis</i>	ATCC 13077
<i>Proteus mirabilis</i>	ATCC 25933
<i>Proteus vulgaris</i>	ATCC 13315
<i>Providencia rettgeri</i>	ATCC 9250
<i>Providencia stuartii</i>	ATCC 29914
<i>Pseudomonas aeruginosa</i>	ATCC 27853
<i>Pseudomonas fluorescens</i>	ATCC 13525
<i>Salmonella choleraesuis</i>	ATCC 7001
<i>Salmonella typhimurium</i>	ATCC 14028
<i>Serratia marcescens</i>	ATCC 8100
<i>Shigella flexneri</i>	ATCC 12022
<i>Shigella sonnei</i>	ATCC 29930
<i>Stenotrophomonas maltophilia</i>	ATCC 13843
<i>Yersinia enterocolitica</i>	ATCC 9610
Other Gram-positive bacteria (n = 20)	
<i>Bacillus subtilis</i>	ATCC 27370
<i>Enterococcus avium</i>	ATCC 14025
<i>Enterococcus durans</i>	ATCC 19432
<i>Enterococcus faecalis</i>	ATCC 19433
<i>Enterococcus faecium</i>	ATCC 19434
<i>Enterococcus faecium</i>	ATCC 49996
<i>Enterococcus gallinarum</i>	ATCC 49573
<i>Lactobacillus acidophilus</i>	ATCC 4356
<i>Lactococcus lactis</i>	ATCC 11454
<i>Listeria innocua</i>	ATCC 33090
<i>Listeria ivanovii</i>	ATCC 19119
<i>Listeria monocytogenes</i>	ATCC 15313
<i>Macrococcus caseolyticus</i>	ATCC 13548
<i>Streptococcus agalactiae</i>	ATCC 13813
<i>Streptococcus anginosus</i>	ATCC 33397
<i>Streptococcus bovis</i>	ATCC 33317
<i>Streptococcus mutans</i>	ATCC 25175
<i>Streptococcus pneumoniae</i>	ATCC 6303

TABLE 12-continued

Bacterial species used to test the specificity of the <i>Staphylococcus</i> -specific amplification primers derived from tuf sequences.	
Strain	Reference number
<i>Streptococcus pyogenes</i>	ATCC 19615
<i>Streptococcus salivarius</i>	ATCC 7073
Gram-negative bacteria (n = 33)	
<i>Abiotrophia adiacens</i>	ATCC 49175
<i>Abiotrophia defective</i>	ATCC 49176
<i>Actinomyces pyogenes</i>	ATCC 19411
<i>Bacillus anthracis</i>	ATCC 4229
<i>Bacillus cereus</i>	ATCC 14579
<i>Bifidobacterium breve</i>	ATCC 15700
<i>Clostridium difficile</i>	ATCC 9689
<i>Enterococcus avium</i>	ATCC 14025
<i>Enterococcus casseliflavus</i>	ATCC 25788
<i>Enterococcus dispar</i>	ATCC 51266
<i>Enterococcus durans</i>	ATCC 19432
<i>Enterococcus faecalis</i>	ATCC 29212
<i>Enterococcus faecium</i>	ATCC 19434
<i>Enterococcus flavescentis</i>	ATCC 49996
<i>Enterococcus gallinarum</i>	ATCC 49573
<i>Enterococcus hirae</i>	ATCC 8043
<i>Enterococcus mundtii</i>	ATCC 43186
<i>Enterococcus raffinosus</i>	ATCC 49427
<i>Lactobacillus lactis</i>	ATCC 19435
<i>Lactobacillus monocytogenes</i>	ATCC 15313
<i>Mobiluncus curtisi</i>	ATCC 35242
<i>Peptococcus niger</i>	ATCC 27731
<i>Peptostreptococcus acnes</i>	ATCC 6919
<i>Peptostreptococcus anaerobius</i>	ATCC 27337
<i>Peptostreptococcus asaccharolyticus</i>	ATCC 2639
<i>Peptostreptococcus lactolyticus</i>	ATCC 51172
<i>Peptostreptococcus magnus</i>	ATCC 15794
<i>Peptostreptococcus prevotii</i>	ATCC 9321
<i>Peptostreptococcus tetradius</i>	ATCC 35098
<i>Staphylococcus aureus</i>	ATCC 25923
<i>Staphylococcus capitis</i>	ATCC 27840
<i>Staphylococcus epidermidis</i>	ATCC 14990
<i>Staphylococcus haemolyticus</i>	ATCC 29970
<i>Staphylococcus hominis</i>	ATCC 27844
<i>Staphylococcus lugdunensis</i>	ATCC 43809
<i>Staphylococcus saprophyticus</i>	ATCC 15305
<i>Staphylococcus simulans</i>	ATCC 27848
<i>Staphylococcus warneri</i>	ATCC 27836
<i>Streptococcus acidominimus</i>	ATCC 51726
<i>Streptococcus agalactiae</i>	ATCC 12403
<i>Streptococcus anginosus</i>	ATCC 33397
<i>Streptococcus bovis</i>	ATCC 33317
<i>Streptococcus constellatus</i>	ATCC 27823
<i>Streptococcus cricetus</i>	ATCC 19624
<i>Streptococcus cristatus</i>	ATCC 51100
<i>Streptococcus downei</i>	ATCC 33748
<i>Streptococcus dysgalactiae</i>	ATCC 43078
<i>Streptococcus equi</i>	ATCC 9528
<i>Streptococcus ferus</i>	ATCC 33477
<i>Streptococcus gordonii</i>	ATCC 10558
<i>Streptococcus intermedius</i>	ATCC 27335
<i>Streptococcus mitis</i>	ATCC 903
<i>Streptococcus mitis</i>	LSPQ 2583
<i>Streptococcus mitis</i>	ATCC 49456
<i>Streptococcus mutans</i>	ATCC 27175
<i>Streptococcus oralis</i>	ATCC 10557
<i>Streptococcus oralis</i>	ATCC 9811
<i>Streptococcus oralis</i>	ATCC 35037
<i>Streptococcus parasanguinis</i>	ATCC 15912

TABLE 13

Bacterial species used to test the specificity of the penicillin-resistant <i>Streptococcus pneumoniae</i> assay.	
Strain	Reference number
Gram-positive species (n = 67)	

5	Strain	Reference number
10		
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		
65		

TABLE 13-continued

Bacterial species used to test the specificity of the penicillin-resistant <i>Streptococcus pneumoniae</i> assay.	
Strain	Reference number
<i>Streptococcus parauberis</i>	ATCC 6631
<i>Streptococcus ratus</i>	ATCC 15912
<i>Streptococcus salivarius</i>	ATCC 7073
<i>Streptococcus sanguinis</i>	ATCC 10556
<i>Streptococcus suis</i>	ATCC 43765
<i>Streptococcus uberis</i>	ATCC 19436
<i>Streptococcus vestibularis</i>	ATCC 49124
Gram-negative species (n = 33)	
<i>Actinetobacter baumannii</i>	ATCC 19606
<i>Bordetella pertussis</i>	ATCC 9797
<i>Citrobacter diversus</i>	ATCC 27028
<i>Citrobacter freundii</i>	ATCC 8090
<i>Enterobacter aerogenes</i>	ATCC 13048
<i>Enterobacter agglomerans</i>	ATCC 27155
<i>Enterobacter cloacae</i>	ATCC 13047
<i>Escherichia coli</i>	ATCC 25922
<i>Haemophilus ducreyi</i>	ATCC 33940
<i>Haemophilus haemolyticus</i>	ATCC 33390
<i>Haemophilus influenzae</i>	ATCC 9007
<i>Haemophilus parainfluenzae</i>	ATCC 7901
<i>Hafnia alvei</i>	ATCC 13337
<i>Klebsiella oxytoca</i>	ATCC 13182
<i>Klebsiella pneumoniae</i>	ATCC 13883
<i>Moraxella atlantae</i>	ATCC 29525
<i>Moraxella catarrhalis</i>	ATCC 43628
<i>Moraxella morganii</i>	ATCC 13077
<i>Neisseria gonorrhoeae</i>	ATCC 35201
<i>Neisseria meningitidis</i>	ATCC 13077
<i>Proteus mirabilis</i>	ATCC 25933
<i>Proteus vulgaris</i>	ATCC 13315
<i>Providencia alcalfaciens</i>	ATCC 9886
<i>Providencia rettgeri</i>	ATCC 9250
<i>Providencia rustigianii</i>	ATCC 33673
<i>Providencia stuartii</i>	ATCC 33672
<i>Pseudomonas aeruginosa</i>	ATCC 35554
<i>Pseudomonas fluorescens</i>	ATCC 13525
<i>Pseudomonas stutzeri</i>	ATCC 17588
<i>Salmonella typhimurium</i>	ATCC 14028
<i>Serratia marcescens</i>	ATCC 13880
<i>Shigella flexneri</i>	ATCC 12022
<i>Yersina enterocolitica</i>	ATCC 9610

TABLE 14

Bacterial species (n = 104) detected by the platelet contaminants assay. Bold characters indicate the major bacterial contaminants found in platelet concentrates.	
	45
<i>Abiotrophia adiacens</i>	
<i>Abiotrophia defectiva</i>	
<i>Acinetobacter baumannii</i>	50
<i>Acinetobacter lwofii</i>	
<i>Aerococcus viridans</i>	
<i>Bacillus anthracis</i>	
<i>Bacillus cereus</i>	
<i>Bacillus subtilis</i>	
<i>Brucella abortus</i>	55
<i>Burkholderia cepacia</i>	
<i>Citrobacter diversus</i>	
<i>Citrobacter freundii</i>	
<i>Enterobacter aerogenes</i>	
<i>Enterobacter agglomerans</i>	
<i>Enterobacter cloacae</i>	60
<i>Enterococcus avium</i>	
<i>Enterococcus casseliflavus</i>	
<i>Enterococcus dispar</i>	
<i>Enterococcus durans</i>	
<i>Enterococcus faecalis</i>	
<i>Enterococcus faecium</i>	
<i>Enterococcus flavescens</i>	65
<i>Enterococcus gallinarum</i>	

TABLE 14-continued

Bacterial species (n = 104) detected by the platelet contaminants assay. Bold characters indicate the major bacterial contaminants found in platelet concentrates.

5	<i>Enterococcus mundtii</i>
	<i>Enterococcus raffinosus</i>
	<i>Enterococcus solitarius</i>
	<i>Escherichia coli</i>
	<i>Gemella morbillorum</i>
	<i>Haemophilus ducreyi</i>
	<i>Haemophilus haemolyticus</i>
	<i>Haemophilus influenzae</i>
	<i>Haemophilus parahaemolyticus</i>
	<i>Haemophilus parainfluenzae</i>
	<i>Hafnia alvei</i>
	<i>Kingella kingae</i>
	<i>Klebsiella oxytoca</i>
	<i>Klebsiella pneumoniae</i>
	<i>Legionella pneumophila</i>
	<i>Megamonas hypermegale</i>
	<i>Moraxella atlantae</i>
	<i>Moraxella catarrhalis</i>
	<i>Morganella morganii</i>
	<i>Neisseria gonorrhoeae</i>
	<i>Neisseria meningitidis</i>
	<i>Pasteurella aerogenes</i>
	<i>Pasteurella multocida</i>
	<i>Peptostreptococcus magnus</i>
	<i>Proteus mirabilis</i>
	<i>Providencia alcalfaciens</i>
	<i>Providencia rettgeri</i>
	<i>Providencia rustigianii</i>
	<i>Providencia stuartii</i>
	<i>Pseudomonas aeruginosa</i>
	<i>Pseudomonas fluorescens</i>
	<i>Pseudomonas stutzeri</i>
	<i>Salmonella bongori</i>
	<i>Salmonella choleraesuis</i>
	<i>Salmonella enteritidis</i>
	<i>Salmonella gallinarum</i>
	<i>Salmonella typhimurium</i>
	<i>Serratia liquefaciens</i>
	<i>Serratia marcescens</i>
	<i>Shigella flexneri</i>
	<i>Shigella sonnei</i>
	<i>Staphylococcus aureus</i>
	<i>Staphylococcus capitis</i>
	<i>Staphylococcus epidermidis</i>
	<i>Staphylococcus haemolyticus</i>
	<i>Staphylococcus hominis</i>
	<i>Staphylococcus lugdunensis</i>
	<i>Staphylococcus saprophyticus</i>
	<i>Staphylococcus simulans</i>
	<i>Staphylococcus warneri</i>
	<i>Stenotrophomonas maltophilia</i>
	<i>Streptococcus acidomimutus</i>
	<i>Streptococcus agalactiae</i>
	<i>Streptococcus anginosus</i>
	<i>Streptococcus bovis</i>
	<i>Streptococcus constellatus</i>
	<i>Streptococcus cricetus</i>
	<i>Streptococcus cristatus</i>
	<i>Streptococcus dysgalactiae</i>
	<i>Streptococcus equi</i>
	<i>Streptococcus ferus</i>
	<i>Streptococcus gordonii</i>
	<i>Streptococcus intermedius</i>
	<i>Streptococcus macacae</i>
	<i>Streptococcus mitis</i>
	<i>Streptococcus mutans</i>
	<i>Streptococcus oralis</i>
	<i>Streptococcus parasanguinis</i>
	<i>Streptococcus paraueris</i>
	<i>Streptococcus pneumoniae</i>
	<i>Streptococcus pyogenes</i>
	<i>Streptococcus ratti</i>
	<i>Streptococcus salivarius</i>
	<i>Streptococcus sanguinis</i>
	<i>Streptococcus sobrinus</i>
	<i>Streptococcus uberis</i>

TABLE 14-continued

Bacterial species (n = 104) detected by the platelet contaminants assay. Bold characters indicate the major bacterial contaminants found in platelet concentrates.

<i>Streptococcus vestibularis</i>
<i>Vibrio cholerae</i>
<i>Yersinia enterocolitica</i>
<i>Yersinia pestis</i>
<i>Yersinia pseudotuberculosis</i>

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TABLE 15

Microorganisms identified by commercial systems¹.

<i>Abiotrophia adiacens</i> (<i>Streptococcus adjacens</i>)
<i>Abiotrophia defectiva</i> (<i>Streptococcus defectivus</i>)
<i>Achromobacter</i> species
<i>Acidaminococcus fermentans</i>
<i>Acinetobacter alcaligenes</i>
<i>Acinetobacter anitratus</i>
<i>Acinetobacter baumannii</i>
<i>Acinetobacter calcoaceticus</i>
<i>Acinetobacter calcoaceticus</i> biovar <i>anitratus</i>
<i>Acinetobacter calcoaceticus</i> biovar <i>Iwoffii</i>
<i>Acinetobacter genomospecies</i>
<i>Acinetobacter haemolyticus</i>
<i>Acinetobacter johnsonii</i>
<i>Acinetobacter junii</i>
<i>Acinetobacter Iwoffii</i>
<i>Acinetobacter radioresistens</i>
<i>Acinetobacter</i> species
<i>Actinobacillus</i>
<i>actinomycetemcomitans</i>
<i>Actinobacillus capsulatus</i>
<i>Actinobacillus equuli</i>
<i>Actinobacillus hominis</i>
<i>Actinobacillus lignieresii</i>
<i>Actinobacillus pleuropneumoniae</i>
<i>Actinobacillus</i> species
<i>Actinobacillus suis</i>
<i>Actinobacillus ureae</i>
<i>Actinomyces bovis</i>
<i>Actinomyces israelii</i>
<i>Actinomyces meyeri</i>
<i>Actinomyces naeslundii</i>
<i>Actinomyces neutii</i> subsp. <i>anitratus</i>
<i>Actinomyces neutii</i> subsp. <i>neutii</i>
<i>Actinomyces odontolyticus</i>
<i>Actinomyces pyogenes</i>
<i>Actinomyces radingae</i>
<i>Actinomyces</i> species
<i>Actinomyces turicensis</i>
<i>Actinomyces viscosus</i>
<i>Aerococcus</i> species
<i>Aerococcus viridans</i>
<i>Aeromonas caviae</i>
<i>Aeromonas hydrophila</i>
<i>Aeromonas hydrophila</i> group
<i>Aeromonas jandaei</i>
<i>Aeromonas salmonicida</i>
<i>Aeromonas salmonicida</i> subsp. <i>achromogenes</i>
<i>Aeromonas salmonicida</i> subsp. <i>masoucida</i>
<i>Aeromonas salmonicida</i> subsp. <i>salmonicida</i>
<i>Aeromonas schubertii</i>
<i>Aeromonas sobria</i>
<i>Aeromonas</i> species
<i>Aeromonas trota</i>
<i>Aeromonas veronii</i>
<i>Aeromonas veronii</i> biovar <i>sobria</i>
<i>Aeromonas veronii</i> biovar <i>veronii</i>
<i>Agrobacterium radiobacter</i>
<i>Agrobacterium</i> species
<i>Agrobacterium tumefaciens</i>
<i>Alcaligenes denitrificans</i>
<i>Alcaligenes faecalis</i>
<i>Alcaligenes odorans</i>

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TABLE 15-continued

Microorganisms identified by commercial systems¹.

<i>Alcaligenes odorans</i> (<i>Alcaligenes faecalis</i>)
<i>Alcaligenes</i> species
<i>Alcaligenes xylosoxidans</i>
<i>Alcaligenes xylosoxidans</i> subsp. <i>denitrificans</i>
<i>Alcaligenes xylosoxidans</i> subsp. <i>xylosoxidans</i>
<i>Alloiooccus otitis</i>
<i>Anaerobiospirillum succiniciproducens</i>
<i>Anaerovibrio lipolytica</i>
<i>Arachnia propionica</i>
<i>Arcanobacterium</i> (<i>Actinomyces</i>) <i>bernardiae</i>
<i>Arcanobacterium</i> (<i>Actinomyces</i>) <i>pyogenes</i>
<i>Arcanobacterium haemolyticum</i>
<i>Arco bacter</i> <i>cryaerophilus</i>
(<i>Campylobacter</i> <i>cryaerophilus</i>)
<i>Arthrobacter globiformis</i>
<i>Arthrobacter</i> species
<i>Arxiozyma telluris</i> (<i>Torulopsis pintolopesii</i>)
<i>Atopobium minutum</i> (<i>Lactobacillus minutus</i>)
<i>Aureobacterium</i> species
<i>Bacillus amyloliquefaciens</i>
<i>Bacillus anthracis</i>
<i>Bacillus badius</i>
<i>Bacillus cereus</i>
<i>Bacillus circulans</i>
<i>Bacillus coagulans</i>
<i>Bacillus firmus</i>
<i>Bacillus lenthus</i>
<i>Bacillus licheniformis</i>
<i>Bacillus megaterium</i>
<i>Bacillus mycoides</i>
<i>Bacillus pantothenticus</i>
<i>Bacillus pumilus</i>
<i>Bacillus</i> species
<i>Bacillus sphaericus</i>
<i>Bacillus stearothermophilus</i>
<i>Bacillus subtilis</i>
<i>Bacillus thuringiensis</i>
<i>Bacteroides caccae</i>
<i>Bacteroides capillosus</i>
<i>Bacteroides distasonis</i>
<i>Bacteroides eggerthii</i>
<i>Bacteroides fragilis</i>
<i>Bacteroides merdae</i>
<i>Bacteroides ovatus</i>
<i>Bacteroides</i> species
<i>Bacteroides splanchnicus</i>
<i>Bacteroides stercoris</i>
<i>Bacteroides thetaiotaomicron</i>
<i>Bacteroides uniformis</i>
<i>Bacteroides ureolyticus</i> (<i>B. corrodens</i>)
<i>Bacteroides vulgaris</i>
<i>Bergevella</i> (<i>Weeksella</i>) <i>zoohelcum</i>
<i>Bifidobacterium adolescentis</i>
<i>Bifidobacterium bifidum</i>
<i>Bifidobacterium breve</i>
<i>Bifidobacterium dentium</i>
<i>Bifidobacterium infantis</i>
<i>Bifidobacterium</i> species
<i>Blastoschizomyces</i> (<i>Dipodascus</i>) <i>capitatus</i>
<i>Bordetella avium</i>
<i>Bordetella bronchiseptica</i>
<i>Bordetella parapertussis</i>
<i>Bordetella pertussis</i>
<i>Bordetella</i> species
<i>Borrelia</i> species
<i>Branhamella</i> (<i>Moraxella</i>) <i>catarrhalis</i>
<i>Branhamella</i> species
<i>Brevibacillus brevis</i>
<i>Brevibacillus laterosporus</i>
<i>Brevibacterium casei</i>
<i>Brevibacterium epidermidis</i>
<i>Brevibacterium linens</i>
<i>Brevibacterium</i> species
<i>Brevundimonas diminuta</i>
<i>Brevundimonas</i> (<i>Pseudomonas</i>) <i>vesicularis</i>
<i>Brevundimonas</i> species
<i>Brochothrix thermosphacta</i>
<i>Brucella abortus</i>

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Brucella canis</i>	5
<i>Brucella melitensis</i>	
<i>Brucella ovis</i>	
<i>Brucella species</i>	
<i>Brucella suis</i>	
<i>Budvicia aquatica</i>	
<i>Burkholderia (Pseudomonas) cepacia</i>	10
<i>Burkholderia (Pseudomonas) gladioli</i>	
<i>Burkholderia (Pseudomonas) mallei</i>	
<i>Burkholderia (Pseudomonas) pseudomallei</i>	
<i>Burkholderia species</i>	
<i>Butti auxella agrestis</i>	
<i>Campylobacter coli</i>	15
<i>Campylobacter concisus</i>	
<i>Campylobacter fetus</i>	
<i>Campylobacter fetus subsp. <i>fetus</i></i>	
<i>Campylobacter fetus subsp. <i>venerealis</i></i>	
<i>Campylobacter hyoilealis</i>	
<i>Campylobacter jejuni</i> subsp. <i>douylei</i>	
<i>Campylobacter jejuni</i> subsp. <i>jejuni</i>	20
<i>Campylobacter lari</i>	
<i>Campylobacter lari</i> subsp. UPTC	
<i>Campylobacter mucosalis</i>	
<i>Campylobacter species</i>	
<i>Campylobacter sputorum</i>	25
<i>Campylobacter sputorum</i> subsp. <i>bubulus</i>	
<i>Campylobacter sputorum</i> subsp. <i>fecalis</i>	
<i>Campylobacter sputorum</i> subsp. <i>sputorum</i>	
<i>Campylobacter upsaliensis</i>	
<i>Candida (Clavispora) lusitaniae</i>	
<i>Candida (Pichia) guilliermondii</i>	
<i>Candida (Torulopsis) glabrata</i>	30
<i>Candida albicans</i>	
<i>Candida boidinii</i>	
<i>Candida catenulata</i>	
<i>Candida ciferrii</i>	
<i>Candida colliculosa</i>	
<i>Candida conglobata</i>	
<i>Candida curvata</i> (<i>Cryptococcus curvatus</i>)	35
<i>Candida dattila</i>	
<i>Candida dubliniensis</i>	
<i>Candida famata</i>	
<i>Candida globosa</i>	
<i>Candida helleonica</i>	
<i>Candida holmi</i>	40
<i>Candida humicola</i>	
<i>Candida inconspicua</i>	
<i>Candida intermedia</i>	
<i>Candida kefir</i>	
<i>Candida krusei</i>	
<i>Candida lambica</i>	45
<i>Candida magnoliae</i>	
<i>Candida maris</i>	
<i>Candida melibiosica</i>	
<i>Candida membranaefaciens</i>	
<i>Candida norvegensis</i>	
<i>Candida norvegica</i>	
<i>Candida parapsilosis</i>	50
<i>Candida paratropicalis</i>	
<i>Candida pelliculosa</i>	
<i>Candida pseudotropicalis</i>	
<i>Candida pulcherrima</i>	
<i>Candida ravautii</i>	
<i>Candida rugosa</i>	55
<i>Candida sake</i>	
<i>Candida silvicola</i>	
<i>Candida species</i>	
<i>Candida sphaerica</i>	
<i>Candida stellatoidea</i>	
<i>Candida tenuis</i>	60
<i>Candida tropicalis</i>	
<i>Candida utilis</i>	
<i>Candida valida</i>	
<i>Candida vini</i>	
<i>Candida viswanathii</i>	
<i>Candida zeylanoides</i>	65
<i>Capnocytophaga gingivalis</i>	
<i>Capnocytophaga ochracea</i>	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Capnocytophaga species</i>	
<i>Capnocytophaga sputigena</i>	
<i>Cardiobacterium hominis</i>	
<i>Carnobacterium divergens</i>	
<i>Carnobacterium piscicola</i>	
CDC group ED-2	
CDC group EF4 (<i>Pasteurella</i> sp.)	
CDC group EF-4A	
CDC group EF-4B	
CDC group EQ-Z	
CDC group HB-5	
CDC group II K-2	
CDC group IV C-2 (<i>Bordetella</i> -like)	
CDC group M5	
CDC group M6	
<i>Cedecea davisa</i>	
<i>Cedecea lapagei</i>	
<i>Cedecea neteri</i>	
<i>Cedecea species</i>	
<i>Cellulomonas (Oerskovia) turbata</i>	
<i>Cellulomonas species</i>	
<i>Chlamydia species</i>	
<i>Chromobacterium violaceum</i>	
<i>Chryseobacterium (Flavobacterium) indologenes</i>	
<i>Chryseobacterium (Flavobacterium) meningosepticum</i>	
<i>Chryseobacterium gleum</i>	
<i>Chryseobacterium species</i>	
<i>Chryseomonas indologenes</i>	
<i>Citeromyces matritensis</i>	
<i>Citrobacter amalonaticus</i>	
<i>Citrobacter braakii</i>	
<i>Citrobacter diversus</i>	
<i>Citrobacter farmeri</i>	
<i>Citrobacter freundii</i>	
<i>Citrobacter freundii complex</i>	
<i>Citrobacter koseri</i>	
<i>Citrobacter sedlakii</i>	
<i>Citrobacter species</i>	
<i>Citrobacter werkmanii</i>	
<i>Citrobacter youngae</i>	
<i>Clostridium acetobutylicum</i>	
<i>Clostridium barati</i>	
<i>Clostridium beijerinckii</i>	
<i>Clostridium bifermentans</i>	
<i>Clostridium botulinum</i>	
<i>Clostridium botulinum (NP) B&F</i>	
<i>Clostridium botulinum (NP) E</i>	
<i>Clostridium botulinum (P) A&H</i>	
<i>Clostridium botulinum (P) F</i>	
<i>Clostridium botulinum G1</i>	
<i>Clostridium botulinum G2</i>	
<i>Clostridium butyricum</i>	
<i>Clostridium cadaveris</i>	
<i>Clostridium chauvoei</i>	
<i>Clostridium clostridiiforme</i>	
<i>Clostridium difficile</i>	
<i>Clostridium fallax</i>	
<i>Clostridium glycolicum</i>	
<i>Clostridium hastiforme</i>	
<i>Clostridium histolyticum</i>	
<i>Clostridium innocuum</i>	
<i>Clostridium limosum</i>	
<i>Clostridium novyi</i>	
<i>Clostridium novyi A</i>	
<i>Clostridium paraputreficum</i>	
<i>Clostridium perfringens</i>	
<i>Clostridium putrificum</i>	
<i>Clostridium ramosum</i>	
<i>Clostridium septicum</i>	
<i>Clostridium sordellii</i>	
<i>Clostridium species</i>	
<i>Clostridium sphenoides</i>	
<i>Clostridium sporogenes</i>	
<i>Clostridium subterminalae</i>	
<i>Clostridium tertium</i>	
<i>Clostridium tetani</i>	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Clostridium tyrobutyricum</i>	
<i>Comamonas (Pseudomonas) acidovorans</i>	5
<i>Comamonas (Pseudomonas) testosteroni</i>	
<i>Comamonas species</i>	
<i>Corynebacterium accolens</i>	
<i>Corynebacterium afermentans</i>	10
<i>Corynebacterium amycolatum</i>	
<i>Corynebacterium aquaticum</i>	
<i>Corynebacterium argentoratense</i>	
<i>Corynebacterium auris</i>	
<i>Corynebacterium bovis</i>	
<i>Corynebacterium coyleae</i>	
<i>Corynebacterium cystitidis</i>	
<i>Corynebacterium diphtheriae</i>	15
<i>Corynebacterium diphtheriae</i> biotype <i>belfanti</i>	
<i>Corynebacterium diphtheriae</i> biotype <i>gravis</i>	
<i>Corynebacterium diphtheriae</i> biotype <i>intermedius</i>	
<i>Corynebacterium diphtheriae</i> biotype <i>mitis</i>	
<i>Corynebacterium flavescentis</i>	20
<i>Corynebacterium glucuronolyticum</i>	
<i>Corynebacterium glucuronolyticum-seminalis</i>	
<i>Corynebacterium group A</i>	
<i>Corynebacterium group A-4</i>	
<i>Corynebacterium group A-5</i>	
<i>Corynebacterium group ANF</i>	25
<i>Corynebacterium group B</i>	
<i>Corynebacterium group B-3</i>	
<i>Corynebacterium group F</i>	
<i>Corynebacterium group F-1</i>	
<i>Corynebacterium group F-2</i>	
<i>Corynebacterium group G</i>	30
<i>Corynebacterium group G-1</i>	
<i>Corynebacterium group G-2</i>	
<i>Corynebacterium group I</i>	
<i>Corynebacterium group I-2</i>	
<i>Corynebacterium jeikeium</i> (group JK)	
<i>Corynebacterium kutscheri</i> (<i>C. murium</i>)	35
<i>Corynebacterium macginleyi</i>	
<i>Corynebacterium minutissimum</i>	
<i>Corynebacterium pilosum</i>	
<i>Corynebacterium propinquum</i>	
<i>Corynebacterium pseudodiphtheriticum</i>	40
<i>Corynebacterium pseudotuberculosis</i>	
<i>Corynebacterium pyogenes</i>	
<i>Corynebacterium renale</i>	
<i>Corynebacterium renale</i> group	
<i>Corynebacterium seminale</i>	
<i>Corynebacterium species</i>	
<i>Corynebacterium striatum</i> (<i>C. flavidum</i>)	45
<i>Corynebacterium ulcerans</i>	
<i>Corynebacterium urealyticum</i> (group D2)	
<i>Corynebacterium xerosis</i>	
<i>Cryptococcus albidus</i>	
<i>Cryptococcus ater</i>	50
<i>Cryptococcus cereanus</i>	
<i>Cryptococcus gastricus</i>	
<i>Cryptococcus humicolus</i>	
<i>Cryptococcus lactativorus</i>	
<i>Cryptococcus laurentii</i>	
<i>Cryptococcus luteolus</i>	
<i>Cryptococcus melibiosum</i>	55
<i>Cryptococcus neoformans</i>	
<i>Cryptococcus species</i>	
<i>Cryptococcus terreus</i>	
<i>Cryptococcus uniguttulatus</i>	
<i>Debaryomyces hansenii</i>	
<i>Debaryomyces marama</i>	60
<i>Debaryomyces polymorphus</i>	
<i>Debaryomyces species</i>	
<i>Dermabacter hominis</i>	
<i>Dermacoccus (Micrococcus) nishinomiyaensis</i>	
<i>Dietzia species</i>	
<i>Edwardsiella hoshinae</i>	65
<i>Edwardsiella ictaluri</i>	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Edwardsiella species</i>	
<i>Edwardsiella tarda</i>	
<i>Eikenella corrodens</i>	
<i>Empedobacter brevis</i> (<i>Flavobacterium breve</i>)	
<i>Enterobacter aerogenes</i>	
<i>Enterobacter agglomerans</i>	
<i>Enterobacter ammigenus</i>	
<i>Enterobacter ammigenus asburiae</i> (CDC enteric group 17)	
<i>Enterobacter ammigenus</i> biogroup 1	
<i>Enterobacter ammigenus</i> biogroup 2	
<i>Enterobacter asburiae</i>	
<i>Enterobacter cancerogenus</i>	
<i>Enterobacter cloacae</i>	
<i>Enterobacter gergoviae</i>	
<i>Enterobacter hormaechei</i>	
<i>Enterobacter intermedius</i>	
<i>Enterobacter sakazakii</i>	
<i>Enterobacter species</i>	
<i>Enterobacter taylorae</i>	
<i>Enterobacter taylorae</i> (CDC enteric group 19)	
<i>Enterococcus (Streptococcus) cecorum</i>	
<i>Enterococcus (Streptococcus) faecalis</i> (Group D)	
<i>Enterococcus (Streptococcus) faecium</i> (Group D)	
<i>Enterococcus (Streptococcus) faecium</i> subsp. <i>casseliflavus</i>	
<i>Enterococcus durans</i> (<i>Streptococcus faecium</i> subsp. <i>durans</i>) (Group D)	
<i>Enterococcus gallinarum</i>	
<i>Enterococcus hirae</i>	
<i>Enterococcus malodoratus</i>	
<i>Enterococcus mundtii</i>	
<i>Enterococcus raffinosus</i>	
<i>Enterococcus species</i>	
<i>Erwinia amylovora</i>	
<i>Erwinia carotovora</i>	
<i>Erwinia carotovora</i> subsp. <i>atroseptica</i>	
<i>Erwinia carotovora</i> subsp. <i>betavasculorum</i>	
<i>Erwinia carotovora</i> subsp. <i>carotovora</i>	
<i>Erwinia chrysanthemi</i>	
<i>Erwinia cypripedii</i>	
<i>Erwinia malattovora</i>	
<i>Erwinia nigrifluens</i>	
<i>Erwinia quercina</i>	
<i>Erwinia rhabontici</i>	
<i>Erwinia rubrifaciens</i>	
<i>Erwinia salicis</i>	
<i>Erwinia species</i>	
<i>Erysipelothrix rhusiopathiae</i>	
<i>Erysipelothrix species</i>	
<i>Escherichia blattae</i>	
<i>Escherichia coli</i>	
<i>Escherichia coli</i> A-D	
<i>Escherichia coli</i> O157:H7	
<i>Escherichia fergusonii</i>	
<i>Escherichia hermannii</i>	
<i>Escherichia species</i>	
<i>Escherichia vulneris</i>	
<i>Eubacterium aerofaciens</i>	
<i>Eubacterium alactolyticum</i>	
<i>Eubacterium lentum</i>	
<i>Eubacterium limosum</i>	
<i>Eubacterium species</i>	
<i>Ewingella americana</i>	
<i>Filobasidiella neoformans</i>	
<i>Filobasidium floriforme</i>	
<i>Filobasidium uniguttulatum</i>	
<i>Flavimonas oryzihabitans</i>	
<i>Flavobacterium gleum</i>	
<i>Flavobacterium indologenes</i>	
<i>Flavobacterium odoratum</i>	
<i>Flavobacterium species</i>	
<i>Francisella novicida</i>	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Francisella philomiragia</i>	
<i>Francisella</i> species	5
<i>Francisella tularensis</i>	
<i>Fusobacterium mortiferum</i>	
<i>Fusobacterium necrogenes</i>	
<i>Fusobacterium necrophorum</i>	
<i>Fusobacterium nucleatum</i>	
<i>Fusobacterium</i> species	10
<i>Fusobacterium varium</i>	
<i>Gaffya</i> species	
<i>Gardnerella vaginalis</i>	
<i>Gemella haemolysans</i>	
<i>Gemella morbillorum</i>	
<i>Gemella</i> species	15
<i>Geotrichum candidum</i>	
<i>Geotrichum fermentans</i>	
<i>Geotrichum penicillarum</i>	
<i>Geotrichum penicillatum</i>	
<i>Geotrichum</i> species	
<i>Gordona</i> species	20
<i>Haemophilus aegyptius</i>	
<i>Haemophilus aphrophilus</i>	
<i>Haemophilus ducreyi</i>	
<i>Haemophilus haemoglobinophilus</i>	
<i>Haemophilus haemolyticus</i>	
<i>Haemophilus influenzae</i>	25
<i>Haemophilus influenzae</i> biotype I	
<i>Haemophilus influenzae</i> biotype II	
<i>Haemophilus influenzae</i> biotype III	
<i>Haemophilus influenzae</i> biotype IV	
<i>Haemophilus influenzae</i> biotype V	
<i>Haemophilus influenzae</i> biotype VI	
<i>Haemophilus influenzae</i> biotype VII	30
<i>Haemophilus influenzae</i> biotype VIII	
<i>Haemophilus paragallinarum</i>	
<i>Haemophilus parahaemolyticus</i>	
<i>Haemophilus parainfluenzae</i>	
<i>Haemophilus parainfluenzae</i> biotype I	35
<i>Haemophilus parainfluenzae</i> biotype II	
<i>Haemophilus parainfluenzae</i> biotype III	
<i>Haemophilus parainfluenzae</i> biotype IV	
<i>Haemophilus parainfluenzae</i> biotype V	
<i>Haemophilus parainfluenzae</i> biotype VI	
<i>Haemophilus parainfluenzae</i> biotype VII	
<i>Haemophilus parainfluenzae</i> biotype VIII	40
<i>Haemophilus paraphrohaemolyticus</i>	
<i>Haemophilus paraphrophilus</i>	
<i>Haemophilus segnis</i>	
<i>Haemophilus somnus</i>	
<i>Haemophilus</i> species	
<i>Hafnia alvei</i>	45
<i>Hanseniaspora guilliermondii</i>	
<i>Hanseniaspora uvarum</i>	
<i>Hanseniaspora valbyensis</i>	
<i>Hansenula anomala</i>	
<i>Hansenula holsiti</i>	
<i>Hansenula polymorpha</i>	
<i>Helicobacter (Campylobacter) cinaedi</i>	50
<i>Helicobacter (Campylobacter) fennelliae</i>	
<i>Helicobacter (Campylobacter) pylori</i>	
<i>Issatchenkia orientalis</i>	
<i>Kingella denitrificans</i>	
<i>Kingella indologenes</i>	
<i>Kingella kingae</i>	55
<i>Kingella</i> species	
<i>Klebsiella ornithinolytica</i>	
<i>Klebsiella oxytoca</i>	
<i>Klebsiella planticola</i>	
<i>Klebsiella pneumoniae</i> subsp. <i>ozaenae</i>	
<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i>	
<i>Klebsiella pneumoniae</i> subsp. <i>rhinoscleromatis</i>	60
<i>Klebsiella</i> species	
<i>Klebsiella terrigena</i>	
<i>Kloeckera apiculata</i>	
<i>Kloeckera apis</i>	
<i>Kloeckera japonica</i>	65
<i>Kloeckera</i> species	
<i>Kluyvera ascorbata</i>	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Kluyvera cryocrescens</i>	
<i>Kluyvera</i> species	
<i>Kluyveromyces lactis</i>	
<i>Kluyveromyces marxianus</i>	
<i>Kluyveromyces thermotolerans</i>	
<i>Kocuria (Micrococcus) kristinae</i>	
<i>Kocuria (Micrococcus) rosea</i>	
<i>Kocuria (Micrococcus) varians</i>	
<i>Koserella trubslitii</i>	
<i>Kytococcus (Micrococcus) sedentarius</i>	
<i>Lactobacillus (Weissella) viridescens</i>	
<i>Lactobacillus A</i>	
<i>Lactobacillus acidophilus</i>	
<i>Lactobacillus B</i>	
<i>Lactobacillus brevis</i>	
<i>Lactobacillus buchneri</i>	
<i>Lactobacillus casei</i>	
<i>Lactobacillus casei</i> subsp. <i>casei</i>	
<i>Lactobacillus casei</i> subsp. <i>lactosus</i>	
<i>Lactobacillus casei</i> subsp. <i>rhamnosus</i>	
<i>Lactobacillus catenaformis</i>	
<i>Lactobacillus cellobiosus</i>	
<i>Lactobacillus collinoides</i>	
<i>Lactobacillus coprophilus</i>	
<i>Lactobacillus crispatus</i>	
<i>Lactobacillus curvatus</i>	
<i>Lactobacillus delbrueckii</i> subsp. <i>bulgaricus</i>	
<i>Lactobacillus delbrueckii</i> subsp. <i>delbrueckii</i>	
<i>Lactobacillus delbrueckii</i> subsp. <i>lactis</i>	
<i>Lactobacillus fermentum</i>	
<i>Lactobacillus fructivorans</i>	
<i>Lactobacillus helveticus</i>	
<i>Lactobacillus helveticus</i> subsp. <i>jugurti</i>	
<i>Lactobacillus jensenii</i>	
<i>Lactobacillus lindneri</i>	
<i>Lactobacillus minutus</i>	
<i>Lactobacillus paracasei</i> subsp. <i>paracasei</i>	
<i>Lactobacillus pentosus</i>	
<i>Lactobacillus plantarum</i>	
<i>Lactobacillus salivarius</i>	
<i>Lactobacillus salivarius</i> var. <i>salicinius</i>	
<i>Lactobacillus</i> species	
<i>Lactococcus diacetylactis</i>	
<i>Lactococcus garvieae</i>	
<i>Lactococcus lactis</i> subsp. <i>cremoris</i>	
<i>Lactococcus lactis</i> subsp. <i>diacetylactis</i>	
<i>Lactococcus lactis</i> subsp. <i>hordniae</i>	
<i>Lactococcus lactis</i> subsp. <i>lactis</i>	
<i>Lactococcus plantarum</i>	
<i>Lactococcus raffinolactis</i>	
<i>Leclercia adecarboxylata</i>	
<i>Legionella</i> species	
<i>Leminorella</i> species	
<i>Leptospira</i> species	
<i>Leptotrichia buccalis</i>	
<i>Leuconostoc (Weissella)</i>	
<i>paramesenteroides</i>	
<i>Leuconostoc carnosum</i>	
<i>Leuconostoc citreum</i>	
<i>Leuconostoc gelidum</i>	
<i>Leuconostoc lactis</i>	
<i>Leuconostoc mesenteroides</i>	
<i>Leuconostoc mesenteroides</i> subsp. <i>cremoris</i>	
<i>Leuconostoc mesenteroides</i> subsp. <i>dextranicum</i>	
<i>Leuconostoc mesenteroides</i> subsp.	
<i>mesenteroides</i>	
<i>Leuconostoc</i> species	
<i>Listeria grayi</i>	
<i>Listeria innocua</i>	
<i>Listeria ivanovii</i>	
<i>Listeria monocytogenes</i>	
<i>Listeria murrayi</i>	
<i>Listeria seeligeri</i>	
<i>Listeria</i> species	
<i>Listeria welshimeri</i>	
<i>Megasphaera elsdenii</i>	
<i>Methylobacterium mesophilicum</i>	
<i>Metschnikowia pulcherrima</i>	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Microbacterium</i> species	5
<i>Micrococcus luteus</i>	
<i>Micrococcus lylae</i>	
<i>Micrococcus</i> species	
<i>Mobiluncus curtisi</i>	
<i>Mobiluncus mulieris</i>	
<i>Mobiluncus</i> species	
<i>Moellerella wisconsensis</i>	10
<i>Moraxella (Branhamella) catarrhalis</i>	
<i>Moraxella atlantae</i>	
<i>Moraxella bovis</i>	
<i>Moraxella lacunata</i>	
<i>Moraxella nonliquefaciens</i>	
<i>Moraxella osloensis</i>	15
<i>Moraxella phenylpyruvica</i>	
<i>Moraxella</i> species	
<i>Morganella morganii</i>	
<i>Morganella morganii</i> subsp. <i>morganii</i>	
<i>Morganella morganii</i> subsp. <i>sibonii</i>	
<i>Mycobacterium africanum</i>	20
<i>Mycobacterium asiaticum</i>	
<i>Mycobacterium avium</i>	
<i>Mycobacterium bovis</i>	
<i>Mycobacterium chelonae</i>	
<i>Mycobacterium fortuitum</i>	
<i>Mycobacterium gordoneae</i>	25
<i>Mycobacterium kansasii</i>	
<i>Mycobacterium malmoense</i>	
<i>Mycobacterium marinum</i>	
<i>Mycobacterium phlei</i>	
<i>Mycobacterium scrofulaceum</i>	
<i>Mycobacterium smegmatis</i>	30
<i>Mycobacterium</i> species	
<i>Mycobacterium tuberculosis</i>	
<i>Mycobacterium ulcerans</i>	
<i>Mycobacterium xenopi</i>	
<i>Mycoplasma fermentans</i>	
<i>Mycoplasma hominis</i>	
<i>Mycoplasma orale</i>	35
<i>Mycoplasma pneumoniae</i>	
<i>Mycoplasma</i> species	
<i>Myrodes</i> species	
<i>Neisseria cinerea</i>	
<i>Neisseria elongata</i> subsp. <i>elongata</i>	
<i>Neisseria flava</i>	40
<i>Neisseria flavescens</i>	
<i>Neisseria gonorrhoeae</i>	
<i>Neisseria lactamica</i>	
<i>Neisseria meningitidis</i>	
<i>Neisseria mucosa</i>	
<i>Neisseria perflava</i>	45
<i>Neisseria polysaccharea</i>	
<i>Neisseria saprophytes</i>	
<i>Neisseria sicca</i>	
<i>Neisseria subflava</i>	
<i>Neisseria weaveri</i>	
<i>Neisseria weaveri</i> (CDC group M5)	
<i>Nocardia</i> species	50
<i>Ochrobactrum anthropi</i>	
<i>Oerskovia</i> species	
<i>Oerskovia xanthineolytica</i>	
<i>Oligella (Moraxella) urethralis</i>	
<i>Oligella</i> species	
<i>Oligella ureolytica</i>	55
<i>Paenibacillus alvei</i>	
<i>Paenibacillus macerans</i>	
<i>Paenibacillus polymyxa</i>	
<i>Pantoea agglomerans</i>	
<i>Pantoea ananas</i> (<i>Erwinia uredovora</i>)	
<i>Pantoea dispersa</i>	60
<i>Pantoea</i> species	
<i>Pantoea stewartii</i>	
<i>Pasteurella (Haemophilus) avium</i>	
<i>Pasteurella aerogenes</i>	
<i>Pasteurella gallinarum</i>	
<i>Pasteurella haemolytica</i>	65
<i>Pasteurella haemolyticus</i>	
<i>Pasteurella multocida</i>	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Pasteurella multocida</i> SF	
<i>Pasteurella multocida</i> subsp. <i>multocida</i>	
<i>Pasteurella multocida</i> subsp. <i>septica</i>	
<i>Pasteurella pneumotropica</i>	
<i>Pasteurella</i> species	
<i>Pasteurella ureae</i>	
<i>Pediococcus acidilactici</i>	
<i>Pediococcus damnosus</i>	
<i>Pediococcus pentosaceus</i>	
<i>Pediococcus</i> species	
<i>Peptococcus niger</i>	
<i>Peptococcus</i> species	
<i>Peptostreptococcus anaerobius</i>	
<i>Peptostreptococcus asaccharolyticus</i>	
<i>Peptostreptococcus indolicus</i>	
<i>Peptostreptococcus magnus</i>	
<i>Peptostreptococcus micros</i>	
<i>Peptostreptococcus parvulus</i>	
<i>Peptostreptococcus prevotti</i>	
<i>Peptostreptococcus productus</i>	
<i>Peptostreptococcus</i> species	
<i>Peptostreptococcus tetradius</i>	
<i>Phaecoccomyces exophialiae</i>	
<i>Photobacterium damselae</i>	
<i>Pichia (Hansenula) anomala</i>	
<i>Pichia (Hansenula) jadinii</i>	
<i>Pichia (Hansenula) petersonii</i>	
<i>Pichia angusta</i> (<i>Hansenula polymorpha</i>)	
<i>Pichia carsonii</i> (P. <i>vini</i>)	
<i>Pichia etchellsii</i>	
<i>Pichia farinosa</i>	
<i>Pichia fermentans</i>	
<i>Pichia membranaefaciens</i>	
<i>Pichia norvegensis</i>	
<i>Pichia ohmeri</i>	
<i>Pichia spartinae</i>	
<i>Pichia</i> species	
<i>Plesiomonas shigelloides</i>	
<i>Porphyromonas asaccharolytica</i>	
<i>Porphyromonas endodontalis</i>	
<i>Porphyromonas gingivalis</i>	
<i>Porphyromonas levii</i>	
<i>Prevotella (Bacteroides) buccae</i>	
<i>Prevotella (Bacteroides) buccalis</i>	
<i>Prevotella (Bacteroides) corporis</i>	
<i>Prevotella (Bacteroides) denticola</i>	
<i>Prevotella (Bacteroides) loescheii</i>	
<i>Prevotella (Bacteroides) oralis</i>	
<i>Prevotella (Bacteroides) disiens</i>	
<i>Prevotella (Bacteroides) oris</i>	
<i>Prevotella bivia</i> (<i>Bacteroides bivius</i>)	
<i>Prevotella intermedia</i> (<i>Bacteroides intermedius</i>)	
<i>Prevotella melanogenica</i> (<i>Bacteroides melanogenicus</i>)	
<i>Prevotella ruminicola</i>	
<i>Propionibacterium acnes</i>	
<i>Propionibacterium avidum</i>	
<i>Propionibacterium granulosum</i>	
<i>Propionibacterium propionicum</i>	
<i>Propionibacterium</i> species	
<i>Proteus mirabilis</i>	
<i>Proteus penneri</i>	
<i>Proteus</i> species	
<i>Proteus vulgaris</i>	
<i>Prototheca</i> species	
<i>Prototheca wickerhamii</i>	
<i>Prototheca zopfii</i>	
<i>Providencia alcalifaciens</i>	
<i>Providencia heimbachae</i>	
<i>Providencia rettgeri</i>	
<i>Providencia rustigianii</i>	
<i>Providencia</i> species	
<i>Providencia stuartii</i>	
<i>Providencia stuartii urea +</i>	
<i>Pseudomonas (Chryseomonas) luteola</i>	
<i>Pseudomonas acidovorans</i>	
<i>Pseudomonas aeruginosa</i>	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Pseudomonas alcaligenes</i>	
<i>Pseudomonas cepacia</i>	5
<i>Pseudomonas chlororaphis</i> (<i>P. aureofaciens</i>)	
<i>Pseudomonas fluorescens</i>	
<i>Pseudomonas fluorescens</i> group	
<i>Pseudomonas mendocina</i>	
<i>Pseudomonas pseudoalcaligenes</i>	
<i>Pseudomonas putida</i>	10
<i>Pseudomonas species</i>	
<i>Pseudomonas stutzeri</i>	
<i>Pseudomonas testosteroni</i>	
<i>Pseudomonas vesicularis</i>	
<i>Pseudoramibacter</i> (<i>Eubacterium</i>) <i>lactolyticus</i>	
<i>Psychrobacter</i> (<i>Moraxella</i>) <i>phenylpyruvicus</i>	15
<i>Rahnella aquatilis</i>	
<i>Ralstonia</i> (<i>Pseudomonas</i> , <i>Burkholderia</i>) <i>pickettii</i>	
<i>Rhodococcus</i> (<i>Corynebacterium</i>) <i>equi</i>	
<i>Rhodococcus</i> species	
<i>Rhodospiridium toruloides</i>	20
<i>Rhodotorula glutinis</i>	
<i>Rhodotorula minuta</i>	
<i>Rhodotorula mucilaginosa</i> (<i>R. rubra</i>)	
<i>Rhodotorula</i> species	
<i>Rickettsia</i> species	
<i>Rothia dentocariosa</i>	25
<i>Saccharomyces cerevisiae</i>	
<i>Saccharomyces exiguius</i>	
<i>Saccharomyces kluveri</i>	
<i>Saccharomyces</i> species	
<i>Sakaguchia dacryoides</i>	
(<i>Rhodospiridium dacryoidum</i>)	
<i>Salmonella arizona</i>	30
<i>Salmonella choleraesuis</i>	
<i>Salmonella enteritidis</i>	
<i>Salmonella gallinarum</i>	
<i>Salmonella paratyphi A</i>	
<i>Salmonella paratyphi B</i>	
<i>Salmonella pullorum</i>	35
<i>Salmonella</i> species	
<i>Salmonella typhi</i>	
<i>Salmonella typhimurium</i>	
<i>Salmonella typhisuis</i>	
<i>Salmonella Arizona</i>	
<i>Serratia ficaria</i>	40
<i>Serratia fonticola</i>	
<i>Serratia grimesii</i>	
<i>Serratia liquefaciens</i>	
<i>Serratia marcescens</i>	
<i>Serratia odorifera</i>	
<i>Serratia odorifera</i> type 1	45
<i>Serratia odorifera</i> type 2	
<i>Serratia plymuthica</i>	
<i>Serratia proteamaculans</i>	
<i>Serratia proteamaculans</i> subsp. proteamaculans	
<i>Serratia proteamaculans</i> subsp. <i>quinovora</i>	50
<i>Serratia rubidaea</i>	
<i>Serratia</i> species	
<i>Shewanella</i> (<i>Pseudomonas</i> , <i>Alteromonas</i>) <i>putrefaciens</i>	
<i>Shigella boydii</i>	55
<i>Shigella dysenteriae</i>	
<i>Shigella flexneri</i>	
<i>Shigella sonnei</i>	
<i>Shigella</i> species	
<i>Sphingobacterium multivorum</i>	
<i>Sphingobacterium</i> species	
<i>Sphingobacterium spiritivorum</i>	
<i>Sphingobacterium thalpophilum</i>	60
<i>Sphingomonas</i> (<i>Pseudomonas</i>) <i>paucimobilis</i>	
<i>Sporidiobolus salmonicolor</i>	
<i>Sporobolomyces roseus</i>	
<i>Sporobolomyces salmonicolor</i>	
<i>Sporobolomyces</i> species	
<i>Staphylococcus</i> (<i>Peptococcus</i>) <i>saccharolyticus</i>	65
<i>Staphylococcus</i> <i>arlettae</i>	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Staphylococcus aureus</i>	
<i>Staphylococcus aureus</i> (Coagulase-negative)	
<i>Staphylococcus auricularis</i>	
<i>Staphylococcus capitis</i>	
<i>Staphylococcus capitis</i> subsp. <i>capitis</i>	
<i>Staphylococcus capitis</i> subsp. <i>ureolyticus</i>	
<i>Staphylococcus caprae</i>	
<i>Staphylococcus carnosus</i>	
<i>Staphylococcus caseolyticus</i>	
<i>Staphylococcus chromogenes</i>	
<i>Staphylococcus cohnii</i>	
<i>Staphylococcus cohnii</i> subsp. <i>cohnii</i>	
<i>Staphylococcus cohnii</i> subsp. <i>urealyticum</i>	
<i>Staphylococcus epidermidis</i>	
<i>Staphylococcus equorum</i>	
<i>Staphylococcus gallinarum</i>	
<i>Staphylococcus haemolyticus</i>	
<i>Staphylococcus hominis</i>	
<i>Staphylococcus hominis</i> subsp. <i>hominis</i>	
<i>Staphylococcus hominis</i> subsp. <i>novobiosepticus</i>	
<i>Staphylococcus hyicus</i>	
<i>Staphylococcus intermedius</i>	
<i>Staphylococcus kloosii</i>	
<i>Staphylococcus lentus</i>	
<i>Staphylococcus lugdunensis</i>	
<i>Staphylococcus saprophyticus</i>	
<i>Staphylococcus schleiferi</i>	
<i>Staphylococcus sciuri</i>	
<i>Staphylococcus simulans</i>	
<i>Staphylococcus</i> species	
<i>Staphylococcus warneri</i>	
<i>Staphylococcus xylosus</i>	
<i>Stenotrophomonas</i> (<i>Xanthomonas</i>) <i>maltophilia</i>	
<i>Stephanoascus ciferrii</i>	
<i>Stomatococcus mucilaginosus</i>	
<i>Streptococcus acidominimus</i>	
<i>Streptococcus agalactiae</i>	
<i>Streptococcus agalactiae</i> (Group B)	
<i>Streptococcus agalactiae</i> hemolytic	
<i>Streptococcus agalactiae</i> non-hemolytic	
<i>Streptococcus alactolyticus</i>	
<i>Streptococcus anginosus</i>	
<i>Streptococcus anginosus</i> (Group D, nonenterococci)	
<i>Streptococcus</i> beta-hemolytic group A	
<i>Streptococcus</i> beta-hemolytic non- group A or B	
<i>Streptococcus</i> beta-hemolytic non-group A	
<i>Streptococcus</i> beta-hemolytic	
<i>Streptococcus bovis</i> (Group D, nonenterococci)	
<i>Streptococcus bovis</i> I	
<i>Streptococcus bovis</i> II	
<i>Streptococcus canis</i>	
<i>Streptococcus constellatus</i>	
<i>Streptococcus constellatus</i> (<i>Streptococcus milleri</i> I)	
<i>Streptococcus constellatus</i> (viridans)	
<i>Streptococcus</i>	
<i>Streptococcus downei</i>	
<i>Streptococcus dysgalactiae</i> subsp. <i>dysgalactiae</i>	
<i>Streptococcus dysgalactiae</i> subsp. <i>equisimilis</i>	
<i>Streptococcus equi</i> (Group C/Group G)	
<i>Streptococcus</i>	
<i>Streptococcus equi</i> subsp. <i>equi</i>	
<i>Streptococcus equi</i> subsp. <i>zooepidemicus</i>	
<i>Streptococcus equinus</i>	
<i>Streptococcus equinus</i> (Group D, nonenterococci)	
<i>Streptococcus equisimilis</i>	
<i>Streptococcus equisimilis</i> (Group C/Group G <i>Streptococcus</i>)	
<i>Streptococcus</i> Gamma (non)-hemolytic	
<i>Streptococcus gordoni</i>	
<i>Streptococcus</i> Group B	
<i>Streptococcus</i> Group C	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Streptococcus</i> Group D	5
<i>Streptococcus</i> Group E	
<i>Streptococcus</i> Group F	
<i>Streptococcus</i> Group G	
<i>Streptococcus</i> Group L	
<i>Streptococcus</i> Group P	
<i>Streptococcus</i> Group U	
<i>Streptococcus intermedius</i>	10
<i>Streptococcus intermedius</i> (viridans)	
(<i>Streptococcus milleri</i> II)	
<i>Streptococcus intermedius</i> (viridans)	
<i>Streptococcus</i>	
<i>Streptococcus milleri</i> group	
<i>Streptococcus mitis</i>	15
<i>Streptococcus mitis</i> (viridans)	
<i>Streptococcus</i>	
<i>Streptococcus mitis</i> group	
<i>Streptococcus mutans</i>	
<i>Streptococcus mutans</i> (viridans)	
<i>Streptococcus</i>	20
<i>Streptococcus oralis</i>	
<i>Streptococcus parasanguis</i>	
<i>Streptococcus pneumoniae</i>	
<i>Streptococcus porcinus</i>	
<i>Streptococcus pyogenes</i>	
<i>Streptococcus pyogenes</i> (Group A)	25
<i>Streptococcus salivarius</i>	
<i>Streptococcus salivarius</i> (viridans)	
<i>Streptococcus</i>	
<i>Streptococcus salivarius</i> subsp. <i>salivarius</i>	
<i>Streptococcus salivarius</i> subsp. <i>thermophilus</i>	
<i>Streptococcus sanguis</i>	
<i>Streptococcus sanguis</i> I (viridans)	
<i>Streptococcus</i>	
<i>Streptococcus sanguis</i> II	
<i>Streptococcus sanguis</i> II (viridans)	
<i>Streptococcus</i>	35
<i>Streptococcus sobrinus</i>	
<i>Streptococcus</i> species	
<i>Streptococcus suis</i> I	
<i>Streptococcus suis</i> II	
<i>Streptococcus uberis</i>	
<i>Streptococcus uberis</i> (viridans)	
<i>Streptococcus</i>	
<i>Streptococcus vestibularis</i>	
<i>Streptococcus zooepidemicus</i>	40
<i>Streptococcus zooepidemicus</i> (Group C)	
<i>Streptomyces somaliensis</i>	
<i>Streptomyces</i> species	
<i>Suttonella (Kingella) indologenes</i>	
<i>Tatumella ptyseos</i>	
<i>Tetragenococcus (Pediococcus) halophilus</i>	
<i>Torulaspora delbrueckii</i>	45
(<i>Saccharomyces rosei</i>)	
<i>Torulopsis candida</i>	
<i>Torulopsis haemulonii</i>	
<i>Torulopsis inconspicua</i>	
<i>Treponema</i> species	
<i>Trichosporon asahii</i>	50
<i>Trichosporon asteroides</i>	
<i>Trichosporon beigelii</i>	
<i>Trichosporon cutaneum</i>	
<i>Trichosporon inkin</i>	
<i>Trichosporon mucoides</i>	
<i>Trichosporon ovoides</i>	55
<i>Trichosporon pullulans</i>	
<i>Trichosporon</i> species	
<i>Turicella otitidis</i>	
<i>Ureaplasma</i> species	
<i>Ureaplasma urealyticum</i>	
<i>Veillonella parvula</i> (<i>V. alcalescens</i>)	60
<i>Veillonella</i> species	
<i>Vibrio alginolyticus</i>	
<i>Vibrio cholerae</i>	
<i>Vibrio damsela</i>	
<i>Vibrio fluialis</i>	
<i>Vibrio fumispii</i>	65
<i>Vibrio harveyi</i>	

TABLE 15-continued

Microorganisms identified by commercial systems ¹ .	
<i>Vibrio</i> <i>holilae</i>	
<i>Vibrio metschnikovii</i>	
<i>Vibrio mimicus</i>	
<i>Vibrio parahaemolyticus</i>	
<i>Vibrio</i> species	
<i>Vibrio</i> species SF	
<i>Vibrio vulnificus</i>	
<i>Weeksella (Bergeyella) virosa</i>	
<i>Weeksella</i> species	
<i>Weeksella virosa</i>	
<i>Williopsis (Hansenula) saturnus</i>	
<i>Xanthomonas campestris</i>	
<i>Xanthomonas</i> species	
<i>Yarrowia (Candida) lipolytica</i>	
<i>Yersinia aldovae</i>	
<i>Yersinia enterocolitica</i>	
<i>Yersinia enterocolitica</i> group	
<i>Yersinia frederiksenii</i>	
<i>Yersinia intermedia</i>	
<i>Yersinia intermedius</i>	
<i>Yersinia kristensenii</i>	
<i>Yersinia pestis</i>	
<i>Yersinia pseudotuberculosis</i>	
<i>Yersinia pseudotuberculosis</i> SF	
<i>Yersinia ruckeri</i>	
<i>Yersinia</i> species	
<i>Yokenella regensburgei</i>	
<i>Yokenella regensburgei</i> (<i>Koserella trabulsi</i>)	
<i>Zygoascus hellenicus</i>	
<i>Zygosaccharomyces</i> species	

¹The list includes microorganisms that may be identified by API identification test systems and VITEK® automated identification system from bioMérieux Inc., or by the MicroScan® WalkAway® automated systems from Dade Behring. Identification relies on classical identification methods using batteries of biochemical and other phenotypical tests.

TABLE 16

tuf gene sequences obtained in our laboratory (Example 42).			
Species	Strain no.	Gene	GenBank Accession no.*
<i>Abiotrophia adiacens</i>	ATCC49175	tuf	AF124224
<i>Enterococcus avium</i>	ATCC14025	tufA	AF124220
		tufB	AF274715
<i>Enterococcus casseliflavus</i>	ATCC25788	tufA	AF274716
		tufB	AF274717
<i>Enterococcus cecorum</i>	ATCC43198	tuf	AF274718
<i>Enterococcus columbae</i>	ATCC51263	tuf	AF274719
		tufA	AF274720
<i>Enterococcus dispar</i>	ATCC51266	tufA	AF274721
		tufB	AF274722
<i>Enterococcus durans</i>	ATCC19432	tufA	AF274722
		tufB	AF274723
<i>Enterococcus faecalis</i>	ATCC29212	tuf	AF124221
<i>Enterococcus faecium</i>	ATCC 19434	tufA	AF124222
		tufB	AF274724
<i>Enterococcus gallinarum</i>	ATCC49573	tufA	AF124223
		tufB	AF274725
<i>Enterococcus hirae</i>	ATCC8043	tufA	AF274726
		tufB	AF274727
<i>Enterococcus malodoratus</i>	ATCC43197	tufA	AF274728
		tufB	AF274729
<i>Enterococcus mundtii</i>	ATCC43186	tufA	AF274730
		tufB	AF274731
<i>Enterococcus pseudoavium</i>	ATCC49372	tufA	AF274732
		tufB	AF274733
<i>Enterococcus raffinosus</i>	ATCC49427	tufA	AF274734
		tufB	AF274735
<i>Enterococcus saccharolyticus</i>	ATCC43076	tuf	AF274736
<i>Enterococcus solitarius</i>	ATCC49428	tuf	AF274737
<i>Enterococcus sulfureus</i>	ATCC49903	tuf	AF274738
<i>Lactococcus lactis</i>	ATCC11154	tuf	AF274745
<i>Listeria monocytogenes</i>	ATCC15313	tuf	AF274746
<i>Listeria seeligeri</i>	ATCC35967	tuf	AF274747
<i>Staphylococcus aureus</i>	ATCC25923	tuf	AF274739
<i>Staphylococcus epidermidis</i>	ATCC14990	tuf	AF274740

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TABLE 16-continued

tuf gene sequences obtained in our laboratory (Example 42).			
Species	Strain no.	Gene	GenBank Accession no.*
<i>Streptococcus mutans</i>	ATCC25175	tuf	AF274741
<i>Streptococcus pneumoniae</i>	ATCC6303	tuf	AF274742
<i>Streptococcus pyogenes</i>	ATCC19615	tuf	AF274743
<i>Streptococcus suis</i>	ATCC43765	tuf	AF274744

*Corresponding sequence ID NO. for the above ATCC strains are given in table 7.

TABLE 17

tuf gene sequences selected from databases for Example 42.		
Species	Gene	Accession no.*
<i>Agrobacterium tumefaciens</i>	tufA	X99673
	tufB	X99674
<i>Anacystis nidulans</i>	tuf	X17442
<i>Aquifex aeolicus</i>	tufA	AE000657
	tufB	AE000657
<i>Bacillus stearothermophilus</i>	tuf	AJ000260
<i>Bacillus subtilis</i>	tuf	AL009126
<i>Bacteroides fragilis</i>	tuf	P33165
<i>Borrelia burgdorferi</i>	tuf	AE000783
<i>Brevibacterium linens</i>	tuf	X76863
<i>Bulkholderia cepacia</i>	tuf	P33167
<i>Campylobacter jejuni</i>	tufB	Y17167
<i>Chlamydia pneumoniae</i>	tuf	AE001363
<i>Chlamydia trachomatis</i>	tuf	M74221
<i>Corynebacterium glutamicum</i>	tuf	X77034
<i>Cytophaga lytica</i>	tuf	X77035
<i>Deinococcus radiodurans</i>	tuf	AE000513
<i>Escherichia coli</i>	tufA	J01690
	tufB	J01717
<i>Fervidobacterium islandicum</i>	tuf	Y15788
<i>Haemophilus influenzae</i>	tufA	L42023
	tufB	L42023

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TABLE 17-continued

tuf gene sequences selected from databases for Example 42.		
Species	Gene	Accession no.*
<i>Helicobacter pylori</i>	tuf	AE000511
<i>Homo sapiens</i> (Human)	EF-1 α	X03558
<i>Methanococcus jannaschii</i>	EF-1 α	U67486
<i>Mycobacterium leprae</i>	tuf	D13869
<i>Mycobacterium tuberculosis</i>	tuf	X63539
<i>Mycoplasma genitalium</i>	tuf	L43967
<i>Mycoplasma pneumoniae</i>	tuf	U00089
<i>Neisseria gonorrhoeae</i>	tufA	L36380
<i>Nicotiana tabacum</i> (Tobacco)	EF-1 α	U04632
<i>Peptococcus niger</i>	tuf	X76869
<i>Planobispora rosea</i>	tuf1	U67308
<i>Saccharomyces cerevisiae</i> (Yeast)	EF-1 α	X00779
<i>Salmonella typhimurium</i>	tufA	X55116
	tufB	X55117
<i>Shewanella putrefaciens</i>	tuf	P33169
<i>Spirochaeta aurantia</i>	tuf	X76874
<i>Spirulina platensis</i>	tufA	X15646
<i>Streptomyces aureofaciens</i>	tuf1	AF007125
<i>Streptomyces cinnamoneus</i>	tuf1	X98831
<i>Streptomyces coelicolor</i>	tuf1	X77039
	tuf3	X77040
<i>Streptomyces collinus</i>	tuf1	S79408
<i>Streptomyces ramocissimus</i>	tuf1	X67057
	tuf2	X67058
	tuf3	X67059
<i>Synechocystis</i> sp.	tuf	AB001339
<i>Taxeobacter ocellatus</i>	tuf	X77036
<i>Thermotoga maritima</i>	tuf	AE000512
<i>Thermus aquaticus</i>	tuf	X66322
<i>Thermus thermophilus</i>	tuf	X06657
<i>Thiobacillus cuprinus</i>	tuf	U78300
<i>Treponema pallidum</i>	tuf	AE000520
<i>Wolinella succinogenes</i>	tuf	X76872

*Sequence data were obtained from GenBank, EMBL, and SWISSPROT databases. Genes were designated as appeared in the references.

Table 18

Nucleotide and amino acid sequence identities of EF-Tu between different enterococci and other low G + C gram-positive bacteria. The upper right triangle represents the deduced amino acid sequence identities of gram-positive bacterial EF-Tu, while the lower left triangle represents the DNA sequence identities of the corresponding tuf genes. The sequence identities between different enterococcal tufA genes are boxed while those between enterococcal tufB genes are shaded.

Bacterial tuf gene	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
1. <i>E. avium</i> tufA	96	98	96	96	96	96	96	97	95	98	99	95	95	96	94	96	95	96	94	96	95	96	95	96	95	96	86	86	86	85	86	84	82	83					
2. <i>E. casseliflavus</i> tufA	90	97	96	99	96	95	96	95	96	95	96	95	96	94	93	87	88	86	87	87	86	87	85	87	86	87	88	92	91	90	90	90	90	90	90	90			
3. <i>E. dispar</i> tufA	93	90	95	95	96	95	96	95	97	97	91	90	95	95	94	92	87	87	86	87	85	87	86	87	87	87	87	93	90	90	90	90	90	90	90	90			
4. <i>E. durans</i> tufA	90	89	90	98	99	93	99	95	96	90	90	91	94	95	94	92	87	87	86	86	86	86	87	87	88	87	94	90	90	90	90	90	90	90	90				
5. <i>E. faecium</i> tufA	89	90	89	96	96	98	93	98	95	96	99	91	88	94	93	92	87	88	86	86	87	87	87	87	87	87	87	94	92	91	91	93	95	86	84	84			
6. <i>E. gallinarum</i> tufA	90	90	89	89	89	96	93	95	96	98	89	96	93	92	93	92	87	87	86	87	87	86	87	87	87	87	93	92	90	90	90	90	90	90	90				
7. <i>E. hirae</i> tufA	90	90	89	99	99	95	96	91	91	89	95	94	92	86	87	86	87	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	84	84					
8. <i>E. malodoratus</i> tufA	96	91	94	90	89	90	89	92	97	89	89	90	93	96	92	86	85	85	85	85	85	85	85	85	85	85	85	86	86	86	86	86	84	84					
9. <i>E. mundtii</i> tufA	89	89	88	96	93	89	96	88	94	95	88	90	89	94	94	92	87	87	86	86	85	86	87	87	88	87	94	90	89	90	91	91	86	84	84				
10. <i>E. pseudoaoxium</i> tufA	97	92	93	90	89	91	89	97	89	98	90	90	91	95	96	94	87	87	86	87	87	86	87	87	86	87	88	88	88	89	89	90	90	91	85	85	84		
11. <i>E. raffininosus</i> tufA	97	91	93	90	89	89	89	97	88	97	91	90	90	94	96	93	86	87	85	86	85	86	87	87	87	87	89	89	90	90	91	91	84	84	83				
12. <i>E. cecorum</i> tufA	90	90	95	96	96	95	96	92	95	95	95	98	95	93	93	93	88	88	88	87	87	86	86	87	87	87	89	89	89	89	89	86	86	85	84				
13. <i>E. columbae</i> tufA	90	90	95	96	97	96	96	93	95	95	95	95	95	94	95	94	92	89	88	87	88	88	87	87	87	88	89	89	89	89	89	86	86	85	85				
14. <i>E. facecabs</i> tufA	91	91	90	89	96	97	94	94	95	96	90	89	94	94	94	93	87	87	86	87	87	86	87	87	86	87	87	87	87	87	87	86	86	85	85				
15. <i>E. saccharolyticus</i> tufA	91	89	90	91	88	88	90	91	89	92	91	89	89	92	91	89	89	92	91	94	92	86	87	87	92	90	89	89	89	89	89	89	89	89	89				
16. <i>E. sulfureus</i> tufA	83	84	83	83	84	83	82	84	83	84	83	84	83	83	83	83	88	87	87	86	87	87	86	87	87	86	87	88	88	89	91	91	91	91	86	85	85		
17. <i>E. solitarius</i> tuf	83	84	83	83	84	83	82	84	83	84	83	84	83	83	83	83	88	87	87	86	87	87	86	87	87	86	87	88	88	89	89	89	89	89	89	89			
18. <i>E. arrium</i> tufB	77	77	78	78	76	77	78	78	77	78	77	78	77	77	77	78	75	78	72	79	72	79	72	79	72	79	72	79	72	79	72	79	72	79	72	79	72		
19. <i>E. casseliflavus</i> tufB	11	72	72	70	72	70	71	72	72	72	70	72	72	72	72	70	72	68	72	79	73	72	79	73	72	79	73	72	79	73	72	79	73	72	79	73	72		
20. <i>E. dispar</i> tufB	76	78	77	77	77	77	77	76	77	77	77	77	77	77	77	78	75	78	72	79	72	79	72	79	72	79	72	79	72	79	72	79	72	79	72	79	72		
21. <i>E. durans</i> tufB	77	78	78	76	76	77	78	77	77	78	77	78	77	77	78	78	75	80	80	62	91	92	93	93	92	93	93	92	93	93	92	93	93	92	93	93	92		
22. <i>E. faecium</i> tufB	76	75	76	76	75	75	76	76	77	77	77	77	77	77	77	76	74	80	78	79	76	79	76	79	76	79	76	79	76	79	76	79	76	79	76	79	76		
23. <i>E. gallinarum</i> tufB	72	73	72	73	72	74	72	71	72	72	73	72	72	72	73	72	72	72	72	73	72	72	73	72	73	72	73	72	73	72	73	72	73	72	73	72	73		
24. <i>E. hirae</i> tufB	75	74	75	75	75	75	75	74	75	74	74	75	74	75	74	74	72	74	80	79	79	83	79	73	71	70	71	72	71	74	73	72	71	74	73	72	71		
25. <i>E. malodoratus</i> tufB	76	76	76	77	77	77	77	76	77	77	77	77	77	77	77	78	76	78	75	78	75	78	75	78	75	78	75	78	75	78	75	78	75	78	75	78	75		
26. <i>E. mundtii</i> tufB	74	74	75	73	74	74	74	74	74	74	74	74	74	74	74	74	75	74	74	73	70	73	70	78	75	70	78	75	70	78	75	70	78	75	70	78	75		
27. <i>E. pseudoaoxium</i> tufB	77	77	78	77	76	77	76	78	77	78	77	78	77	78	77	78	77	78	77	78	77	78	77	78	77	78	77	78	77	78	77	78	77	78	77	78	77		
28. <i>E. raffininosus</i> tufB	78	79	79	78	77	77	78	77	78	78	79	79	78	78	78	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79		
29. <i>A. adiacens</i> tuf	88	87	87	86	88	86	86	88	88	88	88	88	88	88	88	89	89	89	89	89	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87	87		
30. <i>B. subtilis</i> tuf	81	80	79	79	80	79	79	79	80	81	80	81	80	79	78	78	79	78	79	78	79	78	79	78	79	78	79	78	79	78	79	78	79	78	79	78	79		
31. <i>L. monocytogenes</i> tuf	82	81	82	82	82	81	82	81	82	81	82	81	82	81	82	81	82	81	82	81	82	81	82	81	82	81	82	81	82	81	82	81	82	81	82	81	82		
32. <i>L. seeligeri</i> tuf	84	84	83	83	84	84	82	74	83	84	86	86	84	86	86	84	86	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85		
33. <i>S. aureus</i> tuf	83	85	83	84	83	84	84	82	74	83	83	86	87	85	83	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82		
34. <i>S. epidermidis</i> tuf	76	77	76	76	77	76	76	76	77	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76		
35. <i>S. mutans</i> tuf	76	77	76	76	77	76	76	77	77	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76		
36. <i>S. pneumoniae</i> tuf	76	77	76	77	76	77	77	76	77	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76		
37. <i>S. pyogenes</i> tuf	74	78	76	76	74	75	76	74	78	76	77	77	75	76	75																								

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TABLE 19

Taxon	Strain*	Strain†	16S rDNA sequence accession number
<i>Cedecea devisee</i>	ATCC 33431 ^T		
<i>Cedecea lapagei</i>	ATCC 33432 ^T		
<i>Cedecea neteri</i>	ATCC 33855 ^T		
<i>Citrobacter amalonaticus</i>	ATCC 25405 ^T	CDC 9020-77 ^T	AF025370
<i>Citrobacter braakii</i>	ATCC 43162	CDC 080-58 ^T	AF025368
<i>Citrobacter farmeri</i>	ATCC 51112 ^T	CDC 2991-81 ^T	AF025371
<i>Citrobacter freundii</i>	ATCC 8090 ^T	DSM 30039 ^T	AJ233408
<i>Citrobacter koseri</i>	ATCC 27156 ^T		
<i>Citrobacter sedlakii</i>	ATCC 51113 ^T	CDC 4696-86 ^T	AF025364
<i>Citrobacter werkmanii</i>	ATCC 51114 ^T	CDC 0876-58 ^T	AF025373
<i>Citrobacter youngiae</i>	ATCC 29935 ^T		
<i>Edwardsiella hoshinae</i>	ATCC 33379 ^T		
<i>Edwardsiella tarda</i>	ATCC 15947 ^T	CDC 4411-68	AF015259
<i>Enterobacter aerogenes</i>	ATCC 13048 ^T	JCM 1235 ^T	AB004750
<i>Enterobacter agglomerans</i>	ATCC 27989		
<i>Enterobacter amnigenus</i>	ATCC 33072 ^T	JCM 1237 ^T	AB004749
<i>Enterobacter asburiae</i>	ATCC 35953 ^T	JCM 6051 ^T	AB004744
<i>Enterobacter cancerogenus</i>	ATCC 35317 ^T		
<i>Enterobacter cloacae</i>	ATCC 13047 ^T		
<i>Enterobacter gergoviae</i>	ATCC 33028 ^T	JCM 1234 ^T	AB004748
<i>Enterobacter hormaechei</i>	ATCC 49162 ^T		
<i>Enterobacter sakazakii</i>	ATCC 29544 ^T	JCM 1233 ^T	AB004746
<i>Escherichia coli</i>	ATCC 11775 ^T	ATCC 11775 ^T	X80725
<i>Escherichia coli</i>	ATCC 25922	ATCC 25922	X80724
<i>Escherichia coli</i> (ETEC)	ATCC 35401		
<i>Escherichia coli</i> (O157:H7)	ATCC 43895	ATCC 43895	Z83205
<i>Escherichia fergusonii</i>	ATCC 35469 ^T		
<i>Escherichia hermanii</i>	ATCC 33650 ^T		
<i>Escherichia vulneris</i>	ATCC 33821 ^T	ATCC 33821 ^T	X80734
<i>Ewingella americana</i>	ATCC 33852 ^T	NCPPB 3905	X88848
<i>Hafnia alvei</i>	ATCC 13337 ^T	ATCC 13337 ^T	M59155
<i>Klebsiella omithinolytica</i>	ATCC 31898	CIP 103.364	U78182
<i>Klebsiella oxytoca</i>	ATCC 33496	ATCC 13182 ^T	U78183
<i>Klebsiella planticola</i>	ATCC 33531 ^T	JCM 7251 ^T	AB004755
<i>Klebsiella pneumoniae</i>	subsp. <i>pneumoniae</i>	ATCC 13883 ^T	DSM 30104 ^T
	subsp. <i>ozaenae</i>	ATCC 11296 ^T	AJ233420
	subsp. <i>rhinoscleromatis</i>	ATCC 13884 ^T	Y17654
<i>Kluyvera ascorbuta</i>	ATCC 33433 ^T	ATCC 14236	Y07650
<i>Kluyvera cryocrescens</i>	ATCC 33435 ^T		
<i>Kluyvera georgiana</i>	ATCC 51603 ^T		
<i>Leclercia adecarboxylata</i>	ATCC 23216 ^T		
<i>Leminorella grimonii</i>	ATCC 33999 ^T	DSM 5078 ^T	AJ233421
<i>Moellerella wisconsensis</i>	ATCC 35017 ^T		
<i>Morganella morganii</i>	ATCC 25830 ^T		
<i>Pantoea agglomerans</i>	ATCC 27155 ^T	DSM 3493 ^T	AJ233423
<i>Pantoea dispersa</i>	ATCC 14589 ^T		
<i>Plesiomonas shigellokles</i>	ATCC 14029 ^T		
<i>Pragia fontium</i>	ATCC 49100 ^T	DSM 5563 ^T	AJ233424
<i>Proteus mirabilis</i>	ATCC 25933		
<i>Proteus penneri</i>	ATCC 33519 ^T		
<i>Proteus vulgaris</i>	ATCC 13315 ^T	DSM 30118 ^T	AJ233425
<i>Providencia alcalifaciens</i>	ATCC 9886 ^T		

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TABLE 19-continued

Taxon	Strain*	Strain†	16S rDNA sequence accession number
			5
			10
			15
			20
			25
			30
			35
			40
			45

Strains analyzed in Example 43.

Taxon	Strain*	Strain†	16S rDNA sequence accession number
<i>Providencia rettgeri</i>	ATCC 9250		
<i>Providencia rustigianii</i>	ATCC 33673 ^T		
<i>Providencia stuartii</i>	ATCC 33672		
<i>Rahnella aquatilis</i>	ATCC 33071 ^T	DSM 4594 ^T	AJ233426
<i>Salmonella choleraesuis</i>			
subsp. <i>arizonaae</i>	ATCC 13314 ^T		
subsp. <i>choleraesuis</i>			
<i>serotype Choleraesuis</i>	ATCC 7001		
<i>serotype Enteritidis</i> ‡	ATCC 13076 ^T	SE22	SE22
<i>serotype Gallinarum</i>	ATCC 9184		
<i>serotype Heidelberg</i>	ATCC 8326		
<i>serotype Paratyphi A</i>	ATCC 9150		
<i>serotype Paratyphi B</i>	ATCC 8759		
<i>serotype Typhi</i> ‡	ATCC 10749	St111	U88545
<i>serotype Typhimurium</i> ‡	ATCC 14028		
<i>serotype Virchow</i>	ATCC 51955		
subsp. <i>diarizoneae</i>	ATCC 43973 ^T		
subsp. <i>houtouae</i>	ATCC 43974 ^T		
subsp. <i>indica</i>	ATCC 43976 ^T		
subsp. <i>salamae</i>	ATCC 43972 ^T		
<i>Serratia fonticola</i>	DSM 4576 ^T	DSM 4576 ^T	AJ233429
<i>Serratia grimesii</i>	ATCC 14460 ^T	DSM 30063 ^T	AJ233430
<i>Serratia liquefaciens</i>	ATCC 27592 ^T		
<i>Serratia marcescens</i>	ATCC 13880 ^T	DSM 30121 ^T	AJ233431
<i>Serratia odorifera</i>	ATCC 33077 ^T	DSM 4582 ^T	AJ233432
<i>Serratia plymuthica</i>	DSM 4540 ^T	DSM 4540 ^T	AJ233433
<i>Serratia rubidaea</i>	DSM 4480 ^T	DSM 4480 ^T	AJ233436
<i>Shigella boydii</i>	ATCC 9207	ATCC 9207	X96965
<i>Shigella dysenteriae</i>	ATCC 11835		
			ATCC 13313 ^T
			ATCC 25931
			X96964
			X96963
<i>Shigella flexneri</i>	ATCC 12022	ATCC 12022	
<i>Shigella sonnei</i>	ATCC 29930 ^T		
<i>Tatumella pyreos</i>	ATCC 33301 ^T	DSM 50001	AJ233437
<i>Trabulsiella guamensis</i>	ATCC 49490 ^T		
<i>Yersinia enterocolitica</i>	ATCC 9610 ^T	ATCC 9610 ^T	M59292
<i>Yersinia frederiksenii</i>	ATCC 33641 ^T		
<i>Yersinia intermedia</i>	ATCC 29909 ^T		
<i>Yersinia pestis</i>	RRB KIMD27	ATCC 19428 ^T	X75274
<i>Yersinia pseudotuberculosis</i>	ATCC 29833 ^T		
<i>Yersinia röhdei</i>	ATCC 43380 ^T	ER-2935 ^T	X75276
<i>Shewanella putrefaciens</i>	ATCC 8071 ^T		
<i>Vibrio cholerae</i>	ATCC 25870	ATCC 14035 ^T	X74695

†Type strain

*Strains used in this study for sequencing of partial tuf and atpD genes. SEQ ID NOs. for tuf and atpD sequences corresponding to the above reference strains are given in table 7.

†Strains used in other studies for sequencing of 16S rDNA gene. When both strain numbers are on the same row, both strains are considered to be the same although strain numbers may be different.

‡Phylogenetic serotypes considered species by the Bacteriological Code (1990 Revision).

TABLE 20

PCR primer pairs used in this study			
Primer	SEQ ID NO.	Nucleotide positions*	Amplicon length (bp)
tuf			
664	5'-AYATGATIACIGGGCIGCICARATGGA-3'	271-299	884
697	5'-CCIACTGICKICRCRCCYTCRCG-3'	1132-1156	

TABLE 20-continued

PCR primer pairs used in this study			
Primer SEQ ID NO.	Sequence	Nucleotide positions*	Amplicon length (bp)
atpD			
568	5'-RTIATIGGIGCIGTIRTIGAYGT-3'	25-47	884
567	5'-TCRTCIGCIGGIACRTAIAYIGCYTG-3'	883-908	
700	5'-TIRTIGAYGTCGARTTCCCTCARG-3'	38-61	871
567	5'-TCRTCIGCIGGIACRTAIAYIGCYTG-3'	883-908	

*The nucleotide positions given are for *E. coli* tuf and atpD sequences (GenBank accession no. AE000410 and V00267, respectively). Numbering starts from the first base of the initiation codon.

TABLE 21

Selection of *M. catarrhali*-specific primer pairs from SEQ ID NO: 29¹ (466 bp DNA fragment) other than those previously tested².

Primer	Sequence	Amplicon size (bp)	<i>Moraxella catarrhali</i> ATCC 43628	<i>Moraxella non-liquefaciens</i> ATCC 53879	<i>Moraxella lacunata</i>	<i>Moraxella oslensis</i>	<i>Moraxella atlantae</i>	<i>Moraxella phenyl-pyruvica</i>
SEQ ID NO: 118	CGCTGACGGCTTGTGTACCA	118	+ ³	+	-	-	-	-
SEQ ID NO: 119	TGTTTGAGCTTTTATTTTGA				-	-	-	-
VBmcat1 (SEQ ID NO: 2298)	TGCTTAAGATTCACTCTGCCATT	93	+	+	-	-	-	-
VBmcat2 (SEQ ID NO: 2299)	TAAGTGTGCTGACGGCTTGT				-	-	-	-
VBmcat3 (SEQ ID NO: 2300)	CCTGGACCACAAAGTCAT	140	+	+	-	-	-	-
VBmcat4 (SEQ ID NO: 2301)	AATTGACCAAAATGTCAAAGC				-	-	-	-
VBmcat5 (SEQ ID NO: 2302)	AATGATAACCCAGTCAAGCAAGC	219	+	+	-	-	-	-
VBmcat6 (SEQ ID NO: 2303)	GGTGGATGGTGATTGGAAAA				-	-	-	-
VBmcat7 (SEQ ID NO: 2304)	GTTGTGCTGACTTTACAAAT	160	+	+	-	-	-	-
VBmcat8 (SEQ ID NO: 2305)	GGTGTAAAGCTGATGATGAGAG				-	-	-	-
VBmcat9 (SEQ ID NO: 2306)	TGACCATGCAGACCCATT	167	+	+	-	-	-	-
VBmcat10 (SEQ ID NO: 2307)	TCATTTGGATGAAAGTATCATT				-	-	-	-
Primer	Sequence	Amplicon size (bp)	<i>Kingella indologenes</i>	<i>Kingella kingae</i>	<i>Neisseria meningitidis</i>	<i>Neisseria gonorrhoeae</i>	<i>Escherichia coli</i>	<i>Staphylococcus aureus</i>
SEQ ID NO: 118	CGCTGACGGCTTGTGTACCA	118	-	-	-	-	-	-
SEQ ID NO: 119	TGTTTGAGCTTTTATTTTGA				-	-	-	-
VBmcat1 (SEQ ID NO: 2298)	TGCTTAAGATTCACTCTGCCATT	93	-	-	-	-	-	-

TABLE 21 - continued

Selection of <i>M. catarrhalis</i> -specific primer pairs from SEQ ID NO: 29 ¹ (466 bp DNA fragment) other than those previously tested ² .	
VBmcat2 (SEQ ID NO: 2299)	TAAGTCGCTGACGGCTTGT
VBmcat3 (SEQ ID NO: 2300)	CCTGCACCACAAAGTCATCAT
VBmcat4 (SEQ ID NO: 2301)	AATTGACCAACAATGTCAAAGC
VBmcat5 (SEQ ID NO: 2302)	AATGATAACCCAGTCAAGCAAGC
VBmcat6 (SEQ ID NO: 2303)	GGTGATGGTGAATTGTAAAA
VBmcat7 (SEQ ID NO: 2304)	GTGTGCGTCACTTTACAAAT
VBmcat8 (SEQ ID NO: 2305)	GGTGTAAAGCTGATGATGAGAG
VBmcat9 (SEQ ID NO: 2306)	TGACCATGCACACCCCTATT
VBmcat10 (SEQ ID NO: 2307)	TCATGGGATGAAAGTATCGTT

¹SEQ ID NO. from U.S. Pat. No. 6,001,564.²All PCR assays were performed with 1 μg of purified genomic DNA by using an annealing temperature of 55° C. and 30 cycles of amplification. The genomic DNA from the various bacterial species above was always isolated from reference strains obtained from ATCC. All positive results showed a strong amplification signal with genomic DNA from the target species *M. catarrhalis*.

TABLE 22

Selection of *S. epidermidis*-specific primer pairs from SEQ ID No: 36¹ (705 bp DNA fragment) other than those previously tested.

Primer	Sequence (all 25 nucleotides)	Amplicon size (bp)	<i>Staphylococcus epidermidis</i> ATCC 14990	<i>Staphylococcus capitis</i> ATCC 12228	<i>Staphylococcus cohnii</i>	<i>Staphylococcus aureus</i>	<i>Staphylococcus auricularis</i>	<i>Staphylococcus coccus</i>	<i>Staphylococcus coccus</i>	<i>Staphylococcus coccus</i>
SEQ ID NO : 145	ATCAAAAAGTTGGGAAACCTTTC	125	+ ³	+	-	-	-	-	-	-
SEQ ID NO : 146	CAAAAGAGGGGGAAAAAGTATCA	-	-	-	-	-	-	-	-	-
VBsep3 (SEQ ID NO : 2308)	CATAGTCTGATGCTCAAAGTCTTG	208	+	+	-	-	-	-	-	+
VBsep4 (SEQ ID NO : 2309)	GCGAATAGTGAACTACATTCGTTG	208	+	+	-	-	-	-	-	-
VBsep5 (SEQ ID NO : 2310)	CACGCTTTGCAATTCCATTGA	208	+	+	+	+	+	-	-	+
VBsep6 (SEQ ID NO : 2311)	GAAGCAAATATCAAAATGCCAG	+	+	+	+	+	+	-	-	+
VBsep7 (SEQ ID NO : 2312)	AAAGTCTTTGCTTCTCAGATTCA	177	+	+	-	-	-	-	-	+
VBsep8 (SEQ ID NO : 2313)	GTGTCACAGGTATGGATGCTTTA	+	+	+	NT	NT	NT	NT	NT	-
VBsep9 (SEQ ID NO : 2314)	GAGCATCCATACTCTGTGAAACAGA	153	+	+	-	-	-	-	-	+
VBsep10 (SEQ ID NO : 2315)	TTTCCAAATTACAAGAGACATCAGT	+	+	+	NT	NT	NT	NT	NT	-
VBsep11 (SEQ ID NO : 2316)	TTCGAATTGGCATCTACTTGTGTTG	135	+	+	-	-	-	-	-	-
VBsep12 (SEQ ID NO : 2317)	CCCCGGTTGAAATCGATAAAAG	-	-	-	-	-	-	-	-	-
Primer	Sequence (all 25 nucleotides)	Amplicon size (bp)	<i>Staphylococcus hominis</i>	<i>Staphylococcus simulans</i>	<i>Staphylococcus coccus</i>	<i>Staphylococcus warneri</i>	<i>Bacillus subtilis</i>	<i>Enterococcus faecalis</i>	<i>Staphylococcus coccus</i>	<i>Staphylococcus coccus</i>
SEQ ID NO : 145	ATCAAAAAGTTGGGAAACCTTTC	125	-	-	-	-	-	-	-	-
SEQ ID NO : 146	CAAAAGAGGGGGAAAAAGTATCA	-	-	-	-	-	-	-	-	-
VBsep3 (SEQ ID NO : 2308)	CATAGTCTGATGCTCAAAGTCTTG	208	-	-	-	-	-	-	-	-
VBsep4 (SEQ ID NO : 2309)	GCGAATAGTGAACTACATTCGTTG	-	-	-	-	-	-	-	-	-
VBsep5 (SEQ ID NO : 2310)	CACGCTTTGCAATTCCATTGA	208	+	-	-	-	-	-	-	-
VBsep6 (SEQ ID NO : 2311)	GAAGCAAATATCAAAATGCCAG	+	-	-	-	NT	NT	NT	-	-
VBsep7 (SEQ ID NO : 2312)	AAAGTCTTTGCTTCTCAGATTCA	177	-	-	+	-	-	-	-	-

TABLE 22 -continued
Selection of *S. epidermidis*-specific primer pairs from SEQ ID NO: 36¹ (705 bp DNA fragment) other than those previously tested.

Primer	Amplicon size (bp)	Enterococcus faecium	Enterococcus gallinarum	Listeria monocytogenes	Streptococcus agalactiae	Streptococcus pneumoniae	Streptococcus pyogenes	Annealing temperature ² (° C.)
SEQ ID NO: 145	ATAAAAAAAGTTGGGAACCTTTCA	125	-	-	-	-	-	55
SEQ ID NO: 146	CAAAAGAGCGTGGAAAGATACA	-	-	-	-	-	-	55
VBsep3 (SEQ ID NO: 2308)	CATAGTCGATGTCAAAGTCTTG	208	-	-	-	-	-	-
VBsep4 (SEQ ID NO: 2309)	GCGAATAGTGAACTACATTGTTG	-	-	-	-	-	-	60
VBsep5 (SEQ ID NO: 2310)	CAGGCTCTTTGCATTCCATTGA	208	-	-	-	-	-	55
VBsep6 (SEQ ID NO: 2311)	GAAGCAAATATTCAAAATGCCAG	NT	NT	NT	NT	NT	NT	65
VBsep7 (SEQ ID NO: 2312)	AAAGTCCTTGTCTCTCAGATTCA	177	-	-	-	-	-	55
VBsep8 (SEQ ID NO: 2313)	GTGTTCACAGGTATGGATGCTTTA	NT	NT	NT	NT	NT	NT	60
VBsep9 (SEQ ID NO: 2314)	GAGCATCCATACTGTGAACACAGA	153	-	-	-	-	-	55
VBsep10 (SEQ ID NO: 2315)	TTTCCAAATTACAAGAGACATCAGT	NT	NT	NT	NT	NT	NT	65
VBsep11 (SEQ ID NO: 2316)	TTGAAATTGGATGACTTGTGTTG	135	-	-	-	-	-	55
VBsep12 (SEQ ID NO: 2317)	CCCCGGTTGAAATCGATAAAAG	-	-	-	-	-	-	-

¹

SEQ ID NO. from U.S. Pat. No. 6,001,564.

All PCR assays were performed with 1 ng of purified genomic DNA by using an annealing temperature of 55 to 65° C. and 30 cycles of amplification. The genomic DNA from the various bacterial species above was always isolated from reference strains obtained from ATCC. All positive results showed a strong amplification signal with genomic DNA from the target species *S. epidermidis*. The intensity of the positive amplification signal with species other than *S. epidermidis* was variable. NT = not tested.

TABLE 23

Influence of nucleotide variation(s) on the efficiency of the PCR amplification:
Example with SEQ ID NO: 146 from *S. epidermidis*.

A. Primer ¹	Sequence (all 25 nucleotides)	Number of mutation	<i>Staphylococcus epidermidis</i> ² ATTC 14990			<i>Staphylococcus</i>
			50° C.	55° C.	50° C.	
SEQ ID NO: 145	ATCAAAAAGTTGGCGAACCTTTCA	0				
SEQ ID NO: 146	CAAAAGAGCGTGGAGAAAAGTATCA	0	3+	3+	2+	+
VBmut1 (SEQ ID NO: 2318)	CAAAAGAGCGTGGAGAAAAGTATCA	1	3+	3+	2+	+
VBmut2 (SEQ ID NO: 2319)	CAAAAGAGCGTGGAGAAAATATCA	1	3+	3+	2+	+
VBmut3 (SEQ ID NO: 2320)	CAAAAGAGCGTGGAGAAGTATCA	1	3+	3+	2+	+
VBmut4 (SEQ ID NO: 2321)	CAAAAGAGCGTGGAGAAAAGTATCA	1	3+	3+	2+	+
VBmut5 (SEQ ID NO: 2322)	CAAAAGAGCGGGAGAAAAGTATCA	1	3+	3+	2+	+
VBmut6 (SEQ ID NO: 2323)	CAAAAGAGCGTGGAGAAAAGTATCA	1	3+	3+	2+	+
VBmut7 (SEQ ID NO: 2324)	CAAAAGAGCGTGGAGAAAAGTATCA	1	3+	3+	2+	+
VBmut8 (SEQ ID NO: 2325)	CAAAAGAGCGTGGAGAAAAGTATCA	1	3+	3+	2+	+
VBmut9 (SEQ ID NO: 2326)	CAAAAGAGCGTGGAGAAGTATCA	2	3+	3+	2+	+
VBmut10 (SEQ ID NO: 2327)	CAAAAGAGCGGGAGAAGTATCA	2	3+	3+	2+	+
VBmut11 (SEQ ID NO: 2328)	CAAAAGAGCGGGAGAAAAGTATCA	2	3+	3+	2+	+
VBmut12 (SEQ ID NO: 2329)	CAAAAGAGCGTGGAGAAAAGTATCA	3	3+	3+	2+	+
VBmut13 (SEQ ID NO: 2330)	CAAAAGAGCGGGAGAAGTATCA	4	3+	2+	+	+

¹All PCR tests were performed with SEQ ID NO: 145 without modification combined with SEQ ID NO: 146 or 13 modified versions of SEQ ID NO: 146. Boxed nucleotides indicate changes in SEQ ID NO: 146.

²The tests with *S. epidermidis* were performed by using an annealing temperature of 55°C. with 1, 0, 1 and 0,01 ng of purified genomic DNA or at 50°C. with 1 ng of purified genomic DNA.

The tests with *S. aureus* were performed only at 50°C. with 1 ng of genomic DNA.

⁴The intensity of the positive amplification signal was quantified as follows: 3+ = strong signal, 2+ = intermediate signal and + = weak signal.

TABLE 24

Effect of the primer length on the efficiency of the PCR amplification¹: Example with AT-rich SEQ ID NO: 145² and SEQ ID NO: 146² from *S. epidermidis*.

Primer	II. STAPHYLOCOCCUS EPIDERMIDIS ³ ATCC 14990						<i>Staphylococcus aureus</i> ⁴	<i>Staphylococcus haemolyticus</i>	<i>Staphylococcus capitis</i>	<i>Staphylococcus warneri</i>
	Length 45° C.			55° C.						
	Sequence (nt)	1	0.1	0.01	1	0.1	0.01	1	0.1	0.01
VBsep301 (SEQ ID NO: 2331)	ATATCATCAAAAGTTGGGAACCTTTCATA	30	NT	NT	4+	3+	2+	NT	-	NT
VBsep302 (SEQ ID NO: 2332)	AATTGCCCCAAGGGTGGAGAAAAGTA TCA	30	NT	NT	4+	3+	2+	NT	-	NT
SEQ ID NO: 145 (SEQ ID NO: 2333)	ATCAAAAAAGTTGGGAACCTTTCATA	25	4+ ⁵	3+	2+	4+	3+	2+	-	-
SEQ ID NO: 146 (SEQ ID NO: 2334)	CAAAAAGAGCTGTGGAGAAAAGTATCA	25							+	-
VBsep201 (SEQ ID NO: 2335)	AAAGTTGGCGAACCTTTTCATA	20	NT	NT	4+	3+	2+	NT	-	NT
VBsep202 (SEQ ID NO: 2336)	GAGCGTGGAGAAAAGTATCA	20							-	-
VBsep171 (SEQ ID NO: 2337)	GTTGGCGAACCTTTTCATA	17	4+	3+	2+	3+	2+	+	-	-
VBsep172 (SEQ ID NO: 2338)	CGTGGAGAAAAGTATCA	17							-	-
VBsep151 (SEQ ID NO: 2339)	TGGCGAACCTTTTCATA	15	3+	2+	+	-	-	-	-	-
VBsep152 (SEQ ID NO: 2340)	TGGAGAAAAGTATCA	15							-	-

¹All PCR tests were performed using an annealing temperature of 45 or 55° C. and 30 cycles of amplification.

²All SEQ ID NOS. in this table are from U.S. Pat. No. 6,001,546.

³The tests with *S. epidermidis* were made with 1.01 and 0.01 ng of purified genomic DNA.

⁴The tests with all other bacterial species were made only with 1 ng of purified genomic DNA.

⁵The intensity of the positive amplification signal was quantified as follows: 4+ = very strong signal, 3+ = strong signal, 3+ = intermediate signal and + = weak signal.

NT = not tested.

TABLE 25

Effect of the primer length on the efficiency of the PCR amplification¹: Example with the GC-rich SEQ ID NO: 83² and SEQ ID NO: 84² from *P. aeruginosa*.

Primer	Sequence	(nt)	III.			<i>Pseudomonas aeruginosa</i> ³	<i>Pseudomonas fluorescens</i> ⁴	<i>Burkholderia cepacia</i>	<i>Shewanella putida</i>	<i>Stenotrophomonas maltophilia</i>	<i>Neisseria meningitidis</i>	<i>Haemophilus ducreyi</i>
			Length	ATCC 35554	<i>S. aeruginosa</i> ³							
SEQ ID NO 83	CGAGCGGGTGGTGTTCATC	19	2+	+	-	-	-	-	-	-	-	-
SEQ ID NO 84	CAAGTCGTCGTCGGAGGGA	19										
Pse554-16a (SEQ ID NO: 2341)	CGAGCGGGTGGTGTTTC	16	2+	+	-	-	-	-	-	-	-	-
Pse674-16a (SEQ ID NO: 2342)	GTCGTCGTCGGAGGGA	16										
Pse554-13b (SEQ ID NO: 2343)	GCGGGTGGTGTTC	13	2+	+	-	-	-	-	-	-	-	-
Pse674-13a (SEQ ID NO: 2344)	GTCGTCGGAGGGA	13										

¹All PCR tests were performed using an annealing temperature of 55° C. and 30 cycles of amplification.

²All SEQ ID Nos. in this Table are from U.S. Pat. No. 6,001,546.

³The tests with *P. aeruginosa* were made with 1, 0.1 and 0.01 ng of purified genomic DNA.

⁴The tests with all other bacterial species were made only with 1 ng of purified genomic DNA.

⁵The intensity of the positive amplification signal was quantified as follows: 2+ = strong signal and + = moderately strong signal.

TABLE 39

Specific and ubiquitous primers for nucleic acid amplification (tuf sequences).

SEQ ID NO.	Nucleotide sequence	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Bacterial species: <i>Acinetobacter baumannii</i>			
1692	5'-GGT GAG AAC TGT GGT ATC TTA CTT	1	478-501
1693 ^a	5'-CAT TTC AAC GCC TTC TTT CAA CTG	1	691-714
Bacterial species: <i>Chlamydia pneumoniae</i>			
630	5'-CGG AGC TAT CCT AGT CGT TTC A	20	2-23
629 ^a	5'-AAG TTC CAT CTC AAC AAG GTC AAT A	20	146-170
2085	5'-CAA ACT AAA GAA CAT ATC TTG CTA	20	45-68
2086 ^a	5'-ATA TAA TTT GCA TCA CCT TCA AG	20	237-259
2087	5'-TCA GCT CGT GGG ATT AGG AGA G	20	431-452
2088 ^a	5'-AGG CTT CAC GCT GTT AGG CTG A	20	584-605
Bacterial species: <i>Chlamydia trachomatis</i>			
554	5'-GTT CCT TAC ATC GTT GTT TTT CTC	22	82-105
555 ^a	5'-TCT CGA ACT TTC TCT ATG TAT GCA	22	249-272
Parasitical species: <i>Cryptosporidium parvum</i>			
798	5'-TGG TTG TCC CAG CCG ATC GTT T	865	158-179
804 ^a	5'-CCT GGG ACG GCC TCT GGC AT	865	664-683
799	5'-ACC TGT GAA TAC AAG CAA TCT	865	280-300

TABLE 39-continued

Specific and ubiquitous primers for nucleic acid amplification (tuf sequences).			
805 ^a	5'-CTC TTG TCC ATC TTA GCA GT	865	895-914
800	5'-GAT GAA ATC TTC AAC GAA GTT GAT	865	307-330
806 ^a	5'-AGC ATC ACC AGA CTT GAT AAG	865	946-966
801	5'-ACA ACA CCG AGA AGA TCC CA	865	353-372
803 ^a	5'-ACT TCA GTG GTA ACA CCA GC	865	616-635
802	5'-TTG CCA TTT CTG GTT TCG TT	865	377-396
807 ^a	5'-AAA GTG GCT TCA AAG GTT GC	865	981-1000
<i>Bacterial species: Enterococcus faecium</i>			
1696	5'-ATG TTC CTG TAG TTG CTG GA	64	189-208
1697 ^a	5'-TTT CTT CAG CAA TAC CAA CAA C	64	422-443
<i>Bacterial species: Klebsiella pneumoniae</i>			
1329	5'-TGT AGA GCG CGG TAT CAT CAA AGT A	103	352-377
1330 ^a	5'-AGA TTC GAA CTT GGT GTG CGG G	103	559-571
<i>"These sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.</i>			
Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
<i>Bacterial species: Mycoplasma pneumoniae</i>			
2093	5'-TGT TGG CAA TCG AAG ACA CC	2097 ^a	635-654
2094 ^b	5'-TTC AAT TTC TTG ACC TAC TTT CAA	2097 ^a	709-732
<i>Bacterial species: Neisseria gonorrhoeae</i>			
551	5'-GAA GAA AAA ATC TTC GAA CTG GCT A	126	256-280
552 ^b	5'-TAC ACG GCC GGT GAC TAC G	126	378-396
2173	5'-AAG AAA AAA TCT TCG AAC TGG CTA	126	257-280
2174 ^b	5'-TCT ACA CGG CCG GTG	126	384-398
2175	5'-CCG CCA TAC CCC GTT T	126	654-669
2176 ^b	5'-CGG CAT TAC CAT TTC CAC ACC TTT	126	736-759
<i>Bacterial species: Pseudomonas aeruginosa</i>			
1694	5'-AAG GCA AGG ATG ACA ACG GC	153	231-250
1695 ^b	5'-ACG ATT TCC ACT TCT TCC TGG	153	418-438
<i>Bacterial species: Streptococcus agalactiae</i>			
549	5'-GAA CGT GAT ACT GAC AAA CCT TTA	207-210 ^c	308-331 ^d
550 ^b	5'-GAA GAA GAA CAC CAA CGT TG	207-210 ^c	520-539 ^d
<i>Bacterial species: Streptococcus pyogenes</i>			
999	5'-TTG ACC TTG TTG ATG ACG AAG AG	1002	143-165
1000 ^b	5'-TTA GTG TGT GGG TTG ATT GAA CT	1002	622-644
1001	5'-AAG AGT TGC TTG AAT TAG TTG AG	1002	161-183
1000 ^b	5'-TTA GTG TGT GGG TTG ATT GAA CT	1002	622-644

TABLE 39-continued

Specific and ubiquitous primers for nucleic acid amplification (tuf sequences).			
Parasitical species: <i>Trypanosoma brucei</i>			
820	5'-GAA GGA GGT GTC TGC TTA CAC	864	513-533
821 ^b	5'-GGC GCA AAC GTC ACC ACA TCA	864	789-809
820	5'-GAA GGA GGT GTC TGC TTA CAC	864	513-533
822 ^b	5'-CGG CGG ATG TCC TTA ACA GAA	864	909-929
Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Parasitical species: <i>Trypanosoma cruzi</i>			
794	5'-GAC GAC AAG TCG GTG AAC TT	840-842 ^a	281-300 ^c
795 ^b	5'-ACT TGC ACG CGA TGT GGC AG	840-842 ^a	874-893 ^c
Bacterial genus: <i>Clostridium</i> sp.			
796	5'-GGT CCA ATG CCW CAA ACW AGA	32, 719-724, 736 ^a	32-52 ^d
797 ^b	5'-CAT TAA GAA TGG YTT ATC TGT SKC TCT	32, 719-724, 736 ^a	320-346 ^d
808	5'-GCI TTA IWR GCA TTA GAA RAY CCA	32, 719-724, 736 ^a	224-247 ^d
809 ^b	5'-TCT TCC TGT WGC AAC TGT TCC TCT	32, 719-724, 736 ^a	337-360 ^d
810	5'-AGA GMW ACA GAT AAR SCA TTC TTA	32, 719-724, 736 ^a	320-343 ^d
811 ^b	5'-TRA ART AGA ATT GTG GTC TRT ATC C	32, 719-724, 736 ^a	686-710 ^d
Bacterial genus: <i>Corynebacterium</i> sp.			
545	5'-TAC ATC CTB GTY GCI CTI AAC AAG TG	34-44, 662 ^a	89-114 ^e
546 ^b	5'-CCR CGI CCG GTR ATG GTG AAG AT	34-44, 662 ^a	350-372 ^e
Bacterial genus: <i>Enterococcus</i> sp.			
656	5'-AAT TAA TGG CTG CAG TTG AYG A	58-72 ^a	273-294 ^f
657 ^b	5'-TTG TCC ACG TTC GAT RTC TTC A	58-72 ^a	556-577 ^f
656	5'-AAT TAA TGG CTG CAG TTG AYG A	58-72 ^a	273-294 ^f
271 ^b	5'-TTG TCC ACG TTG GAT RTC TTC A	58-72 ^a	556-577 ^f
1137	5'-AAT TAA TGG CTG CWG TTG AYG AA	58-72 ^a	273-295 ^f
1136 ^b	5'-ACT TGT CCA CGT TSG ATR TCT	58-72 ^a	559-579 ^f

^aThese sequences were aligned to derive the corresponding primer.^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^cThe nucleotide positions refer to the *T. cruzi* tuf sequence fragment (SEQ ID NO. 842).^dThe nucleotide positions refer to the *C. perfringens* tuf sequence fragment (SEQ ID NO. 32).^eThe nucleotide positions refer to the *C. diphtheriae* tuf sequence fragment (SEQ ID NO. 662).^fThe nucleotide positions refer to the *E. durans* tuf sequence fragment (SEQ ID NO. 61).

TABLE 39-continued

Specific and ubiquitous primers for nucleic acid amplification (tuf sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial genus: <i>Legionella</i> sp.			
2081	5'-GRA TYR TYA AAG TTG GTG AGG AAG	111-112 ^a	411-434 ^b
2082 ^c	5'-CMA CTT CAT CYC GCT TCG TAC C	111-112 ^a	548-569 ^b
Bacterial genus: <i>Staphylococcus</i> sp.			
553	5'-GGC CGT GTT GAA CGT GGT CAA ATC A	176-203 ^a	313-337 ^d
575 ^c	5'-TIA CCA TTT CAG TAC CTT CTG GTA A	176-203 ^a	653-677 ^d
553	5'-GGC CGT GTT GAA CGT GGT CAA ATC A	176-203 ^a	313-337 ^d
707 ^c	5'-TWA CCA TTT CAG TAC CTT CTG GTA A	176-203 ^a	653-677 ^d
Bacterial genus: <i>Streptococcus</i> sp.			
547	5'-GTA CAG TTG CTT CAG GAC GTA TC	206-231 ^a	372-394 ^e
548 ^c	5'-ACG TTC GAT TTC ATC ACG TTG	206-231 ^a	548-568 ^e
Fungal genus: <i>Candida</i> sp.			
576	5'-AAC TTC RTC AAG AAG GTY GGT TAC AA	407-426, 428-432 ^a	332-357 ^f
632 ^c	5'-CCC TTT GGT GGR TCS TKC TTG GA	407-426, 428-432 ^a	791-813 ^f
631	5'-CAG ACC AAC YGA IAA RCC ATT RAG AT	407-426, 428-432 ^a	523-548 ^f
632 ^c	5'-CCC TTT GGT GGR TCS TKC TTG GA	407-426, 428-432 ^a	791-813 ^f
633	5'-CAG ACC AAC YGA IAA RCC ITT RAG AT	407-426, 428-432 ^a	523-548 ^f
632 ^c	5'-CCC TTT GGT GGR TCS TKC TTG GA	407-426, 428-432 ^a	791-813 ^f

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the *L. pneumophila* tuf sequence fragment (SEQ ID NO. 112).^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^dThe nucleotide positions refer to the *S. aureus* tuf sequence fragment (SEQ ID NO. 179).^eThe nucleotide positions refer to the *S. agalactiae* tuf sequence fragment (SEQ ID NO. 209).^fThe nucleotide positions refer to the *C. albicans* tuf(EF-1) sequence fragment (SEQ ID NO. 408).

Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Fungal genus: <i>Cryptococcus</i> sp.			
1971	5'-CYG ACT GYG CCA TCC TYA TCA	434, 623, 1281, 1985, 1986 ^a	150-170 ^b
1973 ^c	5'-RAC ACC RGI YTT GGW ITC CTT	434, 623, 1281, 1985, 1986 ^a	464-484 ^b
1972	5'-MGI CAG CTC ATY ITT GCW KSC	434, 623, 1281, 1985, 1986 ^a	260-280 ^b
1973 ^c	5'-RAC ACC RGI YTT GGW ITC CTT	434, 623, 1281, 1985, 1986 ^a	464-484 ^b

TABLE 39-continued

Specific and ubiquitous primers for nucleic acid amplification (tuf sequences).			
Parasitical genus: <i>Entamoeba</i> sp.			
703	5'-TAT GGA AAT TCG AAA CAT CT	512	38-57
704 ^c	5'-AGT GCT CCA ATT AAT GTT GG	512	442-461
703	5'-TAT GGA AAT TCG AAA CAT CT	512	38-57
705 ^c	5'-GTA CAG TTC CAA TAC CTG AA	512	534-553
703	5'-TAT GGA AAT TCG AAA CAT CT	512	38-57
706 ^c	5'-TGA AAT CTT CAC ATC CAA CA	512	768-787
793	5'-TTA TTG TTG CTG CTG GTA CT	512	149-168
704 ^c	5'-AGT GCT CCA ATT AAT GTT GG	512	442-461
Parasitical genus: <i>Giardia</i> sp.			
816	5'-GCT ACG ACG AGA TCA AGG GC	513	305-324
819 ^c	5'-TCG AGC TTC TGG AGG AAG AG	513	895-914
817	5'-TGG AAG AAG GCC GAG GAG TT	513	355-374
818 ^c	5'-AGC CGG GCT GGA TCT TCT TC	513	825-844
Parasitical genus: <i>Leishmania</i> sp.			
701	5'-GTG TTC ACG ATC ATC GAT GCG	514-526 ^a	94-114 ^d
702 ^c	5'-CTC TCG ATA TCC GCG AAG CG	514-526 ^a	913-932 ^d

Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Parasitical genus: <i>Trypanosome</i> sp.			
823	5'-GAG CGG TAT GAY GAG ATT GT	529, 840-842, 864 ^a	493-512 ^b
824 ^c	5'-GGC TTC TGC GGC ACC ATG CG	529, 840-842, 864 ^a	1171-1190 ^b
Bacterial family: <i>Enterobacteriaceae</i>			
933	5'-CAT CAT CGT ITT CMT GAA CAA RTG	78, 103, 146, 168, 238, 698 ^a	390-413 ^d
934 ^c	5'-TCA CGY TTR RTA CCA CGC AGI AGA	78, 103, 146, 168, 238, 698 ^a	831-854 ^d
Bacterial family: <i>Mycobacteriaceae</i>			
539	5'-CCI TAC ATC CTB GTY GCI CTI AAC AAG	122	85-111
540 ^c	5'-GGD GCI TCY TCR TCG WAI TCC TG	122	181-203
Bacterial group: <i>Escherichia coli</i> and <i>Shigella</i>			
1661	5'-TGG GAA GCG AAA ATC CTG	1668 ^e	283-300
1665 ^c	5'-CAG TAC AGG TAG ACT TCT G	1668 ^e	484-502

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the *C. neoformans* tuf (EF-1) sequence fragment (SEQ ID NO. 623).^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^dThe nucleotide positions refer to the *L. tropica* tuf (EF-1) sequence fragment (SEQ ID NO. 526).

TABLE 39-continued

Specific and ubiquitous primers for nucleic acid amplification (tuf sequences).			
Bacterial group: <i>Pseudomonads</i> group			
541	5'-GTK GAA ATG TTC CGC AAG CTG CT	153-155 ^a	476-498 ^f
542 ^c	5'-CGG AAR TAG AAC TGS GGA CGG TAG	153-155 ^a	679-702 ^f
541	5'-GTK GAA ATG TTC CGC AAG CTG CT	153-155 ^a	476-498 ^f
544 ^c	5'-AYG TTG TCG CCM GGC ATT MCC AT	153-155 ^a	749-771 ^f

Parasitical group: <i>Trypanosomatidae</i> family			
Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
923	5'-GAC GCI GCC ATC CTG ATG ATC	511, 514-526, 529, 840-842, 864 ^a	166-188 ^b
924 ^c	5'-ACC TCA GTC GTC ACG TTG GCG	511, 514-526, 529, 840-842, 864 ^a	648-668 ^b
925	5'-AAG CAG ATG GTT GTG TGC TG	511, 514-526, 529, 840-842, 864 ^a	274-293 ^b
926 ^c	5'-CAG CTG CTC GTG GTG CAT CTC GAT	511, 514-526, 529, 840-842, 864 ^a	676-699 ^b
927	5'-ACG CGG AGA AGG TGC GCT T	511, 514-526, 529, 840-842, 864 ^a	389-407 ^b
928 ^c	5'-GGT CGT TCT TCG AGT CAC CGC A	511, 514-526, 529, 840-842, 864 ^a	778-799 ^b

Universal primers (bacteria)			
636	5'-ACT GGY GTT GAI ATG TTC CGY AA	7, 54, 78, 100, 103, 159, 209, 224, 227 ^b	470-492 ^d
637 ^c	5'-ACG TCA GTI GTA CGG AAR TAG AA	7, 54, 78, 100, 103, 159, 209, 224, 227 ^b	692-714 ^d
638	5'-CCA ATG CCA CAA ACI CGT GAR CAC AT	7, 54, 78, 100, 103, 159, 209, 224, 227 ^b	35-60 ^e
639 ^c	5'-TTT ACG GAA CAT TTC WAC ACC WGT IAC A	7, 54, 78, 100, 103, 159, 209, 224, 227 ^b	469-496 ^e

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the *L. tropica* tuf (EF-1) sequence fragment (SEQ ID NO. 526).^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^dThe nucleotide positions refer to the *E. coli* tuf sequence fragment (SEQ ID NO. 78).^eThe nucleotide positions refer to the *B. cereus* tuf sequence fragment (SEQ ID NO. 7).

TABLE 39-continued

Specific and ubiquitous primers for nucleic acid amplification (tuf sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Universal primers (bacteria) (continued)			
643	5'-ACT GGI GTI GAR ATG TTC CGY AA	1, 3, 4, 7, 12, 13, 16, 49, 54, 72, 78, 85, 88, 91, 94, 98, 103, 108, 112, 115, 116, 120, 121, 126, 128, 134, 136, 146, 154, 159, 179, 186, 205, 209, 212, 224, 238 ^a	470-492 ^b
644 ^c	5'-ACG TCI GTI GTI CKG AAR TAG AA	same as SEQ ID NO. 643	692-714 ^b
643	5'-ACT GGI GTI GAR ATG TTC CGY AA	1, 3, 4, 7, 12, 13, 16, 49, 54, 72, 78, 85, 88, 91, 94, 98, 103, 108, 112, 115, 116, 120, 121, 126, 128, 134, 136, 146, 154, 159, 179, 186, 205, 209, 212, 224, 238 ^a	470-492 ^b
645 ^c	5'-ACG TCI GTI GTI CKG AAR TAR AA	same as SEQ ID NO. 643	692-714 ^b
646	5'-ATC GAC AAG CCI TTC YTI ATG SC	2, 13, 82 122, 145 ^a	317-339 ^d
647 ^c	5'-ACG TCC GTS GTR CCG AAG TAG AAC TG	2, 13, 82 122, 145 ^a	686-711 ^d
646	5'-ATC GAC AAG CCI TTC YTI ATG SC	2, 13, 82 122, 145 ^a	317-339 ^d
648 ^c	5'-ACG TCS GTS GTR CCG AAG TAG AAC TG	2, 13, 82 122, 145 ^a	686-711 ^d

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the *E. coli* tuf sequence fragment (SEQ ID NO. 78).^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^dThe nucleotide positions refer to the *A. meyeri* tuf sequence fragment (SEQ ID NO. 2)

Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Universal primers (bacteria) (continued)			
649	5'-GTC CTA TGC CTC ARA CWC GIG AGC AC	8, 86, 141, 143 ^a	33-58 ^b
650 ^c	5'-TTA CGG AAC ATY TCA ACA CCI GT	8, 86, 141, 143 ^a	473-495 ^b
636	5'-ACT GGY GTT GAI ATG TTC CGY AA	8, 86, 141, 143 ^a	473-495 ^b
651 ^c	5'-TGA CGA CCA CCI TCY TCY TTY TTC A	8, 86, 141, 143 ^a	639-663 ^b
Universal primers (fungi)			
1974	5'-ACA AGG GIT GGR MSA AGG AGA C	404, 405, 433, 445, 898, 1268, 1276, 1986 ^a	443-464 ^d

TABLE 39-continued

Specific and ubiquitous primers for nucleic acid amplification (tuf sequences).			
1975 ^c	5'-TGR CCR GGG TGG TTR AGG ACG	404, 405, 433, 445, 898, 1268, 1276, 1986 ^a	846-866 ^d
1976	5'-GAT GGA YTC YGT YAA ITG GGA	407-412, 414-426, 428-431, 439, 443, 447, 448, 622, 624, 665, 1685, 1987-1990 ^e	286-306 ^e
1978 ^c	5'-CAT CIT GYA ATG GYA ATC TYA AT	same as SEQ ID NO. 1976	553-575 ^e
1977	5'-GAT GGA YTC YGT YAA RTG GGA	same as SEQ ID NO. 1976	286-306 ^e
1979 ^c	5'-CAT CYT GYA ATG GYA ASC TYA AT	same as SEQ ID NO. 1976	553-575 ^e
1981	5'-TGG ACA CCI SCA AGI GGK CYG	401-405, 433, 435, 436, 438, 444, 445, 449, 453, 455, 457, 779, 781-783, 785, 786, 788-790, 897-903, 1267-1272, 1274-1280, 1282-1287, 1991-1998 ^a	281-301 ^d
1980 ^c	5'-TCR ATG GCI TCI AIR AGR GTY T	same as SEQ ID NO. 1981	488-509 ^d

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the *B. distasonis* tuf sequence fragment (SEQ ID NO. 8).^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^dThe nucleotide positions refer to the *A. fumigatus* tuf (EF-1) sequence fragment (SEQ ID NO. 404).^eThe nucleotide positions refer to the *C. albicans* tuf (EF-1) sequence fragment (SEQ ID NO. 407).

Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Universal primers (fungi) (continued)			
1982	5'-TGG ACA CYI SCA AGI GGK CYG	same as SEQ ID NO. 1981	281-301 ^a
1980 ^b	5'-TCR ATG GCI TCI AIR AGR GTY T	same as SEQ ID NO. 1981	488-509 ^a
1983	5'-CYG AYT GCG CYA TIC TCA TCA	same as SEQ ID NO. 1981	143-163 ^a
1980 ^b	5'-TCR ATG GCI TCI AIR AGR GTY T	same as SEQ ID NO. 1981	488-509 ^a
1984	5'-CYG AYT GYG CYA TYC TSA TCA	same as SEQ ID NO. 1981	143-163 ^a
1980 ^b	5'-TCR ATG GCI TCI AIR AGR GTY T	same as SEQ ID NO. 1981	488-509 ^a
Sequencing primers			
556	5'-CGG CGC NAT CYT SGT TGT TGC	668 ^c	306-326
557 ^b	5'-CCM AGG CAT RAC CAT CTC GGT G	668 ^c	1047-1068
694	5'-CGG CGC IAT CYT SGT TGT TGC	668 ^c	306-326
557 ^b	5'-CCM AGG CAT RAC CAT CTC GGT G	668 ^c	1047-1068
664	5'-AAY ATG ATI ACI GGI GCI GCI CAR ATG GA	619 ^c	604-632
652 ^b	5'-CCW AYA GTI YKI CCI CCY TCY CTI ATA	619 ^c	1482-1508

TABLE 39-continued

Specific and ubiquitous primers for nucleic acid amplification (tuf sequences).			
664	5'-AAY ATG ATI ACI GGI GCI GCI CAR ATG GA	619 ^c	604-632
561 ^b	5'-ACI GTI CGG CCR CCC TCA CGG AT	619 ^c	1483-1505
543	5'-ATC TTA GTA GTT TCT GCT GCT GA	607	8-30
660 ^b	5'-GTA GAA TTG AGG ACG GTA GTT AG	607	678-700
658	5'-GAT YTA GTC GAT GAT GAA GAA TT	621	116-138
659 ^b	5'-GCT TTT TGI GTT TCW GGT TTR AT	621	443-465
658	5'-GAT YTA GTC GAT GAT GAA GAA TT	621	116-138
661 ^b	5'-GTA GAA YTG TGG WCG ATA RTT RT	621	678-700
558	5'-TCI TTY AAR TAY GCI TGG GT	665 ^c	157-176
559 ^b	5'-CCG ACR GCR AYI GTY TGI CKC AT	665 ^c	1279-1301
813	5'-AAT CYG TYG AAA TGC AYC ACG A	665 ^c	687-708
559 ^b	5'-CCG ACR GCR AYI GTY TGI CKC AT	665 ^c	1279-1301

^aThe nucleotide positions refer to the *A. fumigatus* tuf (EF-1) sequence fragment (SEQ ID NO. 404).

^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

^cSequences from databases.

SEQ ID NO.	Nucleotide sequence	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Sequencing primers (continued)			
558	5'-TCI TTY AAR TAY GCI TGG GT	665 ^a	157-176
815 ^b	5'-TGG TGC ATY TCK ACR GAC TT	665 ^a	686-705
560	5'-GAY TTC ATY AAR AAY ATG ATY AC	665 ^a	289-311
559 ^b	5'-CCG ACR GCR AYI GTY TGI CKC AT	665 ^a	1279-1301
653	5'-GAY TTC ATI AAR AAY ATG AT	665 ^a	289-308
559 ^b	5'-CCG ACR GCR AYI GTY TGI CKC AT	665 ^a	1279-1301
558	5'-TCI TTY AAR TAY GCI TGG GT	665 ^a	157-176
655 ^b	5'-CCR ATA CCI CMR ATY TTG TA	665 ^a	754-773
654	5'-TAC AAR ATY KGI GGT ATY GG	665 ^a	754-773
559 ^b	5'-CCG ACR GCR AYI GTY TGI CKC AT	665 ^a	1279-1301
696	5'-ATI GGI CAY RTI GAY CAY GGI AAR AC	698 ^a	52-77
697 ^b	5'-CCI ACI GTI CKI CCR CCY TCR CG	698 ^a	1132-1154
911	5'-GAC GGM KKC ATG CCG CAR AC	853	22-41
914 ^b	5'-GAA RAG CTG CGG RCG RTA GTG	853	700-720
912	5'-GAC GGC GKC ATG CCG CAR AC	846	20-39
914 ^b	5'-GAA RAG CTG CGG RCG RTA GTG	846	692-712
913	5'-GAC GGY SYC ATG CCK CAG AC	843	251-270
915 ^b	5'-AAA CGC CTG AGG RCG GTA GTT	843	905-925
916	5'-GCC GAG CTG GCC GGC TTC AG	846	422-441
561 ^b	5'-ACI GTI CGG CCR CCC TCA CGG AT	619 ^a	1483-1505

TABLE 39-continued

Specific and ubiquitous primers for nucleic acid amplification (tuf sequences).			
664	5'-AAY ATG ATI ACI GGI GCI GCI CAR ATG GA	619 ^a	604-632
917 ^b	5'-TCG TGC TAC CCG TYG CCG CCA T	846	593-614

^aSequences from databases.^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

SEQ ID NO.	Nucleotide sequence	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Sequencing primers (continued)			
1221	5'-GAY ACI CCI GGI CAY GTI GAY TT	1230 ^a	292-314
1226 ^b	5'-GTI RMR TAI CCR AAC ATY TC	1230 ^a	2014-2033
1222	5'-ATY GAY ACI CCI GGI CAY GTI GAY TT	1230 ^a	289-314
1223 ^b	5'-AYI TCI ARR TGI ARY TCR CCC ATI CC	1230 ^a	1408-1433
1224	5'-CCI GYI HTI YTI GAR CCI ATI ATG	1230 ^a	1858-1881
1225 ^b	5'-TAI CCR AAC ATY TCI SMI ARI GGI AC	1230 ^a	2002-2027
1227	5'-GTI CCI YTI KCI GAR ATG TTY GGI TA	1230 ^a	2002-2027
1229 ^b	5'-TCC ATY TGI GCI GCI CCI GTI ATC AT	698 ^a	4-29
1228	5'-GTI CCI YTI KCI GAR ATG TTY GGI TAY GC	1230 ^a	2002-2030
1229 ^b	5'-TCC ATY TGI GCI GCI CCI GTI ATC AT	698 ^a	4-29
1999	5'-CAT GTC AAY ATT GGT ACT ATT GGT CAT GT	498-500, 502, 505, 506, 508, 619, 2004, 2005 ^c	25-53 ^d
2000 ^b	5'-CCA CCY TCI CTC AMG TTG AAR CGT T	same as SEQ ID NO. 1999	1133-1157 ^d
2001	5'-ACY ACI TTR ACI GCY GCY ATY AC	same as SEQ ID NO. 1999	67-89 ^d
2003 ^b	5'-CAT YTC RAI RTT GTC ACC TGG	same as SEQ ID NO. 1999	1072-1092 ^d
2002	5'-CCI GAR GAR AGA GCI MGW GGT	same as SEQ ID NO. 1999	151-171 ^d
2003 ^b	5'-CAT YTC RAI RTT GTC ACC TGG	same as SEQ ID NO. 1999	1072-1092 ^d

^aSequences from databases.^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^cThese sequences were aligned to derive the corresponding primer.^dThe nucleotide positions refer to the *C. albicans* tuf sequence fragment (SEQ ID NO. 2004).

TABLE 40

Specific and ubiquitous primers for nucleic acid amplification (atpD sequences).			
SEQ ID NO.	Nucleotide sequence	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Bacterial species: <i>Acinetobacter baumannii</i>			
1690	5'-CAG GTC CTG TTG CGA CTG AAG AA	243	186-208
1691 ^b	5'-CAC AGA TAA ACC TGA GTG TGC TTT C	243	394-418

TABLE 40-continued

Specific and ubiquitous primers for nucleic acid amplification (atpD sequences).			
Bacterial species: <i>Bacteroides fragilis</i>			
2134	5'-CGC GTG AAG CTT CTG TG	929	184-200
2135 ^b	5'-TCT CGC CGT TAT TCA GTT TC	929	395-414
Bacterial species: <i>Bordetella pertussis</i>			
2180	5'-TTC GCC GGC GTG GGC	1672 ^c	544-558
2181 ^b	5'-AGC GCC ACG CGC AGG	1672 ^c	666-680
Bacterial species: <i>Enterococcus faecium</i>			
1698	5'-GGA ATC AAC AGA TGG TTT ACA AA	292	131-153
1699 ^b	5'-GCA TCT TCT GGG AAA GGT GT	292	258-277
1700	5'-AAG ATG CGG AAA GAA GCG AA	292	271-290
1701 ^b	5'-ATT ATG GAT CAG TTC TTG GAT CA	292	439-461
Bacterial species: <i>Klebsiella pneumoniae</i>			
1331	5'-GCC CTT GAG GTA CAG AAT GGT AAT GAA GTT	317	88-118
1332 ^b	5'-GAC CGC GGC GCA GAC CAT CA	317	183-203

"These sequences were aligned to derive the corresponding primer.
'These sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.
^c Sequence from databases.

Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial species: <i>Streptococcus agalactiae</i>			
627	5'-ATT GTC TAT AAA AAT GGC GAT AAG TC	379-383 ^a	42-67 ^b
625 ^c	5'-CGT TGA AGA CAC GAC CCA AAG TAT CC	379-383 ^a	206-231 ^b
628	5'-AAA ATG GCG ATA AGT CAC AAA AAG TA	379-383 ^a	52-77 ^b
625 ^c	5'-CGT TGA AGA CAC GAC CCA AAG TAT CC	379-383 ^a	206-231 ^b
627	5'-ATT GTC TAT AAA AAT GGC GAT AAG TC	379-383 ^a	42-67 ^b
626 ^c	5'-TAC CAC CTT TTA AGT AAG GTG CTA AT	379-383 ^a	371-396 ^b
628	5'-AAA ATG GCG ATA AGT CAC AAA AAG TA	379-383 ^a	52-77 ^b
626 ^c	5'-TAC CAC CTT TTA AGT AAG GTG CTA AT	379-383 ^a	371-396 ^b
Bacterial group: <i>Campylobacter jejuni</i> and <i>C. coli</i> .			
2131	5'-AAG CMA TTG TTG TAA ATT TTG AAA G	1576, 1600, 1849, 1863, 2139 ^{d,a}	7-31 ^e
2132 ^c	5'-TCA TAT CCA TAG CAA TAG TTC TA	1576, 1600, 1849, 1863, 2139 ^{d,a}	92-114 ^e
Bacterial genus: <i>Bordetella</i> sp.			
825	5'-ATG AGC ARC GSA ACC ATC GTT CAG TG	1672 ^d	1-26
826 ^c	5'-TCG ATC GTG CCG ACC ATG TAG AAC GC	1672 ^d	1342-1367
Fungal genus: <i>Candida</i> sp.			
634	5'-AAC ACY GTC AGR RCI ATT GCY ATG GA	460-472, 474-478 ^a	101-126 ^f

TABLE 40-continued

Specific and ubiquitous primers for nucleic acid amplification (atpD sequences).

635 ^c	5'-AAA CCR GTI ARR GCR ACT CTI GCT CT	460-472, 474-478 ^a	617-642 ^f
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^aThese sequences were aligned to derive the corresponding primer.

^bThe nucleotide positions refer to the *S. agalactiae* atpD sequence fragment (SEQ ID NO. 380).

^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

^dSequence from databases.

^eThe nucleotide positions refer to the *C. jejuni* atpD sequence fragment (SEQ ID NO. 1576).

^fThe nucleotide positions refer to the *C. albicans* atpD sequence fragment (SEQ ID NO. 460).

		Originating DNA fragment
SEQ ID NO.	Nucleotide sequence	SEQ ID Nucleotide NO. position
Universal primers		
562	5'-CAR ATG RAY GAR CCI CCI GGI GYI MGI ATG	243, 244, 262, 528-557 ^b 264, 280, 284, 291, 297, 309, 311, 315, 317, 324, 329, 332, 334-336, 339, 342, 343, 351, 356, 357, 364-366, 370, 375, 379, 393 ^a
563 ^c	5'-GGY TGR TAI CCI ACI GCI GAI GGC AT	243, 244, 262, 687-712 ^b 264, 280, 284, 291, 297, 309, 311, 315, 317, 324, 329, 332, 334-336, 339, 342, 343, 351, 356, 357, 364-366, 370, 375, 379, 393 ^a
564	5'-TAY GGI CAR ATG AAY GAR CCI CCI GGI AA	243, 244, 262, 522-550 ^b 264, 280, 284, 291, 297, 309, 311, 315, 317, 324, 329, 332, 334-336, 339, 342, 343, 351, 356, 357, 364-366, 370, 375, 379, 393 ^a
565 ^c	5'-GGY TGR TAI CCI ACI GCI GAI GGD AT	243, 244, 262, 687-712 ^b 264, 280, 284, 291, 297, 309, 311, 315, 317, 324, 329, 332, 334-336, 339, 342, 343, 351, 356, 357, 364-366, 370, 375, 379, 393 ^a

^aThese sequences were aligned to derive the corresponding primer.

^bThe nucleotide positions refer to the *K. pneumoniae* atpD sequence fragment (SEQ ID NO. 317).

^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

TABLE 40-continued

Specific and ubiquitous primers for nucleic acid amplification (atpD sequences).

SEQ ID NO.	Nucleotide sequence	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Universal primers (continued)			
640	5'-TCC ATG GTI TWY GGI CAR ATG AA	248, 284, 315, 317, 343, 357, 366, 370, 379, 393 ^a	513-535 ^b
641 ^c	5'-TGA TAA CCW ACI GCI GAI GGC ATA CG	248, 284, 315, 317, 343, 357, 366, 370, 379, 393 ^a	684-709 ^b
642	5'-GGC GTI GGI GAR CGI ACI CGT GA	248, 284, 315, 317, 343, 357, 366, 370, 379, 393 ^a	438-460 ^b
641 ^c	5'-TGA TAA CCW ACI GCI GAI GGC ATA CG	248, 284, 315, 317, 343, 357, 366, 370, 379, 393 ^a	684-709 ^b
Sequencing primers			
566	5'-TTY GGI GGI GCI GGI GTI GGI AAR AC	669 ^d	445-470
567 ^c	5'-TCR TCI GCI GGI ACR TAI AYI GCY TG	669 ^d	883-908
566	5'-TTY GGI GGI GCI GGI GTI GGI AAR AC	669 ^d	445-470
814	5'-GCI GGC ACG TAC ACI GCC TG	666 ^d	901-920
568	5'-RTI ATI GGI GCI GTI RTI GAY GT	669 ^d	25-47
567 ^c	5'-TCR TCI GCI GGI ACR TAI AYI GCY TG	669 ^d	883-908
570	5'-RTI RYI GGI CCI GTI RTI GAY GT	672 ^d	31-53
567 ^c	5'-TCR TCI GCI GGI ACR TAI AYI GCY TG	669 ^d	883-908
572	5'-RTI RTI GGI SCI GTI RTI GA	669 ^d	25-44
567 ^c	5'-TCR TCI GCI GGI ACR TAI AYI GCY TG	669 ^d	883-908
569	5'-RTI RTI GGI SCI GTI RTI GAT AT	671 ^d	31-53
567 ^c	5'-TCR TCI GCI GGI ACR TAI AYI GCY TG	669 ^d	883-908
571	5'-RTI RTI GGI CCI GTI RTI GAT GT	670 ^d	31-53
567 ^c	5'-TCR TCI GCI GGI ACR TAI AYI GCY TG	669 ^d	883-908

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the *K. pneumoniae* atpD sequence fragment (SEQ ID NO. 317).^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^dSequences from databases.

SEQ ID NO.	Nucleotide sequence	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Sequencing primers (continued)			
700	5'-TIR TIG AYG TCG ART TCC CTC ARG	669 ^a	38-61
567 ^b	5'-TCR TCI GCI GGI ACR TAI AYI GCY TG	669 ^a	883-908
568	5'-RTI ATI GGI GCI GTI RTI GAY GT	669 ^a	25-47
573 ^b	5'-CCI CCI ACC ATR TAR AAI GC	666 ^a	1465-1484
574	5'-ATI GCI ATG GAY GGI ACI GAR GG	666 ^a	283-305
573 ^b	5'-CCI CCI ACC ATR TAR AAI GC	666 ^a	1465-1484

TABLE 40-continued

Specific and ubiquitous primers for nucleic acid amplification (atpD sequences).				
574	5'-ATI GCI ATG GAY GGI ACI GAR GG	666 ^a	283-305	
708 ^b	5'-TCR TCC ATI CCI ARI ATI GCI ATI AT	666 ^a	1258-1283	
681	5'-GGI SSI TTY GGI ISI GGI AAR AC	685	694-716	
682 ^b	5'-GTI ACI GGY TCY TCR AAR TTI CCI CC	686	1177-1202	
681	5'-GGI SSI TTY GGI ISI GGI AAR AC	685	694-716	
683 ^b	5'-GTI ACI GGI TCI SWI AWR TCI CCI CC	685	1180-1205	
681	5'-GGI SSI TTY GGI ISI GGI AAR AC	685	694-716	
699	5'-GTI ACI GGY TCY TYR ARR TTI CCI CC	686	1177-1202	
681	5'-GGI SSI TTY GGI ISI GGI AAR AC	685	694-716	
812 ^b	5'-GTI ACI GGI TCY TYR ARR TTI CCI CC	685	1180-1205	
1213	5'-AAR GGI GGI ACI GCI GCI ATH CCI GG	714 ^a	697-722	
1212 ^b	5'-CCI CCI RGI GGI GAI ACI GCW CC	714 ^a	1189-1211	
1203	5'-GGI GAR MGI GGI AAY GAR ATG	709 ^a	724-744	
1207 ^b	5'-CCI TCI TCW CCI GGC ATY TC	709 ^a	985-1004	
1204	5'-GCI AAY AAC ITC IWM YAT GCC	709 ^a	822-842	
1206 ^b	5'-CKI SRI GTI GAR TCI GCC A	709 ^a	926-944	
1205	5'-AAY ACI TCI AWY ATG CCI GT	709 ^a	826-845	
1207 ^b	5'-CCI TCI TCW CCI GGC ATY TC	709 ^a	985-1004	
2282	5'-AGR RGC IMA RAT GTA TGA	714 ^a	84-101	
2284 ^b	5'-TCT GWG TRA CIG GYT CKG AGA	714 ^a	1217-1237	
2283	5'-ATI TAT GAY GGK ITT CAG AGG C	714 ^a	271-292	
2285 ^b	5'-CMC CIC CWG GTG GWG AWA C	714 ^a	1195-1213	

^aSequences from databases.^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

TABLE 41

Internal hybridization probes for specific detection of tuf sequences.				
		Originating DNA fragment		
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position	
<i>Bacterial species: Abiotrophia adiacens</i>				
2170	5'-ACG TGA CGT TGA CAA ACC A	1715	313-331	
<i>Bacterial species: Chlamydia pneumoniae</i>				
2089	5'-ATG CTG AAC TTA TTG ACC TT	20	136-155	
2090	5'-CGT TAC TGG AGT CGA AAT G	20	467-485	
<i>Bacterial species: Enterococcus faecalis</i>				
580	5'-GCT AAA CCA GCT ACA ATC ACT CCA C	62-63, 607 ^a	584-608 ^b	
603	5'-GGT ATT AAA GAC GAA ACA TC	62-63, 607 ^a	440-459 ^b	
1174	5'-GAA CGT GGT GAA GTT CGC	62-63, 607 ^a	398-415 ^b	

TABLE 41-continued

Internal hybridization probes for specific detection of tuf sequences.			
Bacterial species: <i>Enterococcus faecium</i>			
602 5'-AAG TTG AAG TTG TTG GTA TT	64, 608 ^a	426-445 ^c	
Bacterial species: <i>Enterococcus gallinarum</i>			
604 5'-GGT GAT GAA GTA GAA ATC GT	66, 609 ^a	419-438 ^d	
Bacterial species: <i>Escherichia coli</i>			
579 5'-GAA GGC CGT GCT GGT GAG AA	78	503-522	
2168 5'-CAT CAA AGT TGG TGA AGA AGT TG	78	409-431	
Bacterial species: <i>Neisseria gonorrhoeae</i>			
2166 5'-GAC AAA CCA TTC CTG CTG	126	322-339 ^e	
Fungal species: <i>Candida albicans</i>			
577 5'-CAT GAT TGA ACC ATC CAC CA	407-411 ^a	406-425 ^f	
Fungal species: <i>Candida dubliniensis</i>			
578 5'-CAT GAT TGA AGC TTC CAC CA	412, 414-415 ^a	418-437 ^g	
Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial species: <i>Haemophilus influenzae</i>			
581 5'-ACA TCG GTG CAT TAT TAC GTG G	610 ^a	551-572	
Bacterial species: <i>Mycoplasma pneumoniae</i>			
2095 5'-CGG TCG GGT TGA ACG TGG	2097 ^a	687-704	
Bacterial species: <i>Staphylococcus aureus</i>			
584 5'-ACA TGA CAC ATC TAA AAC AA	176-180 ^b	369-388 ^c	
585 5'-ACC ACA TAC TGA ATT CAA AG	176-180 ^b	525-544 ^c	
586 5'-CAG AAG TAT ACG TAT TAT CA	176-180 ^b	545-564 ^c	
587 5'-CGT ATT ATC AAA AGA CGA AG	176-180 ^b	555-574 ^c	
588 5'-TCT TCT CAA ACT ATC GTC CA	176-180 ^b	593-612 ^c	
Bacterial species: <i>Staphylococcus epidermidis</i>			
589 5'-GCA CGA AAC TTC TAA AAC AA	185, 611 ^b	445-464 ^d	
590 5'-TAT ACG TAT TAT CTA AAG AT	185, 611 ^b	627-646 ^d	
591 5'-TCC TGG TTC TAT TAC ACC AC	185, 611 ^b	586-605 ^d	
592 5'-CAA AGC TGA AGT ATA CGT AT	185, 611 ^b	616-635 ^d	
593 5'-TTC ACT AAC TAT CGC CCA CA	185, 611 ^b	671-690 ^d	

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the *E. faecalis* tuf sequence fragment (SEQ ID NO. 607).^cThe nucleotide positions refer to the *E. faecium* tuf sequence fragment (SEQ ID NO. 608).^dThe nucleotide positions refer to the *E. gallinarum* tuf sequence fragment (SEQ ID NO. 609).^eThe nucleotide positions refer to the *N. gonorrhoeae* tuf sequence fragment (SEQ ID NO. 126).^fThe nucleotide positions refer to the *C. albicans* tuf(EF-1) sequence fragment (SEQ ID NO. 408).^gThe nucleotide positions refer to the *C. dubliniensis* tuf(EF-1) sequence fragment (SEQ ID NO. 414).

TABLE 41-continued

Internal hybridization probes for specific detection of tuf sequences.			
Bacterial species: <i>Staphylococcus haemolyticus</i>			
594	5'-ATT GGT ATC CAT GAC ACT TC	186, 188-190 ^b	437-456 ^e
595	5'-TTA AAG CAG ACG TAT ACG TT	186, 188-190 ^b	615-634 ^e
Bacterial species: <i>Staphylococcus hominis</i>			
596	5'-GAA ATT ATT GGT ATC AAA GA	191, 193-196 ^b	431-450 ^f
597	5'-ATT GGT ATC AAA GAA ACT TC	191, 193-196 ^b	437-456 ^f
598	5'-AAT TAC ACC TCA CAC AAA AT	191, 193-196 ^b	595-614 ^f
^a Sequences from databases.			
^b These sequences were aligned to derive the corresponding probe.			
^c The nucleotide positions refer to the <i>S. aureus</i> tuf sequence fragment (SEQ ID NO. 179).			
^d The nucleotide positions refer to the <i>S. epidermidis</i> tuf sequence fragment (SEQ ID NO. 611).			
^e The nucleotide positions refer to the <i>S. haemolyticus</i> tuf sequence fragment (SEQ ID NO. 186).			
^f The nucleotide positions refer to the <i>S. hominis</i> tuf sequence fragment (SEQ ID NO. 191).			
Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial species: <i>Staphylococcus saprophyticus</i>			
599	5'-CGG TGA AGA AAT CGA AAT CA	198-200 ^a	406-425 ^b
600	5'-ATG CAA GAA GAA TCA AGC AA	198-200 ^a	431-450 ^b
601	5'-GTT TCA CGT GAT GAT GTA CA	198-200 ^a	536-555 ^b
695	5'-GTT TCA CGT GAT GAC GTA CA	198-200 ^a	563-582 ^b
Bacterial species: <i>Streptococcus agalactiae</i>			
582 ^c	5'-TTT CAA CTT CGT CGT TGA CAC GAA CAG T	207-210 ^a	404-431 ^d
583 ^c	5'-CAA CTG CTT TTT GGA TAT CTT CTT TAA TAC CAA CG	207-210 ^a	433-467 ^d
1199	5'-GTA TTA AAG AAG ATA TCC AAA AAG C	207-210 ^a	438-462 ^d
Bacterial species: <i>Streptococcus pneumoniae</i>			
1201	5'-TCA AAG AAG AAA CTA AAA AAG CTG T	971, 977,	513-537 ^e
		979,	986 ^a
Bacterial species: <i>Streptococcus pyogenes</i>			
1200	5'-TCA AAG AAG AAA CTA AAA AAG CTG T	1002	473-497
Bacterial group: <i>Enterococcus casseliflavus-flavescens-gallinarum</i> group			
620	5'-ATT GGT GCA TTG CTA CGT	58, 65, 66 ^a	527-544 ^f
1122	5'-TGG TGC ATT GCT ACG TGG	58, 65, 66 ^a	529-546 ^f
Bacterial group: <i>Enterococcus</i> sp., <i>Gemella</i> sp., <i>A. adiacens</i>			
2172	5'-GTG TTG AAA TGT TCC GTA AA	58-62, 67-71, 87-88, 607-609, 727, 871 1715, 1722 ^a	477-496 ^g

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the *S. saprophyticus* tuf sequence fragment (SEQ ID NO. 198).^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^dThe nucleotide positions refer to the *S. agalactiae* tuf sequence fragment (SEQ ID NO. 209).

TABLE 41-continued

Internal hybridization probes for specific detection of tuf sequences.

^aThe nucleotide positions refer to the *S. pneumoniae* tuf sequence fragment (SEQ ID NO. 986).

^bThe nucleotide positions refer to the *E. flavescens* tuf sequence fragment (SEQ ID NO. 65).

^cThe nucleotide positions refer to the *E. faecium* tuf sequence fragment (SEQ ID NO. 608).

		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial genus: <i>Gemella</i>			
2171	5'-TCG TTG GAT TAA CTG AAG AA	87, 88 ^a	430-449 ^b
Bacterial genus: <i>Staphylococcus</i> sp.			
605	5'-GAA ATG TTC CGT AAA TTA TT	176-203 ^a	403-422 ^c
606	5'-ATT AGA CTA CGC TGA AGC TG	176-203 ^a	420-439 ^c
1175	5'-GTT ACT GGT GTA GAA ATG TTC	176-203 ^a	391-411 ^c
1176	5'-TAC TGG TGT AGA AAT GTT C	176-203 ^a	393-411 ^c
Bacterial genus: <i>Streptococcus</i> sp.			
1202	5'-GTG TTG AAA TGT TCC GTA AAC A	206-231, 971, 977, 979, 982-986 ^a	466-487 ^d
Fungal species: <i>Candida albicans</i>			
1156	5'-GTT GAA ATG CAT CAC GAA CAA TT	407-412, 624 ^a	680-702 ^c
Fungal group: <i>Candida albicans</i> and <i>C. tropicalis</i>			
1160	5'-CGT TTC TGT TAA AGA AAT TAG AAG	407-412, 429, 624 ^a	748-771 ^e
Fungal species: <i>Candida dubliniensis</i>			
1166	5'-ACG TTA AGA ATG TTT CTG TCA A	414-415 ^a	750-771 ^f
1168	5'-GAA CAA TTG GTT GAA GGT GT	414-415 ^a	707-726 ^f
Fungal species: <i>Candida glabrata</i>			
1158	5'-AAG AGG TAA TGT CTG TGG T	417	781-799
1159	5'-TGA AGG TTT GCC AGG TGA	417	718-735
Fungal species: <i>Candida krusei</i>			
1161	5'-TCC AGG TGA TAA CGT TGG	422	720-737

^aThese sequences were aligned to derive the corresponding primer.

^bThe nucleotide positions refer to the *G. haemolysans* tuf sequence fragment (SEQ ID NO. 87).

^cThe nucleotide positions refer to the *S. aureus* tuf sequence fragment (SEQ ID NO. 179).

^dThe nucleotide positions refer to the *S. pneumoniae* tuf sequence fragment (SEQ ID NO. 986).

^eThe nucleotide positions refer to the *C. albicans* tuf (EF-1) sequence fragment (SEQ ID NO. 408).

^fThe nucleotide positions refer to the *C. dubliniensis* tuf (EF-1) sequence fragment (SEQ ID NO. 414).

TABLE 41-continued

Internal hybridization probes for specific detection of tuf sequences.		
SEQ ID NO.	Nucleotide sequence	Originating DNA fragment
<i>Fungal group: Candida lusitaniae and C. guillermondii</i>		
1162	5'-CAA GTC CGT GGA AAT GCA	418, 424 ^a 682-699 ^b
<i>Fungal species: Candida parapsilosis</i>		
1157	5'-AAG AAC GTT TCA GTT AAG GAA AT	426 749-771
<i>Fungal species: Candida zeylanoides</i>		
1165	5'-GGT TTC AAC GTG AAG AAC	432 713-730
<i>Fungal genus: Candida sp.</i>		
1163	5'-GTT GGT TTC AAC GTT AAG AAC	407-412, 414- 728-748 ^c 415, 417, 418, 422, 429 ^a
1164	5'-GGT TTC AAC GTC AAG AAC	413, 416, 420, 740-757 ^b 421, 424, 425, 426, 428, 431 ^a
1167	5'-GTT GGT TTC AAC GT	406-426, 428- 728-741 ^c 432, 624 ^a

^aThese sequences were aligned to derive the corresponding primer.

^bThe nucleotide positions refer to the *C. lusitaniae* tuf(EF-1) sequence fragment (SEQ ID NO. 424).

^cThe nucleotide positions refer to the *C. albicans* tuf(EF-1) sequence fragment (SEQ ID NO. 408).

TABLE 42

Strategy for the selection of amplification/sequencing primers from atpD (F-type) sequences.

	SEQ ID NO.:	Accession #:
23	49	443
<i>B. cepacia</i>	AGTGCAT CGGGCCGRT ATCGACGTGG . . . TGTTTG GCGGTCTCG CGTGGCAAG ACCG . . . TCCA GCGCGTGT ACGTCCCTGC GGACGACT	2346 X76877
<i>B. pertussis</i> project	AGTGCAT CGGGCCGRTG GTGGATATTTC . . . TGTTTG GCGGCGCCG CGTGGCAAG ACCG . . . TCCA GCGCGTGT ACGTCCCTGC GGACGACT	2347 Genome
<i>P. aeruginosa</i> project	AAATTAT CGGGCCGRTG ATCGACGTGG . . . TGTTTG GCGGCGCCG CGTGGCAAG ACCG . . . TCCA GCGCGTGT ACGTCCCTGC GGACGACC	2348 Genome
<i>E. coli</i>	AGGTAAAT CGGGCCGRTA GTTGACGTGG . . . TGTTTG GCGGTGCCGG GTAGGTAAA ACCG . . . TACA GGCGTAT AGCTACTTGC GGATGACT	2349 J01594
<i>N. gonorrhoeae</i> project	AAATTAT CGGTGCGTT GTTGACGTGG . . . TGTTTG GCGGTGCCGG GTAGGTAAA ACCG . . . TCCA AGCGTAT ATGTACCTGC GGATGACT	2350 Genome
<i>M. thermoacetica</i>	AGGTAT TGGCCCGGTG GTTGACGTGG . . . TGTTTG GCGGCGCGA GGTGGCAAG ACGG . . . TCGA AGCTATCT ATGTGCCCGC CGACGACC	2351 U64318
<i>S. aurantiaca</i>	AGGTT-T CGGTCCCGTG ATTGACGTGG . . . TGTTTG GCGGCGCGA GGTGGCAAG ACGG . . . TCGA GGCGATCT ACGTGCCCGC CGACGACT	2352 X76879
<i>M. tuberculosis</i>	GGGTCACT TGGCCCGTCG GTGAGCGTCA . . . TGTTTG GCGGTGCCGG GTAGGTAAA ACCG . . . TCGA AGCGGTCT ACGTGCCCGC CGACGACT	2353 Z73419
<i>B. fragilis</i>	AGGTAAAT TGGCCCTGTG GTCCATGTGT . . . TGTTTG GCGGGCGCG AGTGGTAAA ACTG . . . TGCA GGCTGGTT ACGTACCCGC TGATGACT	2354 M22247
<i>C. lytica</i>	AAATTAT TGGCCAGTT ATAGATGTGG . . . TATTTG GAGGTGCCGG AGTAGGTAAA ACAG . . . TACA GGCGGTTT ACGTACCTGC GGATGATT	672 M22535
<i>A. woodii</i>	AGGTAT TGGACACGTA GTCGATGTTA . . . TTTCAG GTGGTGCCGG AGTGGTAAA ACCG . . . TICA GGCGGTTT ACGTACCCAGC CGATGACT	2356 U10505
<i>C. acetobutylicum</i>	AGGTAAAT AGGACCTGTG GTGGATATTA . . . TGTTTG GTGGTGCCGG TGTTGGTAAA ACAG . . . TICA GGCTGTAT ATGTCCCTGC TGATGACC	671 AF101055
<i>M. pneumoniae</i>	AAGTGAT TGGCCGGTA GTTGATGTCA . . . TATTTG GTGGTCTCG TGTTGGTAAA ACGG . . . TCGA AGCGATCT ATGTGCCAGC TGATGACT	2357 U43738
<i>H. pylori</i>	AGGTTEL AGGCACGGTG GTAGATGTGG . . . TGTTTG GTGGGCTCG CGTAGGCAA ACCG . . . TICA AGCGGTAT ATGTGCCAGC AGACGACT	670 AF004014
Selected sequences for universal primers	RTAT IGGIGCIGTI RTIGAYGT RTIIRY IGGICCGITI RTIGAYGT RTIIRY IGGISCGITI RTIGAYTA RTIIRY IGGICCGITI RTIGAYTA RTIIRY IGGIGCIGG IGGIGGAAAC	568 570 572 569 571 566
Selected sequence for universal primer ^a	CA RGCIITIT AYGTICCCIGC IGAYGA	567

The sequence numbering refers to the *Escherichia coli* atpD gene fragment (SEQ ID NO. 669). Nucleotides in capitals are identical to the selected sequences or match those sequences. M matches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.
^a"R", "W", "K", "W", and "S" designate nucleotide positions which are degenerate. "R" stands for A or G; "W" stands for C or T; "K" stands for A or C; "W" stands for G or T; "W" stands for A or T; "S" stands for C or G. "W" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T. This sequence is the reverse-complement of the selected primer.

TABLE 43

Strategy for the selection of universal amplification/sequencing
primers from *atpD* (V-type) sequences.

	691	719	1177	1208	SEQ ID NO.:
<i>E. hirae</i>	CC AGGTCCGTTT GGTGCAGGG A <u>GACAGT</u> ...TCTGGTGGAg ATaTCTctGA ACCAGTGACT CA				685
<i>H. salinarum</i>	CC GGGGCCGTT C GGTCCGGGA AGACGGT...CCC <u>GGCGGG</u> ACTTCTccGA GCCGGTCACC CA				687
<i>T. thermophilus</i>	CC TGGGCCCTTC GGCAGCGGCA AGACC <u>G</u> ...CCGGCGGCg ACaTgtccGA GCCCGTGACC CA				693
Human	CC TGGGGCCTTC GGATGTGGCA AGACTGT...CCC <u>GGTGGG</u> ACTTCTcAGA tCCCGTGACG AC				688
<i>T. congolense</i>	CC TGGCGCGTTT GGATGCGGAA AGACGGT...CCTGGAGGTg ACTTTTctGA cCCAGTGACG TC				692
<i>P. falciparum</i>	CC TGGTGCA <u>TTT</u> GGTGTGGAA AA <u>ACTTG</u> ...CCAGGTGGTg ATTTCTctGA cCCTGTA <u>ACT</u> AC				689
<i>C. pneumoniae</i>	CC AGGACCTTTT GGTGCAGGG A <u>AACAGT</u> ...GCAGGAGGAA ACTTT <u>GAAGA</u> ACCAGTC <u>ACT</u> CA				686
Selected sequences for universal primers	GGISSITTY GGIISIGGIA ARAC				681
Selected sequences for universal primers ^a			GGIGGIA AYTTYGARGA RCCIGTIAC		682
			GGIGGIG AYWTIWSIGA ICCIGTIAC		683

The sequence numbering refers to the *Enterococcus hirae* *atpD* gene fragment (SEQ ID NO. 685). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches for SEQ ID NOs. 681 and 682 are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

"R" "Y" "M" "K" "W" and "S" designate nucleotide positions which are degenerated. "R" stands for A or G; "Y" stands for C or T; "M" stands for A or C; "K" stands for G or T; "W" stands for A or T; "S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

^aThese sequences are the reverse-complement of the selected primers.

TABLE 44

Strategy for the selection of universal amplification/sequencing
primers from *tuf* (M) sequences (organelle origin).

	601	635	1479	1511	SEQ ID NO.:	Accession #:
<i>C. neoformans</i> ^a	AAGAA CATGATCACC GGTaCCtCCC AG <u>gctGACTG</u> ...CGC <u>cgTccGA</u> GA <u>catGcGAC</u> AGAC <u>cGTTGc</u> CGT				2358	U81803
<i>S. cerevisiae</i> ^a	AAGAA CATGATTACT GGTaCTtCTC AA <u>gctGACTG</u> ...CG <u>CTgTCAGA</u> GA <u>catGaGAC</u> AA <u>ACTGTcGc</u> TGT				665	X00779
<i>O. volvulus</i> ^b	AAGAA TATGATCACA GGTaCTtCTC AG <u>gctGACTG</u> ...TG <u>CTgTgcGt</u> GA <u>atatGaGAC</u> AA <u>ACaGTTGc</u> GGT				2359	M64333
Human ^a	AAAAAA CATGATTACA GGGaCATCTC AG <u>gctGACTG</u> ...TG <u>CTgTTCGt</u> GA <u>atatGaGAC</u> AGAC <u>aGTTGc</u> TGT				2360	X03558
<i>G. max</i> B1 ^b	AAGAA CATGATCACC GGC <u>GCTGCC</u> AGATGGACGG...TG <u>CTATTAGA</u> GA <u>AGGAGGCA</u> AA <u>ACTGTTGG</u> AGC				2361	Y15107
<i>G. max</i> B2 ^b	AAAAAA CATGATCACC GGC <u>GCGGCC</u> AGATGGACGG...TG <u>CTATTAGA</u> GA <u>AGGAGGCA</u> AA <u>ACTGTTGG</u> AGC				2362	Y15108
<i>E. coli</i> ^c	AAAAAA CATGATCACC GGTGCTGCTC AGATGGACGG...CG <u>CaATCcGt</u> GA <u>AGGCGGCC</u> GT <u>ACcGTTGG</u> CGC				78	-
<i>S. aureofaciens</i> ^c	AAGAA CATGATCACC GGTGCGGCC AGATGGACGG...CG <u>CcATCcGt</u> GAGGG <u>TGGTC</u> GT <u>ACcGTgGG</u> CGC				2363	AF007125
<i>E. tenella</i> ^b	AAAAAA TATGATTACA GGAGCAGCAC AA <u>ATGGATGG</u> ...TG <u>CTATAAGA</u> GA <u>AGGAGGAA</u> AA <u>ACTATAGG</u> AGC				2364	AI755521
<i>T. gondii</i> ^b	AAGAA TATGATTACT GGAGCCGCAC AA <u>ATGGATGG</u> ...TG <u>CTATTAGA</u> GA <u>AGGAGGTC</u> GT <u>ACTATAGG</u> AGC				2365	Y11431
<i>S. cerevisiae</i> ^b	AAGAA TATGATTACC GGTGCTGCTC AA <u>ATGGATGG</u> ...CA <u>ATATCAGA</u> GAGGG <u>TGGAA</u> GA <u>ACTGTTGG</u> TAC				619	K00428
<i>A. thaliana</i> ^b	AAAAAA TATGATTACT GGAGCTGCGC AA <u>ATGGATGG</u> ...TG <u>CctTAAGG</u> GA <u>AGGAGGTA</u> GA <u>ACaGTTGG</u> AGC				2366	X89227
Selected sequence for universal primer	AA YATGATIACI GGIGCIGCIC ARATGGA				664	

TABLE 44-continued

Strategy for the selection of universal amplification/sequencing primers from tuf (M) sequences (organelle origin).

	SEQ ID NO.:	Accession #:		
601	635	1479	1511	
Selected sequences for universal primers	TATIAGR GARGGIGGIM RIACTR TWGG ^d ATCCGT GAGGGYGGCC GITCIGT ^d	652 561		

The sequence numbering refers to the *Saccharomyces cerevisiae* tuf (M) gene (SEQ ID NO. 619). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches for SEQ ID Nos. 652 and 664 are indicated by lower-case letters. Mismatches for SEQ ID NO. 561 are indicated by underlined nucleotides.

Dots indicate gaps in the sequences displayed.

"R" "Y" "M" "K" "W" and "S" designate nucleotide positions which are degenerated. "R" stands for A or G; "Y" stands for C or T; "M" stands for A or C; "K" stands for G or T; "W" stands for A or T; "S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

^aThis sequence refers to tuf(EF-1) gene.

^bThis sequence refers to tuf (M) or organelle gene.

^cThis sequence refers to tuf gene from bacteria.

^dThese sequences are the reverse-complement of the selected primers.

TABLE 45

Strategy for the selection of eukaryotic sequencing primers from tuf (EF-1) sequences.

	SEQ ID NO.:	Accession #:		
154	179	286	314	
<i>S. cerevisiae</i>	GG TTCTTTCAAG TACGCTTGGG TTTT...AGAGA TTTCATCAAG AACATGATTA CTGG...	665	X00779	
<i>B. hominis</i>	GG CTCCTTCAAG TACGCGTGGG TGCT...CGTGA CTTCATCAAG AACATGATCA CGGG...	2367	D64080	
<i>C. albicans</i>	GG TTCTTTCAAA TACGCTTGGG TCTT...AGAGA TTTCATCAAG AACATGATCA CTGG...	2368	M29934	
<i>C. neoformans</i>	TC TTCTTTCAAG TACGCTTGGG TTCT...CGAGA CTTCATCAAG AACATGATCA CGGG...	2369	U81803	
<i>E. histolytica</i>	GG ATCATTCAAA TATGCTTGGG TCTT...AGAGA TTTCATTAAG AACATGATTA CTGG...	2370	M92073	
<i>G. lamblia</i>	GG CTCCTTCAAG TACGCGTGGG TCCT...CGCGA CTTCATCAAG AACATGATCA CGGG...	2371	D14342	
<i>H. capsulatum</i>	AA ATCCTTCAAA TATGCGTGGG TCCT...CGTGA CTTCATCAAG AACATGATCA CTGG...	2372	U14100	
Human	GG CTCCTTCAAG TATGCCTGGG TCTT...AGAGA CTT <u>t</u> ATCAA AACATGATTA CAGG...	2373	X03558	
<i>L. braziliensis</i>	GC GTCCTTCAAG TACGCGTGGG TGCT...CGCGA CTTCATCAAG AACATGATCA CGGG...	2374	U72244	
<i>O. volvulus</i>	GG CTCATTTAAA TATGCTTGGG TATT...CGTGA TTTCATTAAG AATATGATCA CAGG...	2375	M64333	
<i>P. berghei</i>	GG TagTTTCAAA TATGCATGGG TTTT...AAAC <u>A</u> TT <u>T</u> ATCAA AACATGATTA CTGG...	2376	AJ224150	
<i>P. knowlesi</i>	GG AagTTTTAAG TACGCATGGG TGTT...AAGGA TTTCATTTAA AACATGATTA CGGG...	2377	AJ224153	
<i>S. pombe</i>	GG TTCCTTCAAG TACGCCCTGGG TTTT...CGTGA TTTCATCAAG AACATGATTA CGGG...	2378	U42189	
<i>T. cruzi</i>	TC TTCTTTCAAG TACGCGTGGG TCTT...CGCGA CTTCATCAAG AACATGATCA CGGG...	2379	L76077	
<i>Y. lipolytica</i>	GG TTCTTTCAAG TACGCTTGGG TTCT...CGAGA TTTCATCAAG AACATGATCA CGGG...	2380	AF054510	
Selected sequences for amplification primers	TCITTYAAR TAYGCITGGG T GA YTTCATYAAR AAYATGATYA C GA YTTCATIAAR AAYATGAT	558 560 653		

The sequence numbering refers to the *Saccharomyces cerevisiae* tuf (EF-1) gene fragment (SEQ ID NO. 665). Nucleotides in capitals are identical to the selected sequences SEQ ID NOS. 558, 560 or 653, or match those sequences. Mismatches for SEQ ID no. 558 and 560 are indicated by lower-case letters. Mismatches for SEQ ID NO. 653 are indicated by underlined nucleotides.

Dots indicate gaps in the sequences displayed.

"R" "Y" "M" "K" "W" and "S" designate nucleotide positions which are degenerated.

"R" stands for A or G; "Y" stands for C or T; "M" stands for A or C;

"K" stands for G or T; "W" stands for A or T; "S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

TABLE 45-continued

Strategy for the selection of eukaryotic sequencing primers from tuf (EF-1) sequences.					SEQ ID NO.: #:
	751	776	1276	1304	
<i>S. cerevisiae</i>	...GTTTACAA GATCGGTGGT AgTGGTAC...GACATG AGACAAACTG TCGCTGTCGG TGT				665 X00779
<i>B. hominis</i>	...GTGTACAA GATTGGCGGT ATTGGTAC...GATATG AGACAGACTG TCGCTGTCGG TAT				2381 D64080
<i>C. albicans</i>	...GTTTACAA GATCGGTGGT ATTGGTAC...GATATG AGACAAACCG TTGCTGTtGG TGT				2382 M29934
<i>C. neoformans</i>	...GTCTACAA GATCGGTGGT ATCGGCAC...GACATG CGACAGACCG TTGCCGTtGG TGT				2383 U81803
<i>E. histolytica</i>	...GTTTACAA GATTGAGGT ATTGGAAC...GATATG AaACAAACCG TTGCTGTtGG AGT				2384 M92073
<i>G. lamblia</i>	...GTCTACAA GATCTcGGGc gTCGGGAC...~~~~~ ~~~~~ ~~~~~ ~~~				2385 D14342
<i>H. capsulatum</i>	...GTGTACAA AATCTcTGGT ATTGGCAC...GACATG AGACAAACCG TCGCTGTCGG TGT				2386 U14100
Human	...GTCTACAA AATTGGTGGT ATTGGTAC...GATATG AGACAGACAG TTGcgGTgGG TGT				2387 X03558
<i>L. braziliensis</i>	...GTGTACAA GATCGGCAGGT ATCGGCAC...GACATG CGCAGAACGG TCGCCGTtGG CAT				2388 U72244
<i>O. volvulus</i>	...GTTMACAA AATTGGAGGT ATTGGAAC...GATATG AGACAAACAG TTGCTGTtGG CGT				2389 M64333
<i>P. berghei</i>	...GTATACAA AATTGGTGGT ATTGGTAC...GATATG AGACAAACAA TTGCTGTtGG TAT				2390 AJ224150
<i>P. knowlesi</i>	...GTATACAA AATCGGTGGT ATTGGTAC...GATATG AGACAAACCA TTGCTGTCGG TAT				2391 AJ224153
<i>S. pombe</i>	...GTTTACAA GATCGGTGGT ATTGGTAC...GACATG CGTCAAACCG TCGCTGTCGG TGT				2392 U42189
<i>T. cruzi</i>	...GTGTACAA GATCGGCAGGT ATCGGCAC...GACATG CGCCGACAGG TCGCCGTtGG CAT				2393 L76077
<i>Y. lipolytica</i>	...GTCTACAA GATCGGTGGT ATCGGCAC...GACATG CGACAGACCG TTGCTGTCGG TGT				2394 AF054510
Selected sequence for amplification primer	TACAA RATYKGIGGT ATYGG				654
Selected sequences for amplification primers ^a	TACAA RATYKGIGGT ATYGG ATG MGICARACIR TYGCYGTCGG				655 559

The sequence numbering refers to the *Saccharomyces cerevisiae* tuf (EF-1) gene fragment (SEQ ID NO. 665). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. "—" indicate incomplete sequence data.

Dots indicate gaps in the sequences displayed.

"R" "Y" "M" "K" "W" and "S" designate nucleotide positions which are degenerated.

"R" stands for A or G; "Y" stands for C or T; "M" stands for A or C;

"K" stands for G or T; "W" stands for A or T; "S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

^aThis sequences are the reverse-complement of the selected primers.

TABLE 46

Strategy for the selection of <i>Streptococcus agalactiae</i> -specific amplification primers from tuf sequences.					SEQ ID NO.: #:
	305	334	517	542	
<i>S. agalactiae</i>	CCAGAA CGTGATACTG ACAAACCTTT ACTT...GGAC AACGTTGGTG TTCTTCTTCG TG				207 —
<i>S. agalactiae</i>	CCAGAA CGTGATACTG ACAAACCTTT ACTT...GGAC AACGTTGGTG TTCTTCTTCG TG				208 —
<i>S. agalactiae</i>	CCAGAA CGTGATACTG ACAAACCTTT ACTT...GGAC AACGTTGGTG TTCTTCTTCG TG				209 —
<i>S. agalactiae</i>	CCAGAA CGTGATACTG ACAAACCTTT ACTT...GGAC AACGTTGGTG TTCTTCTTCG TG				210 —
<i>S. anginosus</i>	CCAGAA CGTGAcACTG ACAACCATT gCTT...AGAt AACGTaGGgG TTCTTCTTCG TG				211 —
<i>S. anginosus</i>	CCAGAA CGTGATACTG ACAACCATT gCTT...AGAt AACGTaGGgG TTCTTCTTCG TG				221 —
<i>S. bovis</i>	CCAAAA CGTGATACTG ACAACCATT gCTT...GGAt AACGTTGGTG TTCTTCTTCG TG				212 —
<i>S. gordonii</i>	CCAGAA CGTGAcACTG ACAACCATT gCTT...AGAt AAtGTaGGTG TTCTTCTTCG TG				223 —

TABLE 46-continued

Strategy for the selection of <i>Streptococcus agalactiae</i> -specific amplification primers from tuf sequences.				
	305	334	517	SEQ ID NO.: Accession #:
<i>S. mutans</i>	CCAGAA CGTGATACTG ACAAgCCgcT cCTT...GGAt AAtGTTGGTG TTCTcCTTCG TG			224 —
<i>S. pneumoniae</i>	CCAGAA CGTGAcACTG ACAAACCaTT gCTT...AGAt AACGTaGGTG TTCTTCTTCG TG			145 ^a
<i>S. sanguinis</i>	CCAGAA CGcGATACTG ACAAgCCaTT gCTT...GGAC AACGTaGGTG TgCTTCTcCG TG			227 —
<i>S. sobrinus</i>	CCAAaAA CGcGATACTG AtAAgCCaTT gCTT...AGAt AACGTTGGTG TgCTTCTTCG TG			228 —
<i>B. cepacia</i>	CCGGAG CGTGcgATG ACggcgCgTT CCTG...CGAC AACGTTGGTa TcCTgCTgCG cG			16 —
<i>B. fragilis</i>	CCTccg CGcGATgtTG AtAAACCTTT ctTG...TGAC AACGTaGGTc TgtTgCTTCG TG			2395 P33165
<i>B. subtilis</i>	CCAGAA CGcGAcACTG AaAAACCaTT caTG...TGAC AACaTTGGTG ccCTTCTTCG cG			2396 Z99104
<i>C. diphtheriae</i>	CCAGAG CGTGAgACcG ACAAgCCaTT cCTC...CGAC AACtgTGGTc TgCTTCTcCG TG			662 —
<i>C. trachomatis</i>	CCAGAA aGaGAaAtTG ACAAgCCTTT cTTA...AGAg AAtGTTGGat TgCTcCTcaG aG			22 —
<i>E. coli</i>	CCAGAG CGTGcgAtTG ACAAgCCgTT CCTg...TGA AACGTaGGTG TTCTgCTgCG TG			78 —
<i>G. vaginalis</i>	CCAact CacGATctTG ACAAgCCaTT cTTg...CGAt RACacTGGTc TTCTTCTcCG cG			135 ^a
<i>S. aureus</i>	CCAGAA CGTGATtCTG ACAAACCaTT cATg...TGAC AACaTTGGTG catTatTaCG TG			179 —
Selected sequence for species-specific primer	GAA CGTGATACTG ACAAACCTTT A			549
Selected sequence for species-specific primer ^b		C AACGTTGGTG TTCTTCTTC		550

The sequence numbering refers to the *Streptococcus agalactiae* tuf gene fragment (SEQ ID NO. 209). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters.

Dots indicate gaps in the sequences displayed.

"R" "Y" "M" "K" "W" and "S" designate nucleotide positions which are degenerated. "R" stands for A or G; "Y" stands for C or T; "M" stands for A or C; "K" stands for G or T; "W" stands for A or T; "S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

^aThe SEQ ID NO. refers to previous patent publication WO98/20157.

^bThis sequence is the reverse-complement of the selected primer.

TABLE 47
Strategy for the selection of *Streptococcus agalactiae*-specific
hybridization probes from tuf sequences.

	401	431 433	470	SEQ ID NO.:	Accession #:
<i>S. acidominimus</i>	GGTACTGT TaaAGTCAAT GACGAAAGTIG AAATCGTIGG TATCAAAGAC GAAActctca AAGCAGTTGT TA				
<i>S. agalactiae</i>	GGTACTGT TCGTGTCAAC GACGAAAGTIG AAATCGTIGG TATCAAAGAC GAAActccaa AAGCAGTTGT TA	206			
<i>S. agalactiae</i>	GGTACTGT TCGTGTCAAC GACGAAAGTIG AAATCGTIGG TATCAAAGAC GAAActccaa AAGCAGTTGT TA	209			
<i>S. agalactiae</i>	GGTACTGT TCGTGTCAAC GACGAAAGTIG AAATCGTIGG TATCAAAGAC GAAActccaa AAGCAGTTGT TA	2397			
<i>S. agalactiae</i>	GGTACTGT TCGTGTCAAC GACGAAAGTIG AAATCGTIGG TATCAAAGAC GAAActccaa AAGCAGTTGT TA	207			
<i>S. agalactiae</i>	GGTACTGT TCGTGTCAAC GACGAAAGTIG AAATCGTIGG TATCAAAGAC GAAActccaa AAGCAGTTGT TA	210			
<i>S. agalactiae</i>	GGTACTGT TCGTGTCAAC GACGAAAGTIG AAATCGTIGG TATCAAAGAC GAAActccaa AAGCAGTTGT TA	208			
<i>S. anginosus</i>	GGTACTGT TaaAGTCAAC GACGAAAGTIG AAATCGTIGG TATCcgGAT GAAatCCAA AAGCAGTTGT TA	211			
<i>S. anginosus</i>	GGTACTGT TaaAGTCAAC GATGAAAGTIG AAATCGTIGG TATCcgGAG GAAatCCAA AAGCAGTTGT TA	221			
<i>S. bovis</i>	GGTACTGT TaaAGTCAAC GACGAAAGTIG AAATCGTIGG TATCcgGAC GACAtCCAA AAGCAGTTGT TA	212			
<i>S. anginosus</i>	GGTACTGT TaaAGTCAAT GATGAAAGTIG AAATCGTIGG TATCcgGAC GAAatCCAA AAGCAGTTGT TA	213			
<i>S. cricetus</i>	GGTACTGT TaaggTCAAT GACGAAAGTIG AAATCGTIGG TATCAAAGAC GAAatCCAA AAGCAGTTGT TA	214			
<i>S. cristatus</i>	GGTACTGT TCGTGTCAAC GATGAAAATG AAATCGTIGG TATCAAAGAC GAAatCCAA AAGCAGTTGT TA	215			
<i>S. downsi</i>	GGTACTGT TaaAGTCAAC GACGAAAGTIG AAATCGTIGG TATCAAAGAC GAAatCCAA AAGCAGTTGT TA	216			
<i>S. dysgalactiae</i>	GGTACTGT TCGTGTCAAC GACGAAAATG AAATCGTIGG TATCAAAGAC GAAataaa AAGCAGTTGT TA	217			
<i>S. equi equi</i>	GGTACTGT TCGTGTCAAT GACGAAAATG AAATCGTIGG TATCAAAGAC GAGATCCAA AAGCAGTTGT TA	218			
<i>S. ferus</i>	GGTACTGT aAGAGTCAAC GATGAAAGTIG AAATCGTIGG TATCAAAGAC GAAActccaa AAGCAGTTGT TA	219			
<i>S. gordoni</i>	GGTACTGT TaaAGTCAAT GACGAAAATG AAATCGTIGG TATCAAAGAC GAAatCCAA AAGCAGTTGT TA	220			
<i>S. macacae</i>	GGTACTGT TaaggTCAAT GATGAAAGTIG AAATCGTIGG TATCcgGAC GATAtCCAA AAGCAGTTGT TA	222			
<i>S. gordoni</i>	GGTACTGT TaaAGTCAAC GACGAAAATG AAATCGTIGG TATCAAAGAC GAAActccaa AAGCAGTTGT TA	223			
<i>S. mutans</i>	GGTACTGT TaaAGTCAAC GATGAAAGTIG AAATCGTIGG TATCcgGAT GACAtCCAA AAGCAGTTGT TA	224			
<i>S. oralis</i>	GGTACTGT TCGTGTCAAC GACGAAAATG AAATCGTIGG TATCAAAGAC GAAActccaa AAGCAGTTGT TA	2398			P33170
<i>S. parasanguinis</i>	GGTgt-TGT TCGTGTCAAT GATGAAAATG AAATCGTIGG TATCAAAGAC GAAatCCAA AAGCAGTTGT TA	225			
<i>S. pneumoniae</i>	GGTAtcGT TaaAGTCAAC GACGAAAATG AAATCGTIGG TATCAAAGAC GAAActccaa AAGCAGTTGT TA	2399			

TABLE 47 - continued
Strategy for the selection of *Streptococcus agalactiae*-specific hybridization probes from tuf sequences.

		SEQ ID NO.:	Accession #:
	401	431 433	470
<i>S. pyogenes</i>	GGTACTGT TCGTGTCAAC GACGAAATCG AAATCGTTGG TATCAAAGAA GAAAtAAA AAGCAGTTGT TA	2400	Genome project
<i>S. ratti</i>	GGTACTGT TaaAGTCAAAT GACGAAAGTTG AAATCGTTGG TATccgtGAT GACATCCAAA AAGCAGTTGT TA	226	
<i>S. salivarius</i>	GGTgtTGT TCGTGTCAAT GACGAAAGTTG AAATCGTTGG TCTTAAGAA GACATCCAAA AAGCAGTTGT TA	2401	
<i>S. sanguinis</i>	GGTAtcGT TaaAGTCAAAC GACGAAATcg AAATCGTTGG TATCAAAGAA GAAAtCCAAA AAGCAGTTGT TA	227	
<i>S. sobrinus</i>	GGTACTGT TaagGTtAAC GACGAAAGTTG AAATCGTTGG TATccgtGAC GATAccGAA AAGCAGTTGT TA	228	
<i>S. suis</i>	GGTACTGT TCGTGTCAAC GACGAAATcg AAATCGTTGG TCTTCAGAA GAAAtatctA AAGCAGTTGT TA	229	
<i>S. uberis</i>	GGTACTGT TCGTGTCAAC GACGAAAtTG AAATCGTTGG TATCAAAGAA GAAAtAAA AAGCAGTTGT TA	230	
<i>S. vestibularis</i>	GGTgtTGT TCGTGTAAAT GACGAAAGTTG AAATCGTTGG TCTTAAGAA GAAAtCCAAA AAGCAGTTGT TA	231	
Selected sequences for species-specific hybridization probes ^b	ACTGT TCGTGTCAAC GACGAAAGTTG AAA CGTTGG TATCAAAGAA GATAccAAA AAGCAGTTG	582	
		583	

The sequence numbering refers to the *Streptococcus agalactiae* tuf gene fragment (SEQ ID NO. 209). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed. These sequences are the reverse-complement of the selected probes.

US 8,182,996 B2

245

246

TABLE 4.8
Strategy for the selection of *Streptococcus agalactiae*-amplification primers from atbp sequences

Strategy for the selection of <i>Streptococcus agalactiae</i> -specific amplification primers from atpD sequences.						
						SEQ ID NO.:
39	TT GATTGTCTAT AAAATGGCG ATAAGTACA AAAAGTAGTA...TAAGATA CTTGGGTG TGTCCTAAC GTTC . . CTT ATTAGCCT TACTTAAG GTGTTAAAG	80	203	234	368	399
S. agalactiae	TT GATTGTCTAT AAAATGGCG ATAAGTACA AAAAGTAGTA...TAAGATA CTTGGGTG TGTCCTAAC GTTC . . CTT ATTAGCCT TACTTAAG GTGTTAAAG					380
S. agalactiae	TT GATTGTCTAT AAAATGGCG ATAAGTACA AAAAGTAGTA...TAAGATA CTTGGGTG TGTCCTAAC GTTC . . CTT ATTAGCCT TACTTAAG GTGTTAAAG					379
S. agalactiae	TT GATTGTCTAT AAAATGGCG ATAAGTACA AAAAGTAGTA...TAAGATA CTTGGGTG TGTCCTAAC GTTC . . CTT ATTAGCCT TACTTAAG GTGTTAAAG					381
S. agalactiae	TT GATTGTCTAT AAAATGGCG ATAAGTACA AAAAGTAGTA...TAAGATA CTTGGGTG TGTCCTAAC GTTC . . CTT ATTAGCCT TACTTAAG GTGTTAAAG					382
S. agalactiae	TT GATTGTCTAT AAAATGGCG ATAAGTACA AAAAGTAGTA...TAAGATA CTTGGGTG TGTCCTAAC GTTC . . CTT ATTAGCCT TACTTAAG GTGTTAAAG					383
S. Bovis	TT GATTGTCTAT AAAATGGCG ATAAGTCTCA AAAATGTG...TAAAGAAA CTTGGGTG TGTTAAAT GTT...CCT tcTTGCCCT TACCTAAAG GTGTTAAAG					2402
S. salivarius	TT GgtCGTTTAN Act9ATCTAA AcgtatGTG...TAAAGATA CctTGGacG TGTCCTAAC GTTC . . CTT gTAGCCCT TACCTAAG GTGTTAAAG					387
S. pneumoniae	cT tgTcGTCTAC AAAAATGACG AAAGaaAAC AAAAATGTC...TAAAGAAA CTTGGacG TGTCCTAAC GTTT . . CcT tcTTGCCCT TACCTAAAG GTGTTAAAG					2403
S. pyogenes	TT GATTGTCTAT AAAATGCTG ATAaaaAGCA AAAAATGTC...TAAAGAAA CTTGGacG CGTCTTTAAT GTaC . . CcT tcTTGCCCT TACCTAAAG GTGTTAAAG					2404
S. anginosus	cT tgTgGTCTAT AAAATGACG AAAttaaAtC AAAAATGTC...TAAAGAAA CactTGGTG CGTCTTTAAC GTTT . . CcT ttTAGCCCT TACCTAAAG GTGGAAG					386
S. sanguinis	cT tgTgGTCTAT AAAAATGATG AgAAAaaAtC AAAAATGTC...AAAGAAA CTTcTagGccG GGTTTCAAAT GTTT . . CcT gTAGCCCT TatctGAAAG GTGGAAG					2405
S. mutans	TT GgtCGTTTAT AAAATGGCG AcaAGTCTCA AAGAATGTT...AAAAGAAA CactAGGTG TGTCCTAAC GTT...CCT tcTTGCCCT TACCTAAAG GTGTTAAAG					2406
B. anthracis	9T aaacacagac AACGaaaaACg gaAcaagcat taACTTAacA...TGATGcaa cactTGGacG TGTTAAAC GTat . . CTT ActTtGCTCT TACATTAAG GTGTTAAAG					247
B. cereus	9T aaacaaacg AACGaaaaACg 9...aagcat gAAact TAACa...TGATGcaa CactTGGacG TGTTAAAC GTat . . CTT ActTtGCTCT TACATTAAG GTGTTAAAG					248
E. faecium	TT agTTGTCTAT AAAATGACG AAAttaaAtC AAAAGttGTT...TAAAGAAA CATTAGGTG CGTCTTTAAC GTaC . . ttt gCTTGCCCA TATTAAAG GTGGAAG					292
E. gallinarum	TT GATCGTTTAC AAAAAGACG AGAAAaaAAC AAAAGTAGTA...AcAGATA CTcTagGccG agTttTTAAAT GTaC . . ttt ATTAGCCTCT TACTTTAAAG GTGTTAAAG					293
E. faecalis	TT agTCGTCTAT AAAATGGCG AgggaaaAC AAAAGTAGTA...TAAAGATA CATTAGGTG TGTTTTAAC GTTT . . CTT ATTAGCCT TACCTAAAG GTGTTAAAG					291
E. coli	Ta cgtAGtGcttT gAggtcgaaa ATggtaatGA gctgtcggtg...TAAAGCGA CTCTGGGGCG TATCATGAA GTaC . . CCT gATgtgtccG TtcgttAAG GccGTTAAAG					2407
L. monocytogenes	Ta tAAatctgtAT gGAGAAGAG caccaactAG ccAAActtact...TACAGTAA CTCTGGTG TGTTTTAAAT GTat . . CTT gCTAGCCCT TACTTTAAAG GTGTTAAAG					324
S. aureus	9T tATTGatgtg cctAAAGaaG AggttacaAt AcAACTAAC...TGATGAA CATTAGGTG TGTTTTAAAT GTatTTAAAG GTGTTAAAG					366
S. epidermidis	ca cATcGaagt cctAAAGaaG ATggagcgt tcAAATTAacA...TGAcGtAA CTcTagGaaG aGtGTTTAAAC GTaC . . CTT ATTAGCCT TACATTAAG GTGTTAAAG					370
Selected sequences for species-specific primers	ATTCGCTAT AAAATGGCG ATAAGTCACA AAAAGTA					627
	AAAATGGCG ATAAGTCACA AAAAGTA					628

TABLE 48 - continued

Strategy for the selection of <i>Streptococcus agalactiae</i> -specific amplification primers from atpD sequences.						
Selected sequences for species-specific primers ^a	80	203	234	368	399	SEQ ID NO.:
	GGATA CTTTGGTCG TGTCTAAC G			ATTAGCACCT TACTTAAG GTGGTA		625 626

The sequence numbering refers to the *Streptococcus agalactiae* tuf gene fragment (SEQ ID NO. 380). Nucleotides in capitals are identical to the selected sequences or match those sequences.

^aMismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

^bThese sequences were obtained from Genbank and have accession #: a = AB009314, d = AF001955, e = U31170, and f = V00311.

^cThese sequences were obtained from genome sequencing projects.

^dThese sequences are the reverse complement of the selected primers.

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249

250

TABLE 49

Strategy for the selection of *Candida albicans/dubliniensis*-specific amplification primers, *Candida albicans*-specific hybridization probe and *Candida dubliniensis*-specific hybridization probe from tuf sequences.

	SEQ NO.	SEQ ID	Accession #:
C. albicans	337	368	403
C. albicans		428	460
C. albicans		491	
C. dubliniensis			
C. dubliniensis			
C. glabrata			
C. guilliermondii			
C. kefyr			
C. krusei			
C. lusitaniae			
C. neoformans			
C. parapsilosis			
C. tropicalis			
A. fumigatus			
Human			X03558
P. anomala			
S. cerevisiae			
S. pombe			U42189
Selected sequence for species-specific	C	AGAAAGGTG GTTACAACCC AACGAGCG... TAAAGATGA TTGAAAGCCAC CACCAACA... AAGGCTGGT tcGTCAGGG TAAGACCTTT T	2409

251

252

TABLE 49-continued

amplification primer ^a	SEQ ID No.: 337	SEQ ID No.: 368	SEQ ID No.: 403	SEQ ID No.: 428	SEQ ID No.: 460	SEQ ID No.: 491	Accession #: 577
Selected sequence for species-specific amplification primer^{a,b}							
Selected sequences for species-specific hybridization probes							
ATCCGGTA AAGTTACTGG TAAGACCT							
CATGA TTGAACCATT CACCA (C. albicans)							
CATGA TTGAAGTTC CACCA (C. dubliniensis)							

The sequence numbering refers to the *Candida albicans* tuf gene fragment (SEQ ID NO. 408). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches for SEQ ID NO. 577 are indicated by lower case letters. Dots indicate gaps in the sequences displayed. "R" "W" "M" "K" "Y" and "S" designate nucleotide positions which are degenerate. "R" stands for C or T; "W" stands for A or G; "Y" stands for C or T; "M" stands for A or C; "K" stands for G or T; "W" stands for A or T; "S" stands for C or G. "N" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

^aC. albicans primers have been described in a previous patent (publication WO2008/20157, SEQ ID NO. 11-12).

^bThis sequence is the reverse-complement of the selected primer.

TABLE 50

Strategy for the selection of *Staphylococcus*-specific amplification primers from tuf sequences.

	310	340	652	682	SEQ ID NO.:	Accession #:
<i>S. aureus</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...CACTTACCA GAAGGTACTG AAATCGTAAT GC				179	-
<i>S. aureus</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...CACTTACCA GAAGGTACTG AAATCGTAAT GC				176	-
<i>S. aureus</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...CACTTACCA GAAGGTACTG AAATCGTAAT GC				177	-
<i>S. aureus aureus</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...CACTTACCA GAAGGTACTG AAATCGTAAT GC				180	-
<i>S. auricularis</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...CACTTACCA GAAGGTACTG AAATCGTAAT GC				181	-
<i>S. capitis capitis</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...CACTTACCA GAAGGTACTG AAATCGTTAT GC				182	-
<i>M. caseolyticus</i>	A CTGGACGTG TGAGCCTGGA CAAGTTAAAG...AACTTACCA GAAGGTACTG AAATCGTAAT GC				183	-
<i>S. cohnii</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				184	-
<i>S. epidermidis</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				185	-
<i>S. epidermidis</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				141 ^a	-
<i>S. haemolyticus</i>	A CAGGCCGTG TGAAACGTGGG CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				186	-
<i>S. haemolyticus</i>	A CAGGTCTGT TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				188	-
<i>S. haemolyticus</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				189	-
<i>S. hominis hominis</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTAAT GC				191	-
<i>S. hominis</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTAAT GC				193	-
<i>S. hominis</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTAAT GC				194	-
<i>S. hominis</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				195	-
<i>S. hominis</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTAAT GC				196	-
<i>S. lugdunensis</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				197	-
<i>S. saprophyticus</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				198	-
<i>S. saprophyticus</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				199	-
<i>S. saprophyticus</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				200	-
<i>S. sciuri sciuri</i>	A CAGGCCGTG TGAAACGTGGT CAATCAAAAG...AACTTACCA GAAGGTACTG AAATCGTTAT GC				201	-

TABLE 50 - continued
Strategy for the selection of *Staphylococcus*-specific amplification primers from tuf sequences.

		SEQ ID NO.:	Accession #:
	310	340 652	682
<i>S. warneri</i>	A CAGGCCGTGT TGAAACGTGGT CAATCAAG... CAATTACCA GAAGGTACTG ~~~~~~ ~~~~~~	187	—
<i>S. warneri</i>	A CAGGCCGTGT TGAAACGTGGT CAATCAAG... ~~~~~~ ~~~~~~ ~~~~~~	192	—
<i>S. warneri</i>	A CAGGCCGTGT TGAAACGTGGT CAATCAAG... CAATTACCA GAAGGTACTG AAATGGTTAT GC	202	—
<i>B. subtilis</i>	A CTGGCCGTGT agAACGcgGA CAAGTTAAAG... CAatCTtCCA GAAGGcgTAG AAATGGTTAT GC	2410	Z99104
<i>E. coli</i>	A CGGTCTGTGt agAACGcgGT atCATCAAG... GAAactgCCG GAAGGcgTAG AgATGGTAAT GC	78	—
<i>L. monocytogenes</i>	A CTGGacGTGT TGAAACGTGGa CAAGTTAAAG... AcacttCCA GAAGGTACTG AAATGGTAAY GC	2411	—
Selected sequence for genus-specific primer	GCCCCGTGT TGAAACGTGGT CAATCA	553	
Selected sequences for genus-specific primers ^b	TTACCA GAAGGTACTG AAATGGTIA TTACCA GAAGGTACTG AAATGGTWA	575 707	

Selected sequence
for genus-specific primer
Selected sequences
for genus-specific primers^b

The sequence numbering refers to the *Staphylococcus aureus* tuf gene fragment (SEQ ID NO. 179). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. “~” indicate incomplete sequence data. Dots indicate gaps in the sequences displayed.
^bIf “W” stands for A or T; “S” stands for C or G; “R” stands for A or C; “K” stands for G or T; “Y” stands for C or T; “M” stands for A or G; “N” stands for C or G, “U” stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T. These sequences are the reverse complement of the selected primers.

TABLE 51

Strategy for the selection of the <i>Staphylococcus</i> -specific hybridization probe from tuf sequences.				
	400	425	SEQ ID NO.:	Accession #:
<i>S. aureus</i>	G TTGAAATGTT CCGTAAATTAA TTAGA		179	—
<i>S. aureus</i>	G TTGAAATGTT CCGTAAATTAA TTAGA		176	—
<i>S. aureus</i>	G TTGAAATGTT CCGTAAATTAA TTAGA		177	—
<i>S. aureus</i>	G TTGAAATGTT CCGTAAATTAA TTAGA		178	—
<i>S. aureus aureus</i>	G TTGAAATGTT CCGTAAATTAA TTAGA		180	—
<i>S. auricularis</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		181	—
<i>S. capitnis capitnis</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		182	—
<i>M. caseolyticus</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		183	—
<i>S. cohnii</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		184	—
<i>S. epidermidis</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		185	—
<i>S. haemolyticus</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		186	—
<i>S. haemolyticus</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		189	—
<i>S. haemolyticus</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		190	—
<i>S. haemolyticus</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		188	—
<i>S. hominis</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		196	—
<i>S. hominis</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		194	—
<i>S. hominis hominis</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		191	—
<i>S. hominis</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		193	—
<i>S. hominis</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		195	—
<i>S. lugdunensis</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		197	—
<i>S. saprophyticus</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		198	—
<i>S. saprophyticus</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		200	—
<i>S. saprophyticus</i>	G TAGAAATGTT CCGTAAATTAA TTAGA		199	—
<i>S. sciuri sciuri</i>	G TTGAAATGTT CCGTAAATTAA TTAGA		201	—
<i>S. warneri</i>	G TAGAAATGTT CCGTAAGTTA TTAGA		187	—
<i>S. warneri</i>	G TAGAAATGTT CCGTAAGTTA TTAGA		192	—
<i>S. warneri</i>	G TAGAAATGTT CCGTAAGTTA TTAGA		202	—
<i>S. warneri</i>	G TAGAAATGTT CCGTAAGTTA TTAGA		203	—
<i>B. subtilis</i>	G TTGAAATGTT CCGTAAGcTt cTTGA		2412	Z99104
<i>E. coli</i>	G TTGAAATGTT CCGcAAAcTg cTGGA		78	—
<i>L. monocytogenes</i>	G TAGAAATGTT CCGTAAATTAA cTAGA		2413	—
Selected sequence for genus-specific hybridization probe	GAAATGTT CCGTAAATTAA TT		605	

The sequence numbering refers to the *Staphylococcus aureus* tuf gene fragment (SEQ ID NO. 179). Nucleotides in capitals are identical to the selected sequence or match that sequence. Mismatches are indicated by lower-case letters.

TABLE 52

Strategy for the selection of *Staphylococcus saprophyticus*-specific and of *Staphylococcus haemolyticus*-specific hybridization probes from tuf sequences.

		SEQ ID NO.:
	339	383
<i>S. aureus</i>	AG TtGGTGAAGA AgTtGAAATC ATcGGTtTaC ATGACACaTC TAA	179
<i>S. aureus</i>	AG TtGGTGAAGA AgTtGAAATC ATeGGTtTaC ATGACACaTC TAA	176
<i>S. aureus</i>	AG TtGGTGAAGA AgTtGAAATC ATeGGTtTaC ATGACACaTC TAA	177
<i>S. aureus</i>	AG TtGGTGAAGA AgTtGAAATC ATeGGTtTaC ATGACACaTC TAA	178
<i>S. aureus aureus</i>	AG TtGGTGAAGA AgTtGAAATC ATcGGTtTaC ATGACACaTC TAA	180
<i>S. auricularis</i>	AG TCGGTGAAGA AgTtGAAATC ATcGGTATgA AaGACggTTC AAA	181
<i>S. capitis capitis</i>	AG TtGGTGAAGA AgTtGAAATC ATcGGTATCC AcGAAACTTC TAA	182
<i>M. caseolyticus</i>	AG TtGGTGAAGA AgTtGAAATC ATTGGTtTaC cTGAagaacC AAA	183
<i>S. cohnii</i>	AG TCGGTGAAGA AgTtGAAATC ATcGGTATgC AaGAagaTTC CAA	184
<i>S. epidermidis</i>	AG TtGGTGAAGA AgTtGAAATC ATcGGTATgC AcGAAACTTC TAA	185
<i>S. haemolyticus</i>	AG TtGGTGAAGA AgTtGAAATC ATTGGTATCC ATGACACTTC TAA	186
<i>S. haemolyticus</i>	AG TtGGTGAAGA AgTtGAAATC ATTGGTATCC ATGACACTTC TAA	189
<i>S. haemolyticus</i>	AG TtGGTGAAGA AgTtGAAATC ATTGGTATCC ATGACACTTC TAA	190
<i>S. haemolyticus</i>	AG TtGGTGAAGA AgTtGAAATT ATTGGTATCa AaGAAACTTC TAA	188
<i>S. hominis</i>	AG TtGGTGAAGA AgTtGAAATT ATTGGTATCa AaGAAACTTC TAA	194
<i>S. hominis hominis</i>	AG TtGGTGAAGA AgTtGAAATT ATTGGTATCa AaGAAACTTC TAA	191
<i>S. hominis</i>	AG TtGGTGAAGA AgTtGAAATT ATTGGTATCa AaGAAACTTC TAA	193
<i>S. hominis</i>	AG TtGGTGAAGA AgTtGAAATT ATTGGTATCa AaGAAACTTC TAA	195
<i>S. hominis</i>	AG TtGGTGAAGA AgTtGAAATT ATTGGTATCa AaGAtACTTC TAA	196
<i>S. lugdunensis</i>	AG TCGGTGAAGA AgTtGAAATT ATTGGTATCC AcGAtACTaC TAA	197
<i>S. saprophyticus</i>	AG TCGGTGAAGA AATCGAAATC ATcGGTATgC AaGAagaaTC CAA	198
<i>S. saprophyticus</i>	AG TCGGTGAAGA AATCGAAATC ATcGGTATgC AaGAagaaTC CAA	200
<i>S. saprophyticus</i>	AG TCGGTGAAGA AATCGAAATC ATcGGTATgC AaGAagaaTC CAA	199
<i>S. sciuri sciuri</i>	TG TtGGTGAAGA AgTtGAAATC ATcGGTtTaC cTGAagaaTC TAA	201
<i>S. warneri</i>	AG TtGGTGAAGA AgTtGAAATC ATcGGTtTaC ATGACACTTC TAA	187
<i>S. warneri</i>	AG TtGGTGAAGA AgTtGAAATC ATeGGTtTaC ATGACACTTC TAA	192
<i>S. warneri</i>	AG TtGGTGAAGA AgTtGAAATC ATcGGTtTaC ATGACACTTC TAA	202
<i>S. warneri</i>	AG TtGGTGAAGA AgTtGAAATC ATcGGTtTaC ATGACACTTC TAA	203
<i>B. subtilis</i>	AG TCGGTGAcGA AgTtGAAATC ATcGGTcTtC AaGAagagag AAA	2414 ^a
<i>E. coli</i>	AG TtGGTGAAGA AgTtGAAATC gTTGGTATCa AaGAgACTca GAA	78
<i>L. monocytogenes</i>	AG TtGGTGAAGA AgTaGAAgTt ATcGGTATCg AaGAagaaag AAA	2415
Selected sequences for CGGTGAAGA AATCGAAATC A (<i>S. saprophyticus</i>) species-specific (<i>S. haemolyticus</i>) ATTGGTATCC ATGACACTTC hybridization probes		599 594

The sequence numbering refers to the *Staphylococcus aureus* tuf gene fragment (SEQ ID NO. 179). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters.

^aThis sequence was obtained from Genbank accession #Z99104.

TABLE 53

Strategy for the selection of *Staphylococcus aureus*-specific and of *Staphylococcus epidermidis*-specific hybridization probes from tuf sequences.

	521	547	592	617	SEQ ID NO.:
<i>S. aureus</i>	TACACCACA TACTGAATTCA AAAGCAG...TTCTTCTCa AACTATCGtC CACAATT				179
<i>S. aureus</i>	TACACCACA TACTGAATTCA AAAGCAG...TTCTTCTC~ ~~~~~ ~~~~				178
<i>S. aureus</i>	TACACCACA TACTGAATTCA AAAGCAG...TTCTTCTCa AACTATCGtC CACAATT				176
<i>S. aureus</i>	TACACCACA TACTGAATTCA AAAGCAG...TTCTTCTCa AACTATCGtC CACAATT				177
<i>S. aureus aureus</i>	TACACCACA TACTGAATTCA AAAGCAG...TTCTTCTCa AACTATCGtC CACAATT				180
<i>S. auricularis</i>	TACACCACA cACTaAATTCA ActGCAG...TTCTTCTCT AACTAcCGtC CACAATT				181
<i>S. capitis capitnis</i>	CACACCACA cACTaAATTCA AAAGCGG...TTCTTCAGt AACTAcCGCC CACAATT				182
<i>M. caseolyticus</i>	TACTCCACA TACTaAATTCA AAAGCTG...TTCTTCACT AACTAcCGCC CtCAGTT				183
<i>S. cohnii</i>	TACACCACA cACaaAcTTt AAAGCGG...TTCTTCAGt AACTATGCC CACAATT				184
<i>S. epidermidis</i>	TACACCACA cACaaAATTCA AAAGCTG...TTCTTCACT AACTATGCC CACAATT				185
<i>S. haemolyticus</i>	CACACCtCA cACaaAATTt AAAGCAG...TTCTTCACa AACTATCGtC CACAATT				186
<i>S. haemolyticus</i>	CACACCtCA cACaaAATTt AAAGCAG...TTCTTCACa AACTATCGtC CACAATT				189
<i>S. haemolyticus</i>	CACACCtCA cACaaAATTt AAAGCAG...TTCTTCACa AACTATCGtC CACAATT				190
<i>S. haemolyticus</i>	TACACCtCA cACaaAATTCA AAAGCAG...TTCTTCACt AACTATCGtC CACAATT				188
<i>S. hominis</i>	CACACCtCA cACaaAATTCA AAAGCAG...TTCTTCACt AACTATCGtC CACAATT				195
<i>S. hominis</i>	TACACCtCA cACaaAATTCA AAAGCAG...TTCTTCACt AACTATCGtC CACAATT				196
<i>S. hominis hominis</i>	TACACCtCA cACaaAATTCA AAAGCAG...TTCTTCTCT AACTATCGtC CACAATT				191
<i>S. hominis</i>	TACACCtCA cACaaAATTCA AAAGCAG...TTCTTCTCT AACTATCGtC CACAATT				193
<i>S. hominis</i>	TACACCtCA cACaaAATTCA AAAGCAG...TTCTTCTCT AACTATCGtC CACAATT				194
<i>S. lugdunensis</i>	TACACCtCA cACTaAATTt AAAGCTG...TTCTTCTCa AACTAcCGCC CACAATT				197
<i>S. saprophyticus</i>	TACACCACA TACaaAATTCA AAAGCGG...TTCTTCACt AACTAcCGCC CACAATT				198
<i>S. saprophyticus</i>	TACACCACA TACaaAATTCA AAAGCGG...TTCTTCACt AACTAcCGCC CACAATT				199
<i>S. saprophyticus</i>	TACACCACA TACaaAATTCA AAAGCGG...TTCTTCACt AACTAcCGCC CACAATT				200
<i>S. sciuri sciuri</i>	CACACCtCA cACTaAATTCA AAAGCTG...TTCTTCACa AACTAcCGCC CACAATT				201
<i>S. warneri</i>	TACACCACA TACaaAATTCA AAAGCGG...~~~~~ ~~~~~ ~~~~				192
<i>S. warneri</i>	TACACCACA TACaaAATTCA AAAGCGG...TTCTTCAGt AACTAcCGCC CACAATT				187
<i>S. warneri</i>	TACACCACA TACaaAATTCA AAAGCGG...TTCTTCAGt AACTAcCGCC CACAATT				202
<i>S. warneri</i>	TACACCACA TACaaAATTCA AAAGCGG...TTCTTCAGt AACTAcCGCC CACAATT				203
<i>B. subtilis</i>	CACtCCACA cAgCaAATTCA AAAGCTG...TTCTTCTCT AACTAcCGtC CtCAGTT				2416
<i>E. coli</i>	CAAGCCgCA cACcaAgTTC gAAatCTG...TTCTTChaa ggCTAcCGtC CgCAGTT				78
<i>L. monocytogenes</i>	TACTCCACA cACTaAcTTC AAAGCTG...TTCTTCACt AACTAcCGCC CACAATT				2417
Selected sequences for species-specific hybridization probes	ACCACA TACTGAATTCA AAAG (<i>S. aureus</i>) (<i>S. epidermidis</i>) TTCACT AACTATGCC CACA				585 593

The sequence numbering refers to the *Staphylococcus aureus* tuf gene fragment (SEQ ID NO. 179). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. "—" indicate incomplete sequence data. Dots indicate gaps in the sequences displayed.

*This sequence was obtained from Genbank accession #Z99104.

TABLE 54

Strategy for the selection of the *Staphylococcus hominis*-specific hybridization probe from tuf sequences.

	358	383	SEQ ID NO.:
<i>S. aureus</i>	ATC ATcGGTtTac AtGAcACaTC TAA		179
<i>S. aureus</i>	ATC ATcGGTtTac AtGAcACaTC TAA		176
<i>S. aureus</i>	ATC ATcGGTtTac AtGAcACaTC TAA		177
<i>S. aureus</i>	ATC ATcGGTtTac AtGAcACaTC TAA		178
<i>S. aureus aureus</i>	ATC ATcGGTtTac AtGAcACaTC TAA		180
<i>S. auricularis</i>	ATC ATcGGTATgA AAGACggTTC AAA		181
<i>S. capititis capititis</i>	ATC ATcGGTATCc AcGAAACTTC TAA		182
<i>M. caseolyticus</i>	ATC ATTGGTtTaA ctGAAGaacC AAA		183
<i>S. cohnii</i>	ATC ATcGGTATgc AAGAAgaTTC CAA		184
<i>S. epidermidis</i>	ATC ATcGGTATgc AcGAAACTTC TAA		185
<i>S. haemolyticus</i>	ATC ATTGGTATCc AtGAcACTTC TAA		186
<i>S. haemolyticus</i>	ATC ATTGGTATCc AtGAcACTTC TAA		189
<i>S. haemolyticus</i>	ATC ATTGGTATCc AtGAcACTTC TAA		190
<i>S. haemolyticus</i>	ATT ATTGGTATCA AAGAAACTTC TAA		188
<i>S. hominis</i>	ATT ATTGGTATCA AAGAtACTTC TAA		196
<i>S. hominis</i>	ATT ATTGGTATCA AAGAAACTTC TAA		194
<i>S. hominis hominis</i>	ATT ATTGGTATCA AAGAAACTTC TAA		191
<i>S. hominis</i>	ATT ATTGGTATCA AAGAAACTTC TAA		193
<i>S. hominis</i>	ATT ATTGGTATCA AAGAAACTTC TAA		195
<i>S. lugdunensis</i>	ATT ATTGGTATCc AcGAtACTaC TAA		197
<i>S. saprophyticus</i>	ATC ATcGGTATgc AAGAAgaaTC CAA		198
<i>S. saprophyticus</i>	ATC ATcGGTATgc AAGAAgaaTC CAA		200
<i>S. saprophyticus</i>	ATC ATcGGTATgc AAGAAgaaTC CAA		199
<i>S. sciuri sciuri</i>	ATC ATcGGTtTaA ctGAAGaaTC TAA		201
<i>S. warneri</i>	ATC ATcGGTtTac AtGAcACTTC TAA		187
<i>S. warneri</i>	ATC ATcGGTtTac AtGAcACTTC TAA		192
<i>S. warneri</i>	ATC ATcGGTtTac AtGAcACTTC TAA		202
<i>S. warneri</i>	ATC ATcGGTtTac AtGAcACTTC TAA		203
<i>B. subtilis</i>	ATC ATcGGTcTtc AAGAAgagag AAA		2418 ^a
<i>E. coli</i>	ATC gTTGGTATCA AAGAgACTca GAA		78
<i>L. monocytogenes</i>	GTT ATcGGTATCg AAGAAgaaag AAA		2419
Selected sequence for species-specific hybridization probe	ATTGGTATCA AAGAAACTTC		597

The sequence numbering refers to the *Staphylococcus aureus* tuf gene fragment (SEQ ID NO. 179). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

^aThis sequence was obtained from Genbank accession #Z99104.

TABLE 55

Strategy for the selection of the <i>Enterococcus</i> -specific amplification primers from tuf sequences.					SEQ ID NO.:	Accession #:
	270	298	556	582		
<i>E. avium</i>	TAGAATTAAT GGCTGCTGTT GACGAATAT...TGAA GATATCCAAC GTGGACAAGT ATT				2420	—
<i>E. casseliflavus</i>	TGGAATTAAT GGCTGCAGTT GACGAATAC...TGAA GACATCCAAC GTGGACAAGT ATT				58	—
<i>E. cecorum</i>	TAGAATTAAT GGCTGCAGTT GACGAATAC...TGAA GATATCCAAC GTGGtCAAGT ATT				59	—
<i>E. dispar</i>	TAGAATTAAT GGCTGCAGTT GACGAATAT...TGAA GATATCCAAC GTGGtCAAGT ATT				60	—
<i>E. durans</i>	TTGAATTAAT GGCTGCAGTT GACGAATAT...TGAA GACATCCAAC GTGGACAAGT TTT				61	—
<i>E. flavescentis</i>	TGGAATTAAT GGCTGCAGTT GACGAATAC...TGAA GACATCCAAC GTGGACAAGT ATT				65	—
<i>E. faecium</i>	TTGAATTAAT GGCTGCAGTT GACGAATAC...TGAA GACATCCAAC GTGGACAAGT TTT				608	—
<i>E. faecalis</i>	TAGAATTAAT GGCTGCAGTT GACGAATAT...TGAA GATATCGAAC GTGGACAAGT ATT				607	—
<i>E. gallinarum</i>	TGGAATTgAT GGCTGCAGTT GACGAATAC...TGAA GACATCCAAC GTGGACAAGT ATT				609	—
<i>E. hirae</i>	TTGAATTgAT GGCTGCAGTT GACGAATAT...TGAA GACATCCAAC GTGGACAAGT TTT				67	—
<i>E. mundtii</i>	TTGAATTgAT GGCTGCAGTT GACGAATAT...TGAA GACATCCAAC GTGGtCAAGT TTT				68	—
<i>E. pseudoavium</i>	TAGAATTAAT GSCTGCTGTT GACGAATAC...TGAA GACATCCAAC GTGGACAAGT ATT				69	—
<i>E. raffinosus</i>	TAGAATTAAT GGCTGCTGTT GATGAATAC...TGAA GACATCCAAC GTGGACAAGT ATT				70	—
<i>E. saccharolyticus</i>	TCGAATTAAT GGCTGCAGTT GACGAATAT...TGAA GACATCCAAC GTGGACAAGT ATT				71	—
<i>E. solitarius</i>	TGGAATTAAT GGATGCAGTT GATGAcTAC...TGAt GATATCGAAC GTGGtCAAGT ATT				72	—
<i>E. coli</i>	TGGAAcTggc tGgcttcTg GATtctTAY...TGAA GAaATCGAAC GTGGtCAGGT ACT				78	—
<i>B. cepacia</i>	TGAgccTggc cGacGCgcTg GACacgTAC...TGAA GACgTgGAgC GTGGcCAGGT TCT				16	—
<i>B. fragilis</i>	TGGAAcTgAT GGaaGCTGTT GATActTGG...GAAC GAaATCaAAC GTGGtatgGT TCT				2421	M22247
<i>B. subtilis</i>	TCGAAcTtAT GGaTGCgGTT GATGAgTAC...TGAA GATATCCAAC GTGGtCAAGT ACT				2422	Z99104
<i>C. diphtheriae</i>	TCGAccTcAT GcagGCTtgc KATGAtTCC...CGAA GACgTtGAgC GTGGcCAGGT TGT				662	—
<i>C. trachomatis</i>	GAGAgcTAAT GcaaGCcGTc GATGAtAAT...GAAC GATgTgGAAa GaGGAatgGT TGT				22	—
<i>G. vaginalis</i>	AGGAAcTcAT GaagGCTGTT GACGAgTAC...TACc GACgTtGAgC GTGGtCAGGT TGT				2423	—
<i>S. aureus</i>	TAGAATTART GGaaGCTGta GATActTAC...TGAA GACgTaCAAAC GTGGtCAAGT ATT				179	—
<i>S. pneumoniae</i>	TGGAATTgAT GaacaCAGTT GATGAgTAT...TGAt GAaATCGAAC GTGGACAAGT TAT				2424	—
<i>A. adiacens</i>	TAGAATTAAT GGCTGCTGTT GACGAATAC...TGAA aACATCGAAC GTGGACAAGT TCT				2425	—
<i>G. haemolyans</i>	TCGAATTAAT GGaaaCAGTT GACGAATAC...TGAA GACATCGAAC GTGGACAAGT TTT				87	—
<i>G. morbillorum</i>	TCGAATTAAT GGaaaCAGTT GACGAgTAC...TGAA GATATCGAAC GTGGACAAGT TTT				88	—
Selected sequence for amplification primer	AATTAAT GGCTGCWGTT GAYGAA				1137	
Selected sequence for amplification primer ^b	A GAYATCSAAC GTGGACAAGT				1136	

The sequence numbering refers to the *Enterococcus durans* tuf gene fragment (SEQ ID NO. 61). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

"Y" "W" and "S" designate nucleotide positions which are degenerated. "Y" stands for C or T; "W" stands for A or T; "S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T. This sequence is the reverse-complement of the selected primer.

TABLE 56

Strategy for the selection of the *Enterococcus faecalis*-specific hybridization probe, of the *Enterococcus faecium*-specific hybridization probe and of the *Enterococcus casseliflavus-flavescens-gallinarum* group-specific hybridization probe from tuf sequences.

	395	448 . . . 526	549	SEQ ID NO.:	Accession #:
<i>E. avium</i>	GTTGA ACGTGacAA GTRGCGGTG GTGACGAAGT TGAAatCGTA GGATCGCT . . . CATC GGTGCTTGT TAGTGGTGT	2426	—		
<i>E. casseliflavus</i>	GTTGA ACGTGacAA GTRGCGGTG GTGACGAAGT TGAAatCGTT GGATATGCT . . . CATT GGTGCATTGC TAGTGGTGT	58	—		
<i>E. cecorum</i>	GTTGA ACGTGacAA GTAGCTGGTG GTGACGAAGT TGAAatAGTT GGATACAT . . . CATC GGTGCATTAT TAGTGGTGT	59	—		
<i>E. dispar</i>	GTTGA ACGTGacAA GTRGCGGTG GTGACGAAGT TGAAatCGTA GGATCGCT . . . CATT GGTGCATTAT TAGTGGTGT	60	—		
<i>E. durans</i>	GTTGA ACGTGacAA GTRGCGGTG GTGACGAAGT TGAAatCGTT GGATATGCT . . . CATT GGTGCATTAT TAGTGGTGT	61	—		
<i>E. faecalis</i>	GTTGA ACCTGGTGA ACGTGacAA GTRGCGGTG GTGACGAAGT TGAAatCGTA GGATCGTT GGATCGCA . . . CATT GGTGCTTAC TAGTGGTGT	62	—		
<i>E. faecium</i>	GTTGA ACCTGGTGA ACGTGacAA GTRGCGGTG GTGACGAAGT TGAAatCGTT GGATCGCT . . . CATT GGTGCTTAC TAGTGGTGT	608	—		
<i>E. flavescens</i>	GTTGA ACCTGGTGA ACGTGacAA GTRGCGGTG GTGACGAAGT TGAAatCGTT GGATATGCT . . . CATT GGTGCATTGC TAGTGGGT	65	—		
<i>E. gallinarum</i>	GTTGA ACCTGGTGA ACGTGacAA GTRGCGGTG GTGACGAAGT TGAAatCGTT GGATATGCT . . . CATT GGTGCATTAT TAGTGGTGT	609	—		
<i>E. hirae</i>	GTTGA ACCTGGTGA ACGTGacAA GTRGCGGTG GTGACCGTT AGATCGTT GGATCGCA . . . CATT GGTGCTTAC TAGTGGTGT	67	—		
<i>E. mundtii</i>	GTTGA ACCTGGTGA ACGTGacAA GTRGCGGTG GTGACCGTT AGATCGTT GGATCGCA . . . CATT GGTGCTTAC TAGTGGTGT	68	—		
<i>E. pseudoavium</i>	GTTGA ACCTGGTGA ACGTGacAA GTRGCGGTG GTGACGAAGT TGAAatCGTA GGATCGCT . . . CATT GGTGCATTAT TAGTGGTGT	69	—		
<i>E. raffinosus</i>	GTTGA ACCTGGTGA ACGTGacAA GTRGCGGTG GTGACGAAGT TGAAatCGTA GGATATGCT . . . CATT GGTGCATTAT TAGTGGTGT	70	—		
<i>E. saccharolyticus</i>	GTTGA ACCTGGTGA ACGTGacAA GTRGCGGTG GTGACCGTT AGAAatCGTT GGATCGAC . . . CATT GGTGCTTAT TAGTGGGT	71	—		
<i>E. solitarius</i>	GTTGA ACCGGGact atcaaaGTCC GCGATGAAGT TGAAatTTAT GGATTCAT . . . CATT GGtaactTTGT TAGTGGTGT	72	—		
<i>C. diphtheriae</i>	GTTGA GCGTGGctcc CTgaaaggTCA ACCGAGGACT cGAGatcatC GGATCGC . . . CTGT GGTctcgcc TccGcgGTAT	662	—		
<i>G. vaginalis</i>	GTTGA GCGGCGcttc CTggGTGTAAG cTcccaATCA ACCCCGAGT TGAAatCGTT GGTTTGCGC . . . CACT GGTcttcTTC TccGcgGTAT	135 ^a	—		
<i>B. cepacia</i>	GTTGA GCGGCGcttc CTggGTGTAAG cTcccaATCA ACCCCGAGT TGAAatCGTT GGTTTGCGC . . . CGTT GGTatcTGC TgcGcGGAC	16	—		
<i>S. aureus</i>	GTTGA ACCTGGTAA atcaaagtTG GTGAGGAAGT TGAAatTCAT GGTTTACAT . . . CATT GGTGCATTAT TAGTGGTGT	179	—		
<i>B. subtilis</i>	GTTGA ACGcGGacAA GTTaaagtCGC GTGACGAAGT TGAAatTCAT GGTCttCAA . . . CATT GGTGCCCCtTC TtcGcGGTGT	2427	Z99104		
<i>S. pneumoniae</i>	ATCGA CGGTGGTAtc GTTaaagtCA ACCGAGAAat CGAAatCGTT GGATCAA . . . CGTA GGTGtcCTTC TtcGtGGTGT	2428	—		
<i>E. coli</i>	GTTGA ACGcGGTAtc atcaaagtTG GTGAGGAAGT TGAAatTCGT GGATCAA . . . CGTA GGTGtcCTGC TgcGtGGTGT	78	—		
<i>B. fragilis</i>	ATCGA AactGGTgtt atccatGTAG GTGATGAAGT CGAAatCCtC GGTTtGGGT . . . CGTA GGTctgtTGC TtcGtGGTGT	2429	M22247		

TABLE 56 - continued

Strategy for the selection of the <i>Enterococcus faecalis</i> -specific hybridization probe, of the <i>Enterococcus faecium</i> -specific hybridization probe and of the <i>Enterococcus casseliflavus-flavescens-gallinarum</i> group-specific hybridization probe from tuf sequences.					
			SEQ ID NO.:	Accession #:	
C. trachomatis	ATTGA gCGTGaatt GTaaAGTT CGATAAAGT TcAgtTgTC GGTCTTAGA...CGTT GgatttgCtCC TcaGAGGTAT	395	448...526	549	22 —

Selected sequences for
species-specific or
group-specific
hybridization probes

GA ACGTGGGAA GTTGCG (*E. faecalis*)
AAGT TGAAGTTGTT GGTATT (*E. faecium*)
T GGTCATTCG TACGTGG

The sequence numbering refers to the *Enterococcus faecium* tuf gene fragments (SEQ ID NO. 608). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

TABLE 57

Strategy for the selection of primers for the identification of platelets contaminants from tuf sequences.

	467	495	689	717	SEQ ID NO.: #:	Accession
<i>B. cereus</i>	GTA ACTGGTGTaG AGATGTTCCG TAAACT...C AGTTCTACTT CCGTACAACt GACGTAAC				7	-
<i>B. subtilis</i>	GTT ACaGGTGTG AAATGTTCCG TAAGCT...C AGTTCTACTT CCGTACAACt GACGTAAC				2430	Z99104
<i>E. cloacae</i>	TGT ACTGGCGTTG AAATGTTCCG CAAACT...C AGTTCTACTT CCGTACAACt GACGTGAC				54	-
<i>E. coli</i>	TGT ACTGGCGTTG AAATGTTCCG CAAACT...C AGTTCTACTT CCGTACTACT GACGTGAC				78	-
<i>K. oxytoca</i>	TGT ACTGGCGTTG AAATGTTCCG CAAACT...C AGTTCTACTT CCGTACAACt GACGTGAC				100	-
<i>K. pneumoniae</i>	TGT ACTGGCGTTG AAATGTTCCG CAAACT...C AGTTCTACTT CCGTACTACT GACGTGAC				103	-
<i>P. aeruginosa</i>	TGC ACCGGCGTTG AAATGTTCCG CAAACT...C AGTTCTACTT CCGTACCAACt GACGTGAC				153	-
<i>S. agalactiae</i>	GTT ACTGGTGTG AAATGTTCCG TAAACA...C AATTCTACTT CCGTACAACt GACGTAAC				209	-
<i>S. aureus</i>	GTT ACaGGTGTG AAATGTTCCG TAAATT...C AATTCTATTT CCGTACTACT GACGTAAC				2431	-
<i>S. choleraesuis</i>	TGT ACTGGCGTTG AAATGTTCCG CAAACT...C AGTTCTACTT CCGTACTACT GACGTGAC				159	-
<i>S. epidermidis</i>	GTT ACTGGTGTaG AAATGTTCCG TAAATT...C AATTCTATTT CCGTACTACT GACGTAAC				611	-
<i>S. marcescens</i>	TGT ACTGGCGTTG AAATGTTCCG CAAACT...C AGTTCTACTT CCGTACCAACt GACGTGAC				168	-
<i>S. mutans</i>	GTT ACTGGTGTG AAATGTTCCG TAAACA...C AATTCTACTT CCGTACAACt GACGTAAC				224	-
<i>S. pyogenes</i>	GTT ACTGGTGTG AAATGTTCCG TAAACA...C AATTCTACTT CCGTACAACt GACGTAAC				2432	U40453
<i>S. salivarius</i>	GTT ACTGGTGTG AAATGTTCCG TAAACA...C AGTTCTACTT CCGTACAACt GACGTTAC				2433	-
<i>S. sanguinis</i>	GTT ACTGGTGTG AAATGTTCCG TAAACA...C AGTTCTACTT CCGTACAACt GACGTTAC				227	-
<i>Y. enterocolitica</i>	TGT ACTGGCGTTG AAATGTTCCG CAAACT...C AGTTCTACTT CCGTACAACt GAtGTAAC				235	-
Selected sequence for amplification primer	ACTGGYGTG AIATGTTCCG YAA				636	
Selected sequence for amplification primer ^b			TTCTAYTT CCGTACIACT GACGT		637	

The sequence numbering refers to the *E. coli* tuf gene fragment (SEQ ID NO. 78). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

"R" "Y" "M" "K" "W" and "S" designate nucleotide positions which are degenerated. "R" stands for A or G; "Y" stands for C or T; "M" stands for A or C; "K" stands for G or T; "W" stands for A or T; "S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

^bThis sequence is the reverse-complement of the selected primer.

TABLE 58
Strategy for the selection of the universal amplification primers from atpD sequences.

	616	657	781	812	SEQ ID NO.	ACCESSION #:
<i>C. glutamicum</i>	GTTT <u>CGGT</u> TC AGATGGATGA GCCACCAGGA GTCCCGTATG CGC...CGTATG CCTTCGCCG TGGTTACCA GCCAAC			2434		X76875
<i>M. tuberculosis</i>	GTATT <u>CGGC</u> AC AGATGGACCA GCGCCGGC a <u>CCCG</u> TATG CGT...CGTATG CGGATG CCGTCCGCCG TGGTACCA GCCAAC			2435		Z73419
<i>E. faecalis</i>	GTTT <u>CGGC</u> AC AAATGAACGA ACCACCAGGT GCTGGATG CGG...CGTATG CCTTCGCCG TTGGTTACCA ACCAAC			291		—
<i>S. agalactiae</i>	GTTT <u>GGTC</u> AAATGAATGA ACCACCAGGA GCACGTATG CGT...CGTATG CCTTCAGCCG TTGGTTACCA ACCAAC			380		—
<i>B. subtilis</i>	GTATT <u>CGGC</u> AC AAATGAACGA GCCGCCGGC GCACGTATG CGT...CGTATG CCTTCAGCCG TTGGTTACCA ACCAAC			2436		Z28592
<i>L. monocytogenes</i>	GTATT <u>CGGT</u> AC AAATGAACGA GCCACCAGGT GCGCTATG CGT...CGTATG CCATCTGCAG TAGTTACCA ACCAAC			324		—
<i>S. aureus</i>	GTATT <u>CGGC</u> AC AAATGAATGA GCCACCTGGT GCACGTATG CGT...CGTATG CCTTCAGCCG TTGGTTACCA ACCAAC			366		—
<i>A. baumannii</i>	GTOTACGGTC AGATGAACGA GCCACCAGGT aaccGTTTA CGC...CGTATG CCTTCAGCCG TAGTTACCA ACCTAC			243		—
<i>N. gonorrhoeae</i>	GTGTATGGCC AAATGAACCA ACCTCAGGG aaccCTCTG CGC...CGTATG CCTTCAGCCG TTGGTTACCA ACCGAC			2437		Genome project
<i>C. freundii</i>	GTATATGGC AGATGAACGA GCCGCCTGGA aaccGTC TG CGT...CGTATG CCTTCAGCCG TAGTTACCA GCCGAC			264		—
<i>E. cloacae</i>	GTTTACGGCC AGATGAACGA GCCACCAGGA aaccGTC TG CGC...CGTATG CCTTCAGCCG TAGTTACCA GCCTAC			284		—
<i>E. coli</i>	GTGTATGGCC AGATGAACGA GCCGCCGG aaccGTC TG CGC...CGTATG CCTTCAGCCG TAGTTACCA GCCGAC			669		V00267
<i>S. typhimurium</i>	GTGTATGGC AGATGAACGA GCCGCCGG aaccGTC TG CGC...CGTATG CCTTCAGCCG TAGTTACCA GCCGAC			351		—
<i>K. pneumoniae</i>	GTGTACGGC AGATGAACGA GCCGCCGG aaccGTC TG CGC...CGTATG CCTTCAGCCG TAGTTACCA GCCGAC			317		—
<i>S. marcescens</i>	GTTTACGGCC AGATGAACGA GCCACCAGGT aaccGTC TG CGC...CGTATG CCTTCAGCCG TAGTTACCA GCCAAC			357		—
<i>Y. enterocolitica</i>	GTTTATGGC AAATGAATGA GCCACCAGGT aaccGTC TG CGC...CGTATG CCTTCAGCCG TAGTTACCA GCCAAC			393		—
<i>B. cepacia</i>	GTGTACGGC AGATGAACGA GCCGCCGG aaccGTC TG CGC...CGTATG CCTTCAGCCG TAGTTACCA GCCGAC			2438		X76877
<i>H. influenzae</i>	GTTTATGGTC AAATGAACCA GCCACCAGGT aaccGTTTA CGT...CGTATG CCTTCAGCCG TAGTTACCA ACCGAC			2439		U32730
<i>M. pneumoniae</i>	GTGT <u>GGTC</u> AGATGAACGA ACCCCAGGA GCACGATG CGG...CGGATG CCTTCAGCCG TGGTTACCA ACCAAC			2440		U43738
<i>H. pylori</i>	TGCTATGGC AAATGAATGA GCCACCAGGT GCAAGGAat CGC...CGTATC CCTTCAGCCG TGGTTACCA GCCCAC			670		V00267
<i>B. fragilis</i>	GTGT <u>CGGC</u> AC AGATGAACGA ACCTCCTGGA GCACGTgt TCA...CGTATG CCTTCAGCCG TAGTTACCA ACCTAC			2441		M22247
Selected sequences for universal primers	C ARATGAYGA RCCICCGGGI GYINGIATG TAYGGIC ARATGAAYGA RCCICCGGI AA			562		
				564		

TABLE 58-continued

Strategy for the selection of the universal amplification primers from atpD sequences.					
Selected sequences for universal primers ^a	616	657	781	812	SEQ ID NO. ACCESSION #:
				ATH CCITCIGCIG TGGTAYCA RCC	565
				ATG CCITCIGCIG TGGTAYCA RCC	563

The sequence numbering refers to the *Escherichia coli* atpD gene fragment (SEQ ID NO. 663). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches for SEQ ID NOS. 562 and 565 are indicated by lower-case letters. Mismatches for SEQ ID NOS. 564 and 563 are indicated by underlined nucleotides. Dots indicate gaps in the sequences displayed. "R" stands for A or G; "Y" stands for C or T; "W" stands for A or C; "K" stands for G or T; "M" stands for A or T; "H" stands for C or T; "S" stands for A, C or T; "V" stands for C or G. "U" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

^aThese sequences are the reverse-complement of the selected primers.

TABLE 59

Specific and ubiquitous primers for nucleic acid amplification (recA sequences).

		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
<u>Universal primers (recA)</u>			
919	5'-GGI CCI GAR TCI TMI GGI AAR AC	918 ^a	437-459
920 ^b	5'-TCI CCV ATI TCI CCI TCI AIY TC	918 ^a	701-723
921	5'-TIY RTI GAY GCI GAR CAI GC	918 ^a	515-534
922 ^b	5'-TAR AAY TTI ARI GCI YKI CCI CC	918 ^a	872-894
<u>Sequencing primers (recA)</u>			
1605	5'-ATY ATY GAA RTI TAY GCI CC	1704 ^a	220-239
1606	5'-CCR AAC ATI AYI CCI ACT TTT TC	1704 ^a	628-650
<u>Universal primers (rad51)</u>			
935	5'-GGI AAR WSI CAR YTI TGY CAY AC	939 ^a	568-590
936 ^b	5'-TCI SIY TCI GGI ARR CAI GG	939 ^a	1126-1145
<u>Universal primers (dmcl)</u>			
937	5'-ATI ACI GAR GYI TTY GGI GAR TT	940 ^a	1038-1060
938 ^b	5'-CYI GTI GYI SWI GCR TGI GC	940 ^a	1554-1573

^aSequences from databases.

^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

TABLE 60

Specific and ubiquitous primers for nucleic acid amplification (speA sequences).

		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
<u>Bacterial species: Streptococcus pyogenes</u>			
994	5'-TGG ACT AAC AAT CTC GCA AGA GG	993 ^a	60-82
995 ^b	5'-ACA TTC TCG TGA GTA ACA GGG T	993 ^a	173-194
996	5'-ACA AAT CAT GAA GGG AAT CAT TTA G	993 ^a	400-424
997 ^b	5'-CTA ATT CTT GAG CAG TTA CCA TT	993 ^a	504-526
998	5'-GGA GGG GTA ACA AAT CAT GAA GG	993 ^a	391-413
997 ^b	5'-CTA ATT CTT GAG CAG TTA CCA TT	993 ^a	504-526

^aSequence from databases.

^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

TABLE 61

First strategy for the selection of *Streptococcus pyogenes*-specific amplification primers from speA sequences.

ACCESSION #	57	85	170	197	SEQ ID NO.:
speA	X61573	CCTT GGgCTAACAA cCTCaCAAGA aGTAT...GTGAtCCT.GT cgtTCatGAG AATGTAAA			2442
speA	AF029051	~~~ GGgCTAACAA cCTCaCAAGA aGTAT...GTGAtCCT.GT cgtTCatGAG AATGTAAA			2443
speA	X61571	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCT.GT TACTCACGAG AATGTGAA			2444
speA	X61570	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCT.GT TACTCACGAG AATGTGAA			2445

TABLE 61-continued

First strategy for the selection of <i>Streptococcus pyogenes</i> -specific amplification primers from speA sequences.				
	ACCESSION #	57	85 170	197 SEQ ID NO.:
speA	X61568	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2446
speA	X61569	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2447
speA	X61572	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2448
speA	X61560	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2449
speA	U40453	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		993
speA	X61554	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2450
speA	X61557	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2451
speA	X61559	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2452
speA	X61558	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2453
speA	X61556	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2454
speA	X61555	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2455
speA	X61560	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2456
speA	X61561	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2457
speA	X61566	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2458
speA	X61567	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2459
speA	X61562	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2460
speA	X61563	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2461
speA	X61564	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2462
speA	X61565	TCTT GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2463
speA	AF055698	~~~~ GGACTAACAA TCTCGCAAGA GGTAT...GTGACCCGT TACTCACGAG AATGTGAA		2464
speA	X03929 ^a	TCTT GGACTAACAA TCTtGCcAaA aGGTA...GTGACCCGT TACTCACGAG AATGTGAA		2465
Selected sequence for T GGACTAACAA TCTCGCAAGA GG species-specific primer				994
Selected sequence for species-specific primer ^b			ACCCGT TACTCACGAG AATGT	995

The sequence numbering refers to the *Streptococcus pyogenes* speA gene fragment (SEQ ID NO. 993). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. "~~" indicate incomplete sequence data. Dots indicate gaps in the sequences displayed.

^aThe extra G nucleotide introducing a gap in the sequence is probably a sequencing error.

^bThis sequence is the reverse-complement of the selected primer.

TABLE 62

Second strategy for the selection of <i>Streptococcus pyogenes</i> -specific amplification primers from speA sequences.				
	Accession #	388	427 501	529 SEQ ID NO.:
speA	X61573	TA TGGAGGGGT ACAAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT		2466
speA	AF029051	TA TGGAGGGGT ACAAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT		2467
speA	X61571	TA CGGAGGGGT ACAAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT		2468
speA	X61570	TA CGGAGGGGT ACAAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT		2469
speA	X61568	TA CGGAGGGGT ACAAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT		2470

TABLE 62-continued

Second strategy for the selection of <i>Streptococcus pyogenes</i> -specific amplification primers from speA sequences.					
	Accession #	388	427	501	SEQ ID NO.:
speA	X61569	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2471
speA	X61572	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2472
speA	X61560	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2473
speA	U40453	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			993
speA	X61554	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2474
speA	X61557	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2475
speA	X61559	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2476
speA	X61558	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2477
speA	X61556	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2478
speA	X61555	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2479
speA	X61560	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2480
speA	X61561	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2481
speA	X61566	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2482
speA	X61567	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2483
speA	X61562	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2484
speA	X61563	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2485
speA	X61564	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2486
speA	X61565	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2487
speA	AF055698	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAGACT			2488
speA	X03929	TA CGGAGGGGT ACAAATCATG AAGGGAATCA TTTAGAAA...AAAAATGGT AACTGCTCAA GAATTAG.CT			2489
Selected sequences for species-specific primers		GGAGGGGT ACAAATCATG AAGG ACAAATCATG AAGGGAATCA TTTAG			998 996
Selected sequence for species-specific primer ^a			AATGGT AACTGCTCAA GAATTAG		997

The sequence numbering refers to the *Streptococcus pyogenes* speA gene fragment (SEQ ID NO. 993). Dots indicate gaps in the sequences displayed.

^aThis sequence is the reverse-complement of the selected primer.

TABLE 63
Strategy for the selection of *Streptococcus* pyogenes-specific amplification primers from tuf sequences.

	140	186	619	647	SEQ ID NO. :
<i>S. anginosus</i>	A AGTTGACTTG GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT CATCCACACA CTAATT				211
<i>S. bovis</i>	A AGTTGACCTT GTTGATGAGC AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT CACCCACACA CTAATT				212
<i>S. dysgalactiae</i>	A AATTGACCTT GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT AACCCACACA CTAATT				217
<i>S. pyogenes</i>	A AGTTGACCTT GTTGATGAGC AAGAATGTGCT TGAATTGGTT GAGATG...CC AGTTCAATT AACCCACACA CTAATT				1002
<i>S. agalactiae</i>	A AGTTGACCTT GTTGATGAGC AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT AACCCACACA CTAATT				144 ^a
<i>S. oralis</i>	A AATTGACTTG GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT AACCCACACA CTAATT				985
<i>S. pneumoniae</i>	A AGTTGACTTG GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT AACCCACACA CTAATT				145 ^a
<i>S. cristatus</i>	A GATCGACTTG GTTGATGAGC AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT AACCCACACA CTAATT				215
<i>S. mitis</i>	A GATCGACTTG GTTGATGAGC AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT AACCCACACA CTAATT				982
<i>S. gordonii</i>	A AGTTGACTTG GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT AACCCACACA CTAATT				200
<i>S. sanguinis</i>	A AGTTGACTTG GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT AACCCACACA CTAATT				227
<i>S. parasanguinis</i>	A AGTTGACTTG GTTGATGAGC AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT AACCCACACA CTAATT				225
<i>S. salivarius</i>	A AGTTGACTTG GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC TGGTCAATT AACCCACACA CTAATT				146 ^a
<i>S. vestibularis</i>	A AGTTGACTTG GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC TGGTCAATT AACCCACACA CTAATT				231
<i>S. suis</i>	A AGTTGACTTG GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCTATC AACCCACACA CTAATT				229
<i>S. mutans</i>	A AGTTGACTTG GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT AACCCACACA CTAATT				224
<i>S. rattii</i>	A GGTGACTTG GTTGATGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT CACCCACACA CTAATT				226
<i>S. macacae</i>	A AGTTGACTTG GTTGATGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC AGTTCAATT matCCACACA CTAATT				222
<i>S. cricetus</i>	A GGTGACTTG GTTGACGAG AAGAATGTGCT TGAATTGGTT GAAATG...CC TGGTCAATT CATCCACACA CTAATT				214
<i>E. faecalis</i>	A AATGGATATG GTTGATGAGC AAGAATATT AGAATTAGTA GAAATG...CC AGCTACAATC ActCCACACA CAAATT				607
<i>S. aureus</i>	A AGTTGACTTG GTTGACGAG AAGAATATT AGAATTAGTA GAAATG...CC TGGTCAATT AcACCAACA CTGAAATT				176
<i>B. cereus</i>	A ATgcGACATG GTTGATGAGC AAGAATATT AGAATTAGTA GAAATG...AG CGGTTCTGTA AAaggctcACG CTAATT				7
<i>E. coli</i>	A ATgcGACATG GTTGATGAGC AAGAATGTGCT GGAAATGGTT GAAATG...CC GGCCACCATC AAGCCGACACA CcAAGTT				78

TABLE 63-continued

Strategy for the selection of <i>Streptococcus pyogenes</i> -specific amplification primers from tuf sequences.					
				SEQ ID NO.:	
Selected sequences for species-specific primers	140	TTGACCTT GTTGATGACG AAGAG AAGAGTTGCT TGAAATTGTT GAG	186	619	647
Selected sequence for species-specific primer ^b					999 1001 1000

The sequence numbering refers to the *Streptococcus pyogenes* tuf gene fragment (SEQ ID NO. 1002). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

^aThe SEQ ID NO. refers to previous patent publication WO98/20157.

^bThis sequence is the reverse-complement of the selected primer.

TABLE 64
Strategy for the selection *stx1*-specific amplification primers
and hybridization probe.

Accession #	230	263	343	375	391	421	SEQ ID NO.:
stx ₁	M19473a	TTGATGTC AGAGGGATAG ATCCAGAGGA AGGGCG...TATCG CTTTGCTGAT TTTTCCACATG TTACCTT...GTTACAT TGTCCTGGTGA CAGTAGCTAT ACCA					2490
stx ₁	M16625	TTGATGTC AGAGGGATAG ATCCAGAGGA AGGGCG...TATCG CTTTGCTGAT TTTTCCACATG TTACCTT...GTTACAT TGTCCTGGTGA CAGTAGCTAT ACCA					2491
stx ₁	M17358	TTGATGTC AGAGGGATAG ATCCAGAGGA AGGGCG...TATCG CTTTGCTGAT TTTTCCACATG TTACCTT...GTTACAT TGTCCTGGTGA CAGTAGCTAT ACCA					2492
stx ₁	Z36900	TTGATGTC AGAGGGATAG ATCCAGAGGA AGGGCG...TATCG CTTTGCTGAT TTTTCCACATG TTACCTT...GTTACAT TGTCCTGGTGA CAGTAGCTAT ACCA					2493
stx ₁	L04539	TTGATGTC AGAGGGATAG ATCCAGAGGA AGGGCG...TATCG CTTTGCTGAT TTTTCCACATG TTACCTT...GTTACAT TGTCCTGGTGA CAGTAGCTAT ACCA					2494
stx ₁	M19437	TTGATGTC AGAGGGATAG ATCCAGAGGA AGGGCG...TATCG CTTTGCTGAT TTTTCCACATG TTACCTT...GTTACAT TGTCCTGGTGA CAGTAGCTAT ACCA					2495
stx ₁	M24352	TTGATGTC AGAGGGATAG ATCCAGAGGA AGGGCG...TATCG CTTTGCTGAT TTTTCCACATG TTACCTT...GTTACAT TGTCCTGGTGA CAGTAGCTAT ACCA					2496
stx ₁	X07903	TTGATGTC AGAGGGATAG ATCCAGAGGA AGGGCG...TATCG CTTTGCTGAT TTTTCCACATG TTACCTT...GTTACAT TGTCCTGGTGA CAGTAGCTAT ACCA					2497
stx ₁	Z36899	TTGATGTC AGAGGGATAG ATCCAGAGGA AGGGCG...TATCG CTTTGCTGAT TTTTCCACATG TTACCTT...GTTACAT TGTCCTGGTGA CAGTAGCTAT ACCA					2498
stx ₁	Z36901	TTGATGTC AGAGGGATAG ATCCAGAGGA AGGGCG...TATCG CTTTGCTGAT TTTTCCACATG TTACCTT...GTTACAT TGTCCTGGTGA CAGTAGCTAT ACCA					1076
stx ₂	X61283	TGGATATA cGAGGGcTTG ATgttAtCA gGcGCG...TACCG tTTTcGAGAT TTTacACATA TatCAGTG...GTTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2499
stx ₂	L11079	TGGATATA cGAGGGcTTG ATgttAtCA gGcGCG...TACCG tTTTcGAGAT TTTacACATA TatCAGTG...GTTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2500
stx ₂	M21534	TAGgtATA cGAGGGcTTG ATgttAtCA gGcGCG...TACAG aTTTcGAGAT TTtgCCACATA TatCATtG...ATTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2501
stx ₂	M36727	TAGgtATA cGAGGGcTTG ATgttAtCA gGcGCG...TACAG aTTTcGAGAT TTtgCCACATA TatCATtG...ATTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2502
stx ₂	X81415	TAGgtATA cGAGGGcTTG ATgttAtCA gGcGCG...TACAG aTTTcGAGAT TTtgCCACATA TatCATtG...ATTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2503
stx ₂	X81416	TAGgtATA cGAGGGcTTG ATgttAtCA gGcGCG...TACAG aTTTcGAGAT TTtgCCACATA TatCATtG...ATTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2504
stx ₂	X81417	TAGgtATA cGAGGGcTTG ATgttAtCA gGcGCG...TACAG aTTTcGAGAT TTtgCCACATA TatCATtG...ATTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2505
stx ₂	X81418	TAGgtATA cGAGGGcTTG ATgttAtCA gGcGCG...TACAG aTTTcGAGAT TTtgCCACATA TatCATtG...ATTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2506
stx ₂	E02962	TGGATATA cGAGGGcTTG ATgttAtCA gGcGCG...TACCG tTTTcGAGAT TTTacACATA TatCAGTG...GTTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2507
stx ₂	E02959	TGGATATA cGAGGGcTTG ATgttAtCA gGcGCG...TACCG tTTTcGAGAT TTTacACATA TatCAGTG...GTTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2508
stx ₂	X07865	TGGATATA cGAGGGcTTG ATgttAtCA gGcGCG...TACCG tTTTcGAGAT TTTacACATA TatCAGTG...GTTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2509
stx ₂	Y10775	TGGATATA cGAGGGcTTG ATgttAtCA gGcGCG...TACCG tTTTcGAGAT TTTacACATA TatCAGTG...GTTtCCA TGacaacGGA CAGCAGt-TAT ACCA					2510
stx ₂	Z37725	TGGATATA cGAGGGcTTG ATgttAtCA gGcGCG...TACCG tTTTcGAGAT TTTacACATA TatCAGTG...GTTtCCA TGacaacGGA CAGCAGt-TAT ACCA					1077

TABLE 64 - continued
Strategy for the selection stxi-specific amplification primers
and hybridization probe.

Accession #	SEQ ID	SEQ ID					
	230	263	343	375	391	421	NO.:
stx ₂	Z50754	TGGATATA cGAGGGcTTG ATgtctAtCA gGCGCG . . TACCG tTTtCAGAT TTTAcACATA TatCaGTG . . GTTtCCA TGacaacGGA CAGCAGtTAT ACCA					2511
stx ₂	X67514	TGGATATA cGAGGGcTTG ATgtctAtCA gGCGCG . . TACCG tTTtCAGAT TTTAcACATA TatCaGTG . . GTTtCCA TGacaacGGA CAGCAGtTAT ACCA					2512
stx ₂	L11078	TGGATATA cGAGGGcTTG ATgtctAtCA gGCGCG . . TACCG tTTtCAGAT TTTAcACATA TatCaGTG . . GTTtCCA TGacaacGGA CAGCAGtTAT ACCA					2513
stx ₂	X65949	TGGATATA cGAGGGcTTG ATgtctAtCA gGCGCG . . TACCG tTTtCAGAT TTTAcACATA TatCaGTG . . GTTtCCA TGacaacGGA CAGCAGtTAT ACCA					2514
stx ₂	AF043627	TGGATATA cGAGGGcTTG ATgtctAtCA gGCGCG . . TACCG tTTtCAGAT TTTAcACATA TatCaGTG . . GTTtCCA TGacaacGGA CAGCAGtTAT ACCA					2515
Selected sequence for amplification primer	ATGTC AGAGGGATAG ATCCAGACCA AGG						1081
Selected sequence for hybridization probe		CG CTTTGCTGAT TTTtCACATG TTACC					1084
Selected sequence for amplification primer ^a			ACAT TGTCTGGTGA CAGTAGCTAT A				1080

The sequence numbering refers to the *Escherichia coli* stxi gene fragment (SEQ ID NO. 1076). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

^aThis sequence is the reverse-complement of the selected primer.

TABLE 65
Strategy for the selection of *stx₂*-specific amplification primers
and hybridization probe.

	Accession #	543	570	614	641	684	708	SEQ ID NO.:
stx ₁	M19473	Accga TgtTaccggTT TGTACTGTG ACA...CAAC ACTGgatGAT ctcAGTGGGC gttcTTA...A AggtTgAGTA gCGTCCCTGCC tGAC						2516
stx ₁	M16625	AGCga TgtTaccggTT TGTACTGTG ACA...CAAC ACTGgatGAT ctcAGTGGGC gttcTTA...A AggtTgAGTA gCGTCCCTGCC tGAC						2517
stx ₁	M17358	AGCga TgtTaccggTT TGTACTGTG ACA...CAAC ACTGgatGAT ctcAGTGGGC gttcTTA...A AggtTgAGTA gCGTCCCTGCC tGAC						2518
stx ₁	Z36900	AGCga TgtTaccggTT TGTACTGTG ACA...CAAC ACTGgatGAT ctcAGTGGGC gttcTTA...A AggtTgAGTA gTGTeCTGCC tGAT						2519
stx ₁	L04539	AGCga TgtTaccggTT TGTACTGTG ACA...CAAC ACTGgatGAT ctcAGTGGGC gttcTTA...A AggtTgAGTA gTGTeCTGCC tGAT						2520
stx ₁	M19437	AGCga TgtTaccggTT TGTACTGTG ACA...CAAC ACTGgatGAT ctcAGTGGGC gttcTTA...A AggtTgAGTA gTGTeCTGCC tGAC						2521
stx ₁	M24352	AGCga TgtTaccggTT TGTACTGTG ACA...CAAC ACTGgatGAT ctcAGTGGGC gttcTTA...A AggtTgAGTA gTGTeCTGCC tGAC						2522
stx ₁	X07903	AGCga TgtTaccggTT TGTACTGTG ACA...CAAC ACTGgatGAT ctcAGTGGGC gttcTTA...A AggtTgAGTA gTGTeCTGCC tGAC						2523
stx ₁	Z36899	AGCga TgtTaccggTT TGTACTGTG ACA...CAAC ACTGgatGAT ctcAGTGGGC gttcTTA...A AggtTgAGTA gTGTeCTGCC tGAC						2524
stx ₁	Z36901	AGCga TgtTaccggTT TGTACTGTG ACA...CAAC ACTGgatGAT ctcAGTGGGC gttcTTA...A AggtTgAGTA gTGTeCTGCC tGAC						1076
stx ₂	X61283	AGCAG TTCTGGGTTT TGTCACTGTG ACA...AGGC ACTGtCTGA...AACTGCTC CTGTGTA...G CGAACATAGCA ATGTGCTTCC GGAG						2525
stx ₂	L11079	AGCAG TTCTGGGTTT TGTCACTGTG ACA...AGGC ACTGtCTGA...AACTGCTC CTGTGTA...G CGAACATAGCA ATGTGCTTCC GGAG						2526
stx ₂	M21534	AGCAG TTCTGGGTTT TGTCACTGTG ACA...TGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G AGAACATAGCA ATGTGCTTCC GGAG						2527
stx ₂	M36727	AGCAG TTCTGGGTTT TGTCACTGTG ACA...TGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G AGAACATAGCA ATGTGCTTCC GGAG						2528
stx ₂	U72191	AGCAG TTCTGGGTTT TGTCACTGTG ACA...TGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G AGAACATAGCA ATGTGCTTCC GGAG						2529
stx ₂	X81415	AGCAG TTCTGGGTTT TGTCACTGTG ACA...TGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G AGAACATAGCA ATGTGCTTCC GGAG						2530
stx ₂	X81416	AGCAG TTCTGGGTTT TGTCACTGTG ACA...TGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G AGAACATAGCA ATGTGCTTCC GGAG						2531
stx ₂	X81417	AGCAG TTCTGGGTTT TGTCACTGTG ACA...TGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G AGAACATAGCA ATGTGCTTCC GGAG						2532
stx ₂	X81418	AGCAG TTCTGGGTTT TGTCACTGTG ACA...TGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G AGAACATAGCA ATGTGCTTCC GGAG						2533
stx ₂	E03962	AGCAG TTCTGGGTTT TGTCACTGTG ACA...AGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G CGAACATAGCA ATGTGCTTCC GGAG						2534
stx ₂	E03959	AGCAG TTCTGGGTTT TGTCACTGTG ACA...AGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G CGAACATAGCA ATGTGCTTCC GGAG						2535
stx ₂	X07865	AGCAG TTCTGGGTTT TGTCACTGTG ACA...AGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G CGAACATAGCA ATGTGCTTCC GGAG						2536
stx ₂	Y10775	AGCAG TTCTGGGTTT TGTCACTGTG ACA...AGGC ACTGtCTGA...AACTGCTC CTGTGTTA...G CGAACATAGCA ATGTGCTTCC GGAG						2537

TABLE 65-continued
Strategy for the selection of *stx₂*-specific amplification primers
and hybridization probe.

Accession #	543	570	614	641	684	708	SEQ ID NO.:
<i>stx₂</i>	Z37725	AGCG TTCTGCGTTT TGTCAGTC ACA...AGGC ACTGTCCTGA...	AACTGCTC CTGTGTA...	G CGAATCAGCA ATGTGCTTC GGGAG			1077
<i>stx₂</i>	Z50754	AGCAG TTCTGCGTTT TGTCAGTC ACA...AGGC ACTGTCCTGA...	AACTGCTC CTGTGTA...	G CGAATCAGCA ATGTGCTTC GGAG			2538
<i>stx₂</i>	X67514	AGCAG TTCTGCGTTT TGTCAGTC ACA...AGGC ACTGTCCTGA...	AACTGCTC CTGTGTA...	G CGAATCAGCA ATGTGCTTC GGAG			2539
<i>stx₂</i>	L11078	AGCAG TTCTGCGTTT TGTCAGTC ACA...AGGC ACTGTCCTGA...	AACTGCTC CTGTGTA...	G AGAATCAGCA ATGTGCTTC GGAG			2540
<i>stx₂</i>	X65949	AGCAG TTCTGCGTTT TGTCAGTC ACA...AGGC ACTGTCCTGA...	AACTGCTC CTGTGTA...	G AGAATCAGCA ATGTGCTTC GGAG			2541
<i>stx₂</i>	AF043627	AGCAG TTCTGCGTTT TGTCAGTC ACA...TGCC ACTGTCCTGA...	AACTGCTC CTGTGTTA...	G AGAATCAGCA ATGTGCTTC GGAG			2542
Selected sequence for amplification primer		AG TTCTGCGTTT TGTCAGTC					1078
Selected sequence for hybridization probe		C ACTGCTGA...	AACTGCTC CTGT				1085
Selected sequence for amplification primer ^a				AATCAGCA ATGTGCTTC G			1079

The sequence numbering refers to the *Escherichia coli stx₂* gene fragment (SEQ ID No. 1077). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.
^aThis sequence is the reverse-complement of the selected primer.

TABLE 66

Strategy for the selection of vanA-specific amplification primers from van sequences.						
	Accession #	926	952	1230	1255	SEQ ID NO.:
vanA	X56895	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1139
vanA	M97297	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1141
vanA	-	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1051
vanA	-	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1052
vanA	-	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1053
vanA	-	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1054
vanA	-	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1055
vanA	-	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1056
vanA	-	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1057
vanA	-	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1049
vanA	-	GTCAAT AGCGCGGACG AATTGGACTA C...GT AGAGGTCTAG CCCGTGTGGA TATG				1050
vanB	U94526	GTAAAc gGtaCGGAaG AAcTtaACGC T...GC AGAGGgCTtG CCCGTGTtGA TCTT				1117
vanB	U94527	GTAAAc AGtaCGGAaG AAcTaaACGC T...GC AGAGGgCTtG CtCGTGTtGA TCTT				2543
vanB	U94528	GTAAAc gGtaCGGAaG AAcTtaACGC T...GC AGAGGgCTtG CCCGTGTtGA TCTT				2544
vanB	U94529	GTAAAc gGtaCGGAaG AAcTtaACGC T...GC AGAGGgCTtG CCCGTGTtGA TCTT				2545
vanB	U94530	GTAAAc gGtaCGGAaG AAcTtaACGC T...GC AGAGGgCTtG CCCGTGTtGA TCTT				2546
vanB	Z83305	GTAAAc gGtaCGGAaG AAcTtaACGC T...GC AGAGGgCTtG CCCGTGTtGA TCTT				2547
vanB	U81452	GTAAAc gGtaCGGAaG AAcTtaACGC T...GC AGAGGgCTtG CCCGTGTtGA TCTT				2548
vanB	U35369	GTAAAc AGtaCGGAaG AAcTaaACGC T...GC AGAGGgCTtG CtCGTGTtGA TCTT				2549
vanB	U72704	GTAAAc gGtaCGGAaG AAcTtaACGC T...GC AGAGGgCTtG CCCGTGTtGA TCTT				2550
vanB	L06138	GTAAAc AGtaCGGAaG AAcTaaACGC T...GC AGAGGgCTtG CtCGTGTtGA TCTT				2551
vanB	L15304	GTAAAc gGtaCGGAaG AAcTtaACGC T...GC AGAGGgCTtG CCCGTGTtGA TCTT				2552
vanB	U00456	GTAAAc AGtaCGGAaG AAcTaaACGC T...GC AGAGGgCTtG CtCGTGTtGA TCTT				2553
vanD	AF130997	GTAtgc AagGCaGAaG AAcTGcAgGC A...GC AGAGGatTgG CCCGcaTtGA cCTG				2554
vanE	AF136925	GTAgAa caaaaaagtG AtTTatAtAA A...GC AaAGGatTAG CgaGaaTcGA cTTT				2555
Selected sequence for amplification primer		AAT AGCGCGGACG AATTGGAC				1090
Selected sequence for amplification primer ^a			GAGGTCTAG CCCGTGTGGA T			1089

The sequence numbering refers to the *Enterococcus faecium* vanA gene fragment (SEQ ID NO. 1139). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

^aThis sequence is the reverse-complement of the above selected primer.

TABLE 67

Strategy for the selection of vanB-specific amplification primers from van sequences.						
	Accession #	470	495	608	633	SEQ ID NO.:
vanA	X56895	A CGCaATtGAA tCgGCAAaGAC AATAT...ACG GaATCTTtCG tATtCATCAG GAA				1139
vanA	M97297	A CGCaATtGAA tCgGCAAaGAC AATAT...ACG GaATCTTtCG tATtCATCAG GAA				1141
vanA	-	A CGCaATtGAA tCgGCAAaGAC AATAT...ACG GaATCTTtCG tATtCATCAG GAA				1051
vanA	-	A CGCaATtGAA tCgGCAAaGAC AATAT...ACG GaATCTTtCG tATtCATCAG GAA				1052

TABLE 67-continued

Strategy for the selection of vanB-specific amplification primers from van sequences.						
	Accession #	470	495	608	633	SEQ ID NO.:
vanA	-	A CGCaATtGAA tCgGCAaGAC AATAT...ACG GaATCTTtCG tATTtCATCAG GAA				1053
vanA	-	A CGCaATtGAA tCgGCAaGAC AATAT...ACG GaATCTTtCG tATTtCATCAG GAA				1054
vanA	-	A CGCaATtGAA tCgGCAaGAC AATAT...ACG GaATCTTtCG tATTtCATCAG GAA				1055
vanA	-	A CGCaATtGAA tCgGCAaGAC AATAT...ACG GaATCTTtCG tATTtCATCAG GAA				1056
vanA	-	A CGCaATtGAA tCgGCAaGAC AATAT...ACG GaATCTTtCG tATTtCATCAG GAA				1057
vanA	-	A CGCaATtGAA tCgGCAaGAC AATAT...ACG GaATCTTtCG tATTtCATCAG GAA				1049
vanA	-	A CGCaATtGAA tCgGCAaGAC AATAT...ACG GaATCTTtCG tATTtCATCAG GAA				1050
vanB	U94526	C TGCGATAGAA GCgGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				1117
vanB	U94527	C TGCGATAGAA GCAGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				2556
vanB	U94528	C TGCGATAGAA GCgGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				2557
vanB	U94529	C TGCGATAGAA GCgGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				2558
vanB	U94530	C TGCGATAGAA GCgGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				2559
vanB	Z83305	C TGCGATAGAA GCgGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				2560
vanB	U81452	C TGCGATAGAA GCgGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				2561
vanB	U35369	C TGCGATAGAA GCAGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				2562
vanB	U72704	C TGCGATAGAA GCgGCAGGAC AATAT...ATG GTATCTTCCG CATCCATCAG GAA				2563
vanB	L06138	C TGCGATAGAA GCAGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				2564
vanB	L15304	C TGCGATAGAA GCgGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				2565
vanB	U00456	C TGCGATAGAA GCAGCAGGAC AATAT...ACG GTATCTTCCG CATCCATCAG GAA				2566
vanD	AF130997	C AGCaATcGAA GaAGCAaGAA AATAT...ACG GctTtTTtaa gATTtCATCAG GAA				2567
vanE	AF136925	A AGCaATAGAc GaAGCttcAa AATAT...ATG GctTtTTCga CtagAagAG AAA				2568
Selected sequence for amplification primer		CGATAGAA GCAGCAGGAC AA				1095
Selected sequence for amplification primer ^a			GTATCTTCCG CATCCATCAG			1096

The sequence numbering refers to the *Enterococcus faecium* vanB gene fragment (SEQ ID NO. 1117). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

^aThis sequence is the reverse-complement of the above vanB sequence.

TABLE 68

Strategy for the selection of vanC-specific amplification primers from vanC sequences.						
	Accession #	929	957	1064	1092	SEQ ID NO.:
vanC1	-	GT CGACGGTTT TTTGATTTG AAGAGAA...ACGGGTC TGGCTCGAAT CGATTTTTTC GT				1058
vanC1	-	GT CGACGGTTT TTTGATTTG AAGAGAA...ACGGGTC TGGCTCGAAT CGATTTTTTC GT				1059
vanC1	M75132	GT CGACGGTTT TTTGATTTG AAGAGAA...ACGGGTC TGGCTCGAAT CGATTTTTTC GT				1138
vanC2	-	GT AGACGGCTT TTGATTTG AAGAAAA...AAAGGTC TTGCTCGCAT CGACTTTTT GT				1060
vanC2	-	GT AGACGGCTT TTGATTTG AAGAAAA...AAAGGTC TTGCTCGCAT CGACTTTTT GT				1061
vanC2	-	GT AGACGGCTT TTGATTTG AAGAAAA...AAAGGTC TTGCTCGCAT CGACTTTTT GT				1062
vanC2	-	GT AGACGGCTT TTGATTTG AAGAAAA...AAAGGTC TTGCTCGCAT CGACTTTTT GT				1063

TABLE 68-continued

Strategy for the selection of vanC-specific amplification primers from vanC sequences.						
	Accession #	929	957	1064	1092	SEQ ID NO.:
vanC2	L29638	GT AGACGGCTTT TTGCGATTTG AAGAAAA...AAAGGTC TTGCTCGCAT CGACTTTTT GT				2569
vanC2	L29638	GT AGACGGCTTT TTGCGATTTG AAGAAAA...AAAGGTC TTGCTCGCAT CGACTTTTT GT				2570
vanC3	-	GT AGACGGCTTT TTGCGATTTG AAGAAAA...AAAGGTC TTGCTCGCAT CGACTTTTT GT				1064
vanC3	-	GT AGACGGCTTT TTGCGATTTG AAGAAAA...AAAGGTC TTGCTCGCAT CGACTTTTT GT				1065
vanC3	-	GT AGACGGCTTT TTGCGATTTG AAGAAAA...AAAGGTC TTGCTCGCAT CGACTTTTT GT				1066
vanC3	L29639	GT AGACGGCTTT TTGCGATTTG AAGAAAA...AAAGGTC TTGCTCGCAT CGACTTTTT GT				2571
Selected sequence for resistance primer		GACGGYTTT TTYGATTTG AAGA				1101
Selected sequence for resistance primer ^a			GGTC TKGCTCGMAT CGAYTTTT			1102

The sequence numbering refers to the vanC1 gene fragment (SEQ ID NO. 1138). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequence displayed. "R" "Y" "M" "K" "W" and "S" designate nucleotide positions which are degenerated. "R" stands for A or G; "Y" stands for C or T; "M" stands for A or C; "K" stands for G or T; "W" stands for A or T; "S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

^aThis sequence is the reverse-complement of the selected sequence.

TABLE 69

Strategy for the selection of *Streptococcus pneumoniae*-specific amplification primers and hybridization probes from pbp1a sequences.

	Accession #	453	505	678	706	SEQ ID NO.:
pbp1a	M90528	A TTGACTACCC AAGCATAAC TATGCTAATG CCATTCAAG TAATACAACC GA . . . TATATG ATGACAGATA TGATGAAAAC CGT . . .				2572
pbp1a	X67873	A TCGACTACCC AAGTATCAC TACTCAAATG CCATTCAAG TAACACAACC GA . . . TATATG ATGACCGAAA TGATGAAAAC AGT . . .				2573
pbp1a	AB006868	A TCGACTACCC AAGTATCAC TACTCAAATG CCATTCAAG TAACACAACC GA . . . TATATG ATGACCGAAA TGATGAAAAC AGT . . .				2574
pbp1a	AF046234	A TCGACTACCC AAGTATCAC TACTCAAATG CCATTCAAG TAACACAACC GA . . . TATATG ATGACCGAAA TGATGAAAAC TGT . . .				2575
pbp1a		A TCGACTACCC AAGTATCAC TACTCAAATG CCATTCAAG TAACACAACC GA . . . TATATG ATGACCGAAA TGATGAAAAC TGT . . .				1014
pbp1a		A TCGACTACCC AAGTATCAC TACTCAAATG CCATTCAAG TAACACAACC GA . . . TATATG ATGACCGAAA TGATGAAAAC TGT . . .				1017
pbp1a	AB006873	A TCGACTACCC AAGTctTCAC TACTCAAATG CCATTCAAG TAACACAACC GA . . . TATATG ATGACCGAAA TGATGAAAAC AGT . . .				2576
pbp1a	AF139883	A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACCGACA TGATGAAAAC AGT . . .				1169
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACCGACA TGATGAAAAC AGT . . .				1004
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACCGACA TGATGAAAAC AGT . . .				1007
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACCGACA TGATGAAAAC AGT . . .				1008
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACCGACA TGATGAAAAC AGT . . .				1009
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACCGACA TGATGAAAAC AGT . . .				1011
pbp1a	AF159448	A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACCGACA TGATGAAAAC AGT . . .				2577
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACCGACA TGATGAAAAC AGT . . .				1005
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACCGACA TGATGAAAAC TGT . . .				1012
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACCGACA TGATGAAAAC TGT . . .				1015
pbp1a	X67867	A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TACATG ATGACCGAAA TGATGAAAAC TGT . . .				2578
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TACATG ATGACCGAAA TGATGAAAAC TGT . . .				1006
pbp1a	Z49094	A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACGAAA TGATGAAAAC TGT . . .				1010
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACGAAA TGATGAAAAC TGT . . .				2579
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACGAAA TGATGAAAAC TGT . . .				1013
pbp1a		A TCGACTATCC AAGCATGAT TATGCAAACG CCATTCAAG TAATACAACA GA . . . TATATG ATGACGAAA TGATGAAAAC TGT . . .				1016

TABLE 69-continued

Strategy for the selection of <i>Streptococcus pneumoniae</i> -specific amplification primers and hybridization probes from pbpla sequences.					
pbpla	X67870	A TCGACTATTC AAGCATGCAAT TACGCCAACG CCATTCAAG TAACAACT GA...TATATG ATGACCCAAA TGATGAAAAC TGT...			2580
pbpla		A TTGACTATCC AGTATAAC TACTCAAATG CTATTCAAG TAATACAATG GA...TATATG ATGACTGAAA TGATGAAAAC TGT...			1018
pbpla	AJ002290	A TTGATTAACCC AACTATGgtc TATGcttAAGC CTATTCAAG TAATACAATG GA...TACATG ATGACTGAAA TGATGAAAAC AGT...			2581
pbpla	X67871	A TCGACTATCC AAGtcttCAC TACTCAAATG CCATTCAAG TAACAAACC GA...TACATG ATGACGAAA TGATGAAAAC AGT...			2582
Selected sequences for amplification primers		GACTATCC AAGCATGCAT TATG			1130
Selected sequence for hybridization probe		CAAACG CCATTCAAG TAATACAAC	ATG ATGACHGAMA TGATGAAAAC		1129
		1197			
<p>The sequence numbering refers to the <i>Streptococcus pneumoniae</i> pbpla gene fragment (SEQ ID NO. 1004). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.</p> <p>"R", "Y", "K", "W" and "S" designate nucleotide positions which are degenerated.</p> <p>"R" stands for A or G; "Y" stands for C or T; "W" stands for A or T; "H" stands for A, C or T;</p> <p>"S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.</p> <p>Accession # 783 813 840</p>					
pbpla	M90528	.. . GCTGGTAA AACGGTACT TCTAACATTA...A ATACGGTTA TGTAGCTCCG GAcGAAA			2583
pbpla	X67873	.. . GCTGGTAA aACAGGAAC TCTAACATTA...A CCTCTcaATT TGTAGCcACCT GATGAAAC			2584
pbpla	AB006868	.. . GCTGGTAA aACAGGAAC TCTAACATTA...A CCTCTcaATT TGTAGCcACCT GACGAAAC			2585
pbpla	AF046234	.. . GCAGGGTAA AACAGGTACT TCTAACATTA...A ACACGGTTA CGTAGCTCCA GATGAAA			2586
pbpla		.. . GCAGGGTAA AACAGGTACT TCTAACATTA...A ACACGGTTA CGTAGCTCCA GATGAAA			1014
pbpla		.. . GCTGGTAA GACAGGTACT TCTAACATTA...A ACACGGTTA TGTAGCTCCA GATGAAA			1017
pbpla	AB006673	.. . GCAGGGTAA GACAGGTACT TCTAACATTA...A ACACGGCTA CGTAGCTCCA GATGAAA			2587
pbpla	AF139883	.. . GCTGGTAA aACAGGAAC TCTAACATTA...A ACACGGCTA TGTAGCTCCA GATGAAA			1169
pbpla		.. . GCTGGTAA aACAGGAAC TCTAACATTA...A ACACGGCTA TGTAGCTCCA GATGAAA			1004
pbpla		.. . GCTGGTAA aACAGGAAC TCTAACATTA...A ACACGGCTA TGTAGCTCCA GATGAAA			1007
pbpla		.. . GCTGGTAA aACAGGAAC TCTAACATTA...A ACACGGCTA TGTAGCTCCA GATGAAA			1008
pbpla		.. . GCTGGTAA aACAGGAAC TCTAACATTA...A ACACGGCTA TGTAGCTCCA GATGAAA			1009
pbpla	AF159448	.. . GCTGGTAA aACAGGAAC TCTAACATTA...A ACACGGCTA TGTAGCTCCA GATGAAA			1011
pbpla		.. . GCTGGTAA aACAGGAAC TCTAACATTA...A ACACGGCTA TGTAGCTCCA GATGAAA			2588

TABLE 69-continued

Strategy for the selection of <i>Streptococcus pneumoniae</i> -specific amplification primers and hybridization probes from pbpla sequences.		
pbpla	.. . GCTGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	1.005
pbpla	.. . GCTGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	1.015
pbpla	.. . GCTGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	1.006
pbpla	.. . GCTGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	1.012
pbpla	.. . GCTGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	2589
pbpla	.. . GCAGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	1010
pbpla	.. . GCAGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	2590
pbpla	.. . GCAGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	1013
pbpla	.. . GCAGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	1016
pbpla	.. . GCAGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	2591
pbpla	.. . GCAGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	1018
pbpla	.. . GCAGGTAA GACAGGTACT TCTAACIATA. . . A ACATGGCTA TGTAGCTCCA GATGAAA	2592
pbpla	.. . GCTGGTAA AACAGGTACT TCTAACIATA. . . A ACATGGCTA C~~~~~ C~~~~~	2593
Selected sequence for hybridization probe	GGTAA GACAGGTACT TCTAACI	1193
Selected sequence for amplification primer ^a	ACTCGYTA YGTAGCTCCA GATG	1131

The sequence numbering refers to the *Streptococcus pneumoniae* pbpla gene fragment (SEQ ID NO. 1004). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

^aThis sequence is the reverse-complement of the selected primer.

"~" indicates incomplete sequence data.

"R" "Y" "W" and "S" designate nucleotide positions which are degenerated. "R" stands for A or G; "Y" stands for C or T; "W" stands for A or T; "S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

"This sequence is the reverse-complement of the selected primer.

TABLE 70

Specific and ubiquitous primers for nucleic acid amplification (toxin sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Toxin gene: cdtA			
2123	5'-TCT ACC ACT GAA GCA TTA C	2129 ^a	442-460
2124 ^b	5'-TAG GTA CTG TAG GTT TAT TG	2129 ^a	580-599
Toxin gene: cdtB			
2126	5'-ATA TCA GAG ACT GAT GAG	2130 ^a	2665-2682
2127 ^b	5'-TAG CAT ATT CAG AGA ATA TTG T	2130 ^a	2746-2767
Toxin gene: stx ₁			
1081	5'-ATG TCA GAG GGA TAG ATC CA	1076 ^a	233-252
1080 ^b	5'-TAT AGC TAC TGT CAC CAG ACA ATG T	1076 ^a	394-418
Toxin gene: stx ₂			
1078	5'-AGT TCT GCG TTT TGT CAC TGT C	1077 ^a	546-567
1079 ^b	5'-CGG AAG CAC ATT GCT GAT T	1077 ^a	687-705
Toxin genes: stx ₁ and stx ₂			
1082	5'-TTG ARC RAA ATA ATT TAT ATG TG	1076 ^a	278-300
1083 ^b	5'-TGA TGA TGR CAA TTC AGT AT	1076 ^a	781-800

^aSequences from databases.^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

TABLE 71

Molecular beacon internal hybridization probes for specific detection of toxin sequences.			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence ^a	SEQ ID NO.	Nucleotide position
Toxin gene: cdtA			
2125 ^b	5'- <u>CAC</u> GCG GAT TTT GAA TCT CTT CCT CTA GTA <u>GCG</u> <u>CGT</u> G	2129 ^c	462-488
Toxin gene: cdtB			
2128	5'- <u>CAA</u> <u>CGC</u> TGG AGA ATC TAT ATT TGT AGA AAC <u>TGC</u> <u>GTT</u> G	2130 ^c	2714-2740
Toxin gene: stx ₁			
1084	5'- <u>CCA</u> <u>CGC</u> CGC TTT GCT GAT TTT TCA CAT GTT ACC <u>GCG</u> <u>TGG</u>	1076 ^c	337-363
2012 ^d	5'- <u>CCG</u> <u>CGG</u> ATT ATT AAA CCG CCC <u>TTC</u> <u>CGC</u> <u>GG</u> -MR-HEG-ATG TCA GAG GGA TAG ATC CA	1076 ^c	248-264
Toxin gene: stx ₂			
1085	5'- <u>CCA</u> <u>CGC</u> CAC TGT CTG AAA CTG CTC CTG TG <u>CGT</u> <u>GG</u>	1077 ^c	617-638

^aUnderlined nucleotides indicate the molecular beacon's stem.^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^cSequences from databases.^dScorpion primer.

TABLE 72

Specific and ubiquitous primers for nucleic acid amplification (van sequences).

SEQ ID NO.	Nucleotide sequence	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Resistance gene: vanA			
1086	5'-CTA CTC CCG CCT TTT GGG TT	1049-1057 ^a	513-532 ^b
1087 ^c	5'-CTC ACA GCC CGA AAC AGC CT	1049-1057 ^a	699-718 ^b
1086	5'-CTA CTC CCG CCT TTT GGG TT	1049-1057 ^a	513-532 ^b
1088 ^c	5'-TGC CGT TTC CTG TAT CCG TC	1049-1057 ^a	885-904 ^b
1086	5'-CTA CTC CCG CCT TTT GGG TT	1049-1057 ^a	513-532 ^b
1089 ^c	5'-ATC CAC ACG GGC TAG ACC TC	1049-1057 ^a	933-952 ^b
1090	5'-AAT AGC GCG GAC GAA TTG GAC	1049-1057 ^a	629-649 ^b
1091 ^c	5'-AAC GCG GCA CTG TTT CCC AA	1049-1057 ^a	734-753 ^b
1090	5'-AAT AGC GCG GAC GAA TTG GAC	1049-1057 ^a	629-649 ^b
1089 ^c	5'-ATC CAC ACG GGC TAG ACC TC	1049-1057 ^a	933-952 ^b
1092	5'-TCG GCA AGA CAA TAT GAC AGC	1049-1057 ^a	662-682 ^b
1088 ^c	5'-TGC CGT TTC CTG TAT CCG TC	1049-1057 ^a	885-904 ^b
Resistance gene: vanB			
1095	5'-CGA TAG AAG CAG CAG GAC AA	1117 ^d	473-492
1096 ^c	5'-CTG ATG GAT GCG GAA GAT AC	1117 ^d	611-630
Resistance genes: vanA, vanB			
1112	5'-GGC TGY GAT ATT CAA AGC TC	1049-1057, 1117 ^a	437-456 ^b
1113 ^c	5'-ACC GAC CTC ACA GCC CGA AA	1049-1057, 1117 ^a	705-724 ^b
1112	5'-GGC TGY GAT ATT CAA AGC TC	1049-1057, 1117 ^a	437-456 ^b
1114 ^c	5'-TCW GAG CCT TTT TCC GGC TCG	1049-1057, 1117 ^a	817-837 ^b
1115	5'-TTT CGG GCT GTG AGG TCG GBT GHG CG	1049-1057, 1117 ^a	705-730 ^b
1114 ^c	5'-TCW GAG CCT TTT TCC GGC TCG	1049-1057, 1117 ^a	817-837 ^b
1116	5'-TTT CGG GCT GTG AGG TCG GBT GHG CGG	1049-1057, 1117 ^a	705-731 ^b
1114 ^c	5'-TCW GAG CCT TTT TCC GGC TCG	1049-1057, 1117 ^a	817-837 ^b
1112	5'-GGC TGY GAT ATT CAA AGC TC	1049-1057, 1117 ^a	437-456 ^b
1118 ^c	5'-TTT TCW GAG CCT TTT TCC GGC TCG	1049-1057, 1117 ^a	817-840 ^b

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the vanA sequence fragment (SEQ ID NO. 1051).^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^dSequences from databases.

Resistance genes:	vanA, vanB
1115	5'-TTT CGG GCT GTG AGG TCG GBT GHG CG
1118 ^c	5'-TTT TCW GAG CCT TTT TCC GGC TCG
1116	5'-TTT CGG GCT GTG AGG TCG GBT GHG CGG
1118 ^c	5'-TTT TCW GAG CCT TTT TCC GGC TCG
1119	5'-TTT CGG GCT GTG AGG TCG GBT GHG C
1118 ^c	5'-TTT TCW GAG CCT TTT TCC GGC TCG
1120	5'-TTT CGG GCT GTG AGG TCG GBT GHG
1118 ^c	5'-TTT TCW GAG CCT TTT TCC GGC TCG

1049-1057, 1117^a 705-730^b
1049-1057, 1117^a 817-840^b
1049-1057, 1117^a 705-731^b
1049-1057, 1117^a 817-840^b
1049-1057, 1117^a 705-729^b
1049-1057, 1117^a 817-840^b
1049-1057, 1117^a 705-728^b
1049-1057, 1117^a 817-840^b

TABLE 72-continued

Specific and ubiquitous primers for nucleic acid amplification (van sequences).

		<u>Originating DNA fragment</u>	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
1121	5'-TGT TTG WAT TGT CYG GYA TCC C	1049-1057, 1117 ^a	408-429 ^b
1111 ^c	5'-CTT TTT CCG GCT CGW YTT CCT GAT G	1049-1057, 1117 ^a	806-830 ^b
1112	5'-GGC TGY GAT ATT CAA AGC TC	1049-1057, 1117 ^a	437-456 ^b
1111 ^c	5'-CTT TTT CCG GCT CGW YTT CCT GAT G	1049-1057, 1117 ^a	806-830 ^b
1123	5'-TTT CGG GCT GTG AGG TCG GBT G	1049-1057, 1117 ^a	705-726 ^b
1111 ^c	5'-CTT TTT CCG GCT CGW YTT CCT GAT G	1049-1057, 1117 ^a	806-830 ^b
1112	5'-GGC TGY GAT ATT CAA AGC TC	1049-1057, 1117 ^a	437-456 ^b
1124 ^c	5'-GAT TTG RTC CAC YTC GCC RAC A	1049-1057, 1117 ^a	757-778 ^b
Resistance gene:	vanC1		
1103	5'-ATC CCG CTA TGA AAA CGA TC	1058-1059 ^a	519-538 ^d
1104 ^c	5'-GGA TCA ACA CAG TAG AAC CG	1058-1059 ^a	678-697 ^d
Resistance genes:	vanC1, vanC2, vanC3		
1097	5'-TCY TCA AAA GGG ATC ACW AAA GTM AC	1058-1066 ^a	607-632 ^d
1098 ^c	5'-TCT TCA AAA TCG AAA AAG CCG TC	1058-1066 ^a	787-809 ^d
1099	5'-TCA AAA GGG ATC ACW AAA GTM AC	1058-1066 ^a	610-632 ^d
1100 ^c	5'-GTA AAK CCC GGC ATR GTR TTG ATT TC	1058-1066 ^a	976-1001 ^d
1101	5'-GAC GGY TTT TTY GAT TTT GAA GA	1058-1066 ^a	787-809 ^d
1102 ^c	5'-AAA AAR TCG ATK CGA GCM AGA CC	1058-1066 ^a	922-944 ^d
Resistance genes:	vanC2, vanC3		
1105	5'-CTC CTA CGA TTC TCT TGA YAA ATC A	1060-1066, 1140 ^a	487-511 ^e
1106 ^c	5'-CAA CCG ATC TCA ACA CCG GCA AT	1060-1066, 1140 ^a	690-712 ^e

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the vanA sequence fragment (SEQ ID NO. 1051).^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^dThe nucleotide positions refer to the vanC1 sequence fragment (SEQ ID NO. 1058).^eThe nucleotide positions refer to the vanC2 sequence fragment (SEQ ID NO. 1140).

Resistance gene: vanD

1591 5'-ATG AGG TAA TAG AAC GGA TT 1594 797-837

1592^b 5'-CAG TAT TTC AGT AAG CGT AAA 1594 979-999

Resistance gene: vanE

1595 5'-AAA TAA TGC TCC ATC AAT TTG CTG A 1599^a 74-981596^b 5'-ATA GTC GAA AAA GCC ATC CAC AAG 1599^a 394-4171597 5'-GAT GAA TTT GCG AAA ATA CAT GGA 1599^a 163-1861598^b 5'-CAG CCA ATT TCT ACC CCT TTC AC 1599^a 319-341

Sequencing primers (vanAB)

1112 5'-GGC TGY GAT ATT CAA AGC TC 1139^a 737-7561111^b 5'-CTT TTT CCG GCT CGW YTT CCT GAT G 1139^a 1106-1130

Sequencing primers (vanA, vanX, vanY)

1150 5'-TGA TAA TCA CAC CGC ATA CG 1141^a 860-8791151^b 5'-TGC TGT CAT ATT GTC TTG CC 1141^a 1549-15681152 5'-ATA AAG ATG ATA GGC CGG TG 1141^a 1422-14411153^b 5'-CTC GTA TGT CCC TAC AAT GC 1141^a 2114-2133

TABLE 72-continued

Specific and ubiquitous primers for nucleic acid amplification (van sequences).

		<u>Originating DNA fragment</u>	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
1154	5'-GTT TGA AGC ATA TAG CCT CG	1141 ^a	2520-2539
1155 ^b	5'-CAG TGC TTC ATT AAC GTA GTC	1141 ^a	3089-3109
	Sequencing primers (vanC1)		
1110	5'-ACG AGA AAG ACA ACA GGA AGA CC	1138 ^a	122-144
1109 ^b	5'-ACA TCG TGA TCG CTA AAA GGA GC	1138 ^a	1315-1337
	Sequencing primers (vanC2, vanC3)		
1108	5'-GTA AGA ATC GGA AAA GCG GAA GG	1140 ^a	1-23
1107 ^b	5'-CTC ATT TGA CTT CCT CCT TTG CT	1140 ^a	1064-1086

^aSequences from databases.^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

TABLE 73

<u>Internal hybridization probes for specific detection of van sequences.</u>			
		<u>Originating DNA fragment</u>	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Resistance gene:	vanA		
1170	5'-ACG AAT TGG ACT ACG CAA TT	1049-1057 ^a	639-658 ^b
2292	5'-GAA TCG GCA AGA CAA TAT G	2293 ^c	583-601
Resistance gene:	vanB		
1171	5'-ACG AGG ATG ATT TGA TTG TC	1117 ^c	560-579
2294	5'-AAA CGA GGA TGA TTT GAT TG	2296 ^a	660-679
2295	5'-TTG AGC AAG CGA TTT CGG	2296 ^a	614-631
Resistance gene:	vanD		
2297	5'-TTC AGG AGG GGG ATC GC	1594 ^c	458-474

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the vanA sequence fragment (SEQ ID NO. 1051).^cSequences from databases.

TABLE 74

<u>Specific and ubiquitous primers for nucleic acid amplification (pbp sequences).</u>			
		<u>Originating DNA fragment</u>	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Resistance gene:	pbpla		
1129	5'-ATG ATG ACH GAM ATG ATG AAA AC	1004-1018 ^a	681-703 ^b
1131 ^c	5'-CAT CTG GAG CTA CRT ARC CAG T	1004-1018 ^a	816-837 ^b
1130	5'-GAC TAT CCA AGC ATG CAT TAT G	1004-1018 ^a	456-477 ^b
1131	5'-CAT CTG GAG CTA CRT ARC CAG T	1004-1018 ^a	816-837 ^b
2015	5'-CCA AGA AGC TCA AAA ACA TCT G	2047 ^d	909-930
2016 ^c	5'-TAD CCT GTC CAW ACA GCC AT	2047 ^d	1777-1796
	Sequencing primers (pbpla)		
1125	5'-ACT CAC AAC TGG GAT GGA TG	1169 ^d	873-892

TABLE 74-continued

Specific and ubiquitous primers for nucleic acid amplification (pbp sequences).

		<u>Originating DNA fragment</u>	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
1126 ^c	5'-TTA TGG TTG TGC TGG TTG AGG	1169 ^d	2140-2160
1125	5'-ACT CAC AAC TGG GAT GGA TG	1169 ^d	873-892
1128 ^c	5'-GAC GAC YTT ATK GAT ATA CA	1169 ^d	1499-1518
1127	5'-KCA AAY GCC ATT TCA AGT AA	1169 ^d	1384-1403
1126 ^c	5'-TTA TGG TTG TGC TGG TTG AGG	1169 ^d	2140-2160
Sequencing primers (pbp2b)			
1142	5'-GAT CCT CTA AAT GAT TCT CAG GTG G	1172 ^d	1-25
1143 ^c	5'-CAA TTA GCT TAG CAA TAG GTG TTG G	1172 ^d	1481-1505
1142	5'-GAT CCT CTA AAT GAT TCT CAG GTG G	1172 ^d	1-25
1145 ^c	5'-AAC ATA TTK GGT TGA TAG GT	1172 ^d	793-812
1144	5'-TGT YTT CCA AGG TTC AGC TC	1172 ^d	657-676
1143 ^c	5'-CAA TTA GCT TAG CAA TAG GTG TTG G	1172 ^d	1481-1505
Sequencing primers (pbp2x)			
1146	5'-GGG ATT ACC TAT GCC AAT ATG AT	1173 ^d	219-241
1147 ^c	5'-AGC TGT GTT AGC VCG AAC ATC TTG	1173 ^d	1938-1961
1146	5'-GGG ATT ACC TAT GCC AAT ATG AT	1173 ^d	219-241
1149 ^c	5'-TCC YAC WAT TTC TTT TTG WG	1173 ^d	1231-1250
1148	5'-GAC TTT GTT TGG CGT GAT AT	1173 ^d	711-730
1147 ^c	5'-AGC TGT GTT AGC VCG AAC ATC TTG	1173 ^d	1938-1961

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the pbp1a sequence fragment (SEQ ID NO. 1004).^cThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^dSequences from databases.

TABLE 75

Internal hybridization probes for specific detection of pbp sequences.

		<u>Originating DNA fragment</u>	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Resistance gene:	pbp1a		
1132	5'-AGT GAA AAR ATG GCT GCT GC	1004-1018 ^a	531-550 ^b
1133	5'-CAT CAA GAA CAC TGG CTA YGT AG	1004-1018 ^a	806-828 ^b
1134	5'-CTA GAT AGA GCT AAA ACC TTC CT	1004-1018 ^a	417-439 ^b
1135	5'-CAT TAT GCA AAC GCC ATT TCA AG	1004-1018 ^a	471-493 ^b
1192	5'-GGT AAA ACA GGA ACC TCT AAC T	1004-1018 ^a	759-780 ^b
1193	5'-GGT AAG ACA GGT ACT TCT AAC T	1004-1018 ^a	759-780 ^b
1194	5'-CAT TTC AAG TAA TAC AAC AGA ATC	1004-1018 ^a	485-508 ^b
1195	5'-CAT TTC AAG TAA CAC AAC TGA ATC	1004-1018 ^a	485-508 ^b
1196	5'-GCC ATT TCA AGT AAT ACA ACA GAA	1004-1018 ^a	483-506 ^b
1197	5'-CAA ACG CCA TTT CAA GTA ATA CAA C	1004-1018 ^a	478-502 ^b

TABLE 75-continued

Internal hybridization probes for specific detection of pbp sequences.

SEQ ID NO.	Nucleotide sequence	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
1094	5'-GGT AAA ACA GGT ACT TCT AAC TA	1004-1018 ^a	759-781 ^b
1214	5'-GGT AAA ACA GGT ACC TCT AAC TA	1004-1018 ^a	759-781 ^b
1216	5'-GGT AAG ACT GGT ACA TCA AAC TA	1004-1018 ^a	759-781 ^b
1217	5'-CAA ATG CCA TTT CAA GTA ACA CAA C	1004-1018 ^a	478-502 ^b
1218	5'-CAA ACG CCA TTT CAA GTA ACA CAA C	1004-1018 ^a	478-502 ^b
1219	5'-CAA ATG CTA TTT CAA GTA ATA CAA C	1004-1018 ^a	478-502 ^b
1220	5'-CAA ACG CCA TTT CAA GTA ATA CGA C	1004-1018 ^a	478-502 ^b
2017	5'-ACT TTG AAT AAG GTC GGT CTA G	2047 ^c	1306-1327
2018	5'-ACA CTA AAC AAG GTT GGT TTA G	2063	354-375
2019	5'-ACA CTA AAC AAG GTC GGT CTA G	2064	346-367
2020	5'-GTA GCT CCA GAT GAA ATG TTT G	2140 ^c	1732-1753
2021	5'-GTA GCT CCA GAC GAA ATG TTT G	2057	831-852
2022	5'-GTA GCT CCA GAT GAA ACG TTT G	2053 ^c	805-826
2023	5'-GTA ACT CCA GAT GAA ATG TTT G	2056	819-840
2024	5'-AGT GAA AAG ATG GCT GCT GC	2048 ^c	1438-1457
2025	5'-AGT GAG AAA ATG GCT GCT GC	2047 ^c	1438-1457
2026	5'-TCC AAG CAT GCA TTA TGC AAA CG	2047 ^c	1368-1390
2027	5'-TCG GTC TAG ATA GAG CTA AAA CG	2047 ^c	1319-1341
2028	5'-TAT GCT CTT CAA CAA TCA CG	2047 ^c	1267-1286
2029	5'-AGC CGT TGA GAC TTT GAA TAA G	2047 ^c	1296-1317
2030	5'-CTT AAT GGT CTT GGT ATC G	2047 ^c	1345-1366
2031	5'-CGT GAC TGG GGT TCT GCT ATG A	2049 ^c	1096-1117
2032	5'-CGT GAC TGG GGA TCA TCA ATG A	2047 ^c	1096-1117
2033	5'-CGT GAC TGG GGT TCT GCC ATG A	2057	195-216
2034	5'-ATC AAG AAC ACT GGC TAT GTA G	2050 ^c	787-808
2035	5'-ATC AAG AAC ACT GGC TAC GTA G	2051 ^c	787-808
2036	5'-ATC AAG AAC ACT GGT TAC GTA G	2047	1714-1735
2037	5'-ATC AAA AAT ACT GGT TAT GTA G	2057	813-834
2038	5'-ATC AAG AAT ACT GGC TAC GTA G	2052 ^c	757-778
2039	5'-ATC AAA AAC ACT GGC TAT GTA G	2053 ^c	787-808

^aThese sequences were aligned to derive the corresponding primer.^bThe nucleotide positions refer to the pbpla sequence fragment (SEQ ID NO. 1004).^cSequence from databases.

TABLE 76

Strategy for the selection of vanAB-specific amplification primers and vanA- and vanB-specific hybridization probes from van sequences.

	Accession #	734	759	936	961	SEQ ID NO.:
vanA	X56895	GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1139
vanA	M97297	GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1141
vanA		GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1051
vanA		GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1052
vanA		GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1053
vanA		GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1054
vanA		GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1055
vanA		GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1056
vanA		GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1057
vanA		GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1049
vanA		GTAGGCT GCGATATTCA AAGCTCAGC . . .	CGGACGAATT GGACTACGCA ATTGAA . . .			1050
vanB	U94526	GTGGGCT GTGATATTCA AAGCTCCGC . . .	CGGAaGAAcT taACgctGCg ATaGAA . . .			1117
vanB	U94527	GTAGGCT GCGATATTCA AAGCTCCGC . . .	CGGAaGAAcT aaACgctGCg ATaGAA . . .			-2594
vanB	U94528	GTGGGCT GTGATATTCA AAGCTCCGC . . .	CGGAaGAAcT taACgctGCg ATaGAA . . .			-2595
vanB	U94529	GTGGGCT GTGATATTCA AAGCTCCGC . . .	CGGAaGAAcT taACgctGCg ATaGAA . . .			-2596
vanB	U94530	GTGGGCT GTGATATTCA AAGCTCCGC . . .	CGGAaGAAcT taACgctGCg ATaGAA . . .			-2597
vanB	Z83305	GTGGGCT GTGATATTCA AAGCTCCGC . . .	CGGAaGAAcT taACgctGCg ATaGAA . . .			-2598
vanB	U81452	GTGGGCT GTGATATTCA AAGCTCCGC . . .	CGGAaGAAcT taACgctGCg ATaGAA . . .			-2599
vanB	U35369	GTAGGCT GCGATATTCA AAGCTCCGC . . .	CGGAaGAAcT aaACgctGCg ATaGAA . . .			-2600
vanB	U72704	GTGGGCT GCGATATTCA AAGCTCCGC . . .	CGGAaGAAcT taACgctGCg ATaGAA . . .			-2601
vanB	L06138	GTAGGCT GCGATATTCA AAGCTCCGC . . .	CGGAaGAAcT aaACgctGCg ATaGAA . . .			-2602
vanB	L15304	GTGGGCT GTGATATTCA AAGCTCCGC . . .	CGGAaGAAcT taACgctGCg ATaGAA . . .			-2603
vanB	U00456	GTAGGCT GCGATATTCA AAGCTCCGC . . .	CGGAaGAAcT aaACgctGCg ATaGAA . . .			-2604
vanD	AF130997	GTGGGat GCGATATTCA AAGCTCCGT . . .	CAGGAaGAAcT GcAgggcaGCA ATcGAA . . .			-2605
vanE	AF136925	GTAGGtT GTGgTATcgG AgctgCAGC . . .	AAAgtGAtTT atAtaAaGCA ATaGAC . . .			-2606
Selected sequence for amplification primer		GGCT GYGATATTCA AAGCTC				1112
Selected sequence for hybridization probe			ACGAATT GGACTACGCA ATT (vanA)			1170

The sequence numbering refers to the *Enterococcus faecium* vanA gene fragment (SEQ ID NO. 1139). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed. "R" "Y" "M" "K" "W" and "S" designate nucleotide positions which are degenerated. "R" stands for A or G; "Y" stands for C or T; "M" stands for A or C; "K" stands for G or T; "W" stands for A or T; "S" stands for C or G. "I" stands for inosine which is a nucleotide analog that can bind to any of the four nucleotides A, C, G or T.

	Accession #	1038	1063	1103	1133	SEQ ID NO.:
vanA	X56895	GAAACagt GccGcGTTAG TTGTTGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT			1139
vanA	M97297	GAAACagt GccGcgTTAG TTGTTGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT			1141
vanA		GAAACagt GccGcgTTAG TTGTTGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT			1051
vanA		GAAACagt GccGcgTTAG cTGTtGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT			1052
vanA		GAAACagt GccGcgTTAG cTGTtGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT			1053

TABLE 76-continued

Strategy for the selection of vanAB-specific amplification primers and vanA- and vanB-specific hybridization probes from van sequences.

vanA	GAAACagt GccGcgTTag TTGTtGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT	1054
vanA	GAAACagt GccGcgTTag cTGTtGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT	1055
vanA	GAAACagt GccGcgTTag cTGTtGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT	1056
vanA	GAAACagt GccGcgTTag cTGTtGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT	1057
vanA	GAAACagt GccGcgTTag cTGTtGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT	1049
vanA	GAAACagt GccGcgTTag cTGTtGGC . . .	ATT CATCAGGAAG TCGAGCCGGA AAAAGGCT	1050
vanB	U94526 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	1117
vanB	U94527 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	-2607
vanB	U94528 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	-2608
vanB	U94529 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	-2609
vanB	U94530 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	-2610
vanB	Z83305 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	-2611
vanB	U81452 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	-2612
vanB	U35369 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	-2613
vanB	U72704 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGAT	-2614
vanB	L06138 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	-2615
vanB	L15304 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	-2616
vanB	U00456 GGAACGAG GATGATTGTA TTGTCGGC . . .	ATC CATCAGGAAA ACGAGCCGGA AAAAGGCT	-2617
vanD	AF130997 GAAACGga aATGATcTcA TgGctGGC . . .	ATT CATCAGGAAG cacAGCCGGA aAAGGGAT	-2618
vanE	AF136925 GGAA...t GAacAaTTGg TcGTtGGA . . .	TAT gAagAGaAAt ACaA..... . . . TT	-2619
Selected sequence for hybridization probe	ACGAG GATGATTGTA TTGTC (vanB)		1171
Selected sequence for amplification primers		CATCAGGAAR WCGAGCCGGA AAAAG	1111

The sequence numbering refers to the *Enterococcus faecium* vanA gene fragment (SEQ ID NO. 1139). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.

"R" and "W" designate nucleotide positions which are degenerated. "R" stands for A or G; "W" stands for A or T

*This sequence is the reverse-complement of the above selected primer.

TABLE 77

Internal hybridization probe for specific detection of *mecA*.

Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Resistance gene: 1177	mecA 5'-GCT CAA CAA GTT CCA GAT TA	1178 ^a	1313-1332

^aSequence from databases.

TABLE 78

Specific and ubiquitous primers for nucleic acid amplification
(hexA sequences).

Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial species:	<i>Streptococcus pneumoniae</i>		
1179	5'-ATT TGG TGA CGG GTG ACT TT	1183 ^a	431-450
1181 ^b	5'-AGC AGC TTA CTA GAT GCC GT	1183-1191 ^c	652-671 ^d
	Sequencing primers		
1179	5'-ATT TGG TGA CGG GTG ACT TT	1183 ^a	431-450
1182 ^b	5'-AAC TGC AAG AGA TCC TTT GG	1183 ^a	1045-1064

^aSequences from databases.^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^cThese sequences were aligned to derive the corresponding primer.^dThe nucleotide positions refer to the hexA sequence fragment (SEQ ID NO. 1183).

TABLE 79

Internal hybridization probe for specific detection of hexA sequences.

Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial species:	<i>Streptococcus pneumoniae</i>		
1180 ^a	5'-TCC ACC GTT GCC AAT CGC A	1183-1191 ^b	629-647 ^c

^aThis sequences is from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.^bThese sequences were aligned to derive the corresponding primer.^cThe nucleotide positions refer to the hexA sequence fragment (SEQ ID NO. 1183).

TABLE 80

Strategy for the selection of *Streptococcus pneumoniae* species-specific amplification primers and hybridization probe from hexA sequences.

	428	453	626	SEQ ID NO.:
<i>S. pneumoniae</i>	TGG ATTGTTGAC GGGTGACTTT TAT . . . ATTTG CGATTGGCAA CGGTGGAGCA			1183
<i>S. pneumoniae</i>	~~~ ~~~~~TGAC GGGTGACTTT TAT . . . ATTTG CGATTGGCAA CGGTGGAGCA			1184
<i>S. pneumoniae</i>	~~~ ~~~~~TGAC GGGTGACTTT TAT . . . ATTTG CGATTGGCAA CGGTGGAGCA			1185
<i>S. pneumoniae</i>	~~~ ~~~~~TGAC GGGTGACTTT TAT . . . ATTTG CGATTGGCAA CGGTGGAGCA			1186
<i>S. pneumoniae</i>	~~~ ~~~~~TGAC GGGTGACTTT TAT . . . ATTTG CGATTGGCAA CGGTGGAGCA			1187
<i>S. oralis</i>	~~~ ~~~~~~~ GGGTGACTTT TAT . . . ATCca CGAcTGGCAG CtGTGGAGCA			1188
<i>S. mitis</i>	~~~ ~~~~~GGTGAC GGGTGACTTT TAT . . . ATTca CGATTGGCAG CtGTGGAGCA			1189
<i>S. mitis</i>	~~~ ~~~~~TGAC GGGTGACTTT CAG . . . GCGaG gagcTGtCtc CtaTGGAGCG			1190
<i>S. mitis</i>	~~~ ~~~~~TGAC GGGTGACTTT CAG . . . GCGaG gaAcTGtCtc CtaTGGAGCG			1191
Selected sequence for amplification primer	ATTTGTTGAC GGGTGACTTT			1179
Selected sequences for amplification primers ^a				1181 1182
Selected sequence for hybridization probe ^a		TG CGATTGGCAA CGGTGGAA		1180

TABLE 80-continued

Strategy for the selection of <i>Streptococcus pneumoniae</i> species-specific amplification primers and hybridization probe from hexA sequences.			
	674	1042	1067
	SEQ ID NO.:		
<i>S. pneumoniae</i>	AACGGCATCT AGTAAGCTGC TCCA . . . AATCCAAAG GATCTCTTGC AGTTGGC		1183
<i>S. pneumoniae</i>	AACGGCATCT AGTAAGCTGC TCCA . . . AATCCAAAG GATCTCTTG~ ~~~~~		1184
<i>S. pneumoniae</i>	AACGGCATCT AGTAAGCTGC TCCA . . . AATCCAAAG GATCTCT~ ~~~~~		1185
<i>S. pneumoniae</i>	AACGGCATCT AGTAAGCTGC TCCA . . . AATCCAAAG GATCTCTT~ ~~~~~		1186
<i>S. pneumoniae</i>	AACGGCATCT AGTAAGCTGC TCCG . . . AATCCAAAG GATCTCTT~ ~~~~~		1187
<i>S. oralis</i>	AgCGGCAGCT AGTAAGCTcC TCCA . . . ~~~~~ ~~~~~ ~~~~~		1188
<i>S. mitis</i>	AgCGGCATCT AGTAAaCTGC TTCA . . . AATCCAAAG GATCTCTT~ ~~~~~		1189
<i>S. mitis</i>	TcaGGCAGCa gGgAAaCTGC TGGA . . . ~~~~~ ~~~~~ ~~~~~		1190
<i>S. mitis</i>	TcaGGCAGCg gGgAAatTGC TAGA . . . AATCCAAAG GATCTCTT~ ~~~~~		1191
Selected sequence for amplification primer			1179
Selected sequences for amplification primers ^a	ACGGCATCT AGTAAGCTGC T CCAAAG GATCTCTTGC AGTT		1181 1182
Selected sequence for hybridization probe ^a			1180

The sequence numbering refers to the *Streptococcus pneumoniae* hexA gene fragment (SEQ ID NO. 1183). Nucleotides in capitals are identical to the selected sequences or match those sequences. Mismatches are indicated by lower-case letters. Dots indicate gaps in the sequences displayed.
"~" indicate incomplete sequence data.

^aThis sequence is the reverse-complement of the selected primer.

TABLE 81

Specific and ubiquitous primers for nucleic acid amplification (pcp sequence).

Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial species: 1211	5'-ATT CTT GTA ACA GGC TTT GAT CCC	1215 ^a	291-314
1210 ^b	5'-ACC AGC TTG CCC AAT ACA AAG G	1215 ^a	473-494

^aSequences from databases.

^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

TABLE 82

Specific and ubiquitous primers for nucleic acid amplification of *S. saprophyticus* sequences of unknown coding potential.

Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial species: 1208	5'-TCA AAA AGT TTT CTA AAA AAT TTA C	74,1093, 1198 ^b	169-193 ^c
1209 ^d	5'-ACG GGC GTC CAC AAA ATC AAT AGG A	74,1093, 1198 ^b	355-379 ^c

^aThis sequence is from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

^bThese sequences were aligned to derive the corresponding primer.

^cThe nucleotide positions refer to the *S. saprophyticus* unknown gene sequence fragment (SEQ ID NO. 1198).

TABLE 83

Molecular beacon internal hybridization probes for specific detection of antimicrobial agents resistance gene sequences.

SEQ ID NO.	Nucleotide sequence ^a	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Resistance gene: <i>gyrA</i>			
2250	5'- <u>CCG</u> TCG GAT GGT GTC GTA TAC CGC GGA GTC GCC <u>GAC</u> GG	1954 ^b	218-243
2251	5'- <u>CGG</u> <u>AGC</u> CGT TCT CGC TGC GTT ACA TGC TGG TGG <u>CTC</u> CG	1954 ^b	259-286
Resistance gene: <i>mecA</i>			
1231	5'- <u>GCG</u> <u>AGC</u> CCG AAG ATA AAA AAG AAC CTC TGC TGC <u>TCG</u> C	1178 ^b	1291-1315
Resistance gene: <i>parC</i>			
1938 ^b	5'- <u>CCG</u> <u>CGC</u> ACC ATT GCT TCG TAC ACT GAG GAG TCT <u>CCG</u> <u>GG</u>	1321 ^c	232-260
1939	5'- <u>CGA</u> <u>CCC</u> <u>GGA</u> TGG TAG TAT CGA TAA TGA TCC GCC AGC <u>GGC</u> <u>CGG</u> GTC G	1321 ^c	317-346
1955 ^b	5'- <u>CGC</u> <u>GCA</u> ACC ATT GCT TCG TAC ACT GAG GAG TCT <u>CGC</u> <u>CG</u>	1321 ^c	235-260
Resistance gene: <i>vanA</i>			
1239	5'- <u>GCG</u> <u>AGC</u> GCA GAC CTT TCA GCA GAG GAG <u>GCT</u> <u>CGC</u>	1051	860-880
1240	5'- <u>GCG</u> <u>AGC</u> CGG CAA GAC AAT ATG ACA GCA AAA TCG <u>CTC</u> <u>GC</u>	1051	663-688
Resistance gene: <i>vanB</i>			
1241	5'- <u>GCG</u> <u>AGC</u> GGG GAA CGA GGA TGA TTT GAT TGG <u>CTC</u> <u>GC</u>	1117	555-577
Resistance gene: <i>vanD</i>			
1593	5'- <u>CCG</u> <u>AGC</u> GAT TTA CCG GAT ACT TGG CTG <u>ICG</u> CTC <u>GG</u>	1594	835-845

^aUnderlined nucleotides indicate the molecular beacon's stem.

^bThis sequence is from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

^cSequence from databases.

TABLE 84

Molecular beacon internal hybridization probe for specific detection of *S. aureus* gene sequences of unknown coding potential.

SEQ ID NO.	Nucleotide sequence ^a	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Bacterial species: <i>S. aureus</i>			
1232	5'- <u>GGA</u> <u>GCC</u> GCG CGA TTT TAT AAA TGA ATG TTG ATA ACC <u>GGC</u> <u>TCC</u>	1244	53-80

^aUnderlined nucleotides indicate the molecular beacon's stem.

TABLE 85

Molecular beacon internal hybridization probes for specific detection of *tuf* sequences.

SEQ ID NO.	Nucleotide sequence ^a	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Bacterial species: <i>Chlamydia pneumoniae</i>			
2091	5'- <u>CGC</u> <u>GAC</u> TTG AGA TGG AAC TTA GTG AGC TTC TTG <u>GTC</u> <u>GCG</u>	20	157-183
2092	5'- <u>CGC</u> <u>GAC</u> GAA AGA ACT TCC TGA AGG TCG	20	491-516

TABLE 85-continued

Molecular beacon internal hybridization probes for specific detection of tuf sequences.			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence ^a	SEQ ID NO.	Nucleotide position
TGC AGG <u>TCC</u> AG			
Bacterial species:	<i>Chlamydia trachomatis</i>		
2213	5'- <u>CGT</u> GCC ATT GAC ATG ATT TCC GAA GAA GAC GCT GAA <u>GCG</u> <u>ACG</u>	1739 ^b	412-441
Bacterial species:	<i>Enterococcus faecalis</i>		
1236	5'- <u>GCG</u> <u>AGC</u> CGT GGT GAA GTT CGC GTT GGT <u>GCG</u> <u>TCG</u> C	883	370-391
Bacterial species:	<i>Enterococcus faecium</i>		
1235	5'- <u>GCG</u> <u>AGC</u> CGA AGT TGA AGT TGT TGG TAT TGC <u>TGG</u> <u>CTC</u> GC	64	412-437
Bacterial species:	<i>Legionella pneumophila</i>		
2084 ^c	5'- <u>CAC</u> <u>GCG</u> TCA ACA CCC GTA CAA GTC GTC TTT <u>TGC</u> <u>GCG</u> TG	112	461-486
Bacterial species:	<i>Mycoplasma pneumoniae</i>		
2096 ^c	5'- <u>GCG</u> <u>GAC</u> CGG TAC CAC GGC CAG TAA TCG TGT <u>GCG</u> G	2097 ^b	658-679
Bacterial species:	<i>Neisseria gonorrhoeae</i>		
2177	5'- <u>GGC</u> <u>ACG</u> GAC AAA CCA TTC CTG CTG CCT ATC GAA ACG TGT <u>TCC</u> <u>CGT</u> <u>GCC</u>	126	323-357
2178	5'- <u>GGC</u> <u>ACG</u> ACA AAC CAT TCC TGC TGC CTA TCG AAC <u>GTG</u> CC	126	323-348
2179	5'- <u>GGC</u> <u>ACG</u> TCT ACT TCC GTA CCA CTG ACG TAA CGG <u>GCT</u> <u>GCC</u>	126	692-718
^a Underlined nucleotides indicate the molecular beacon's stem.			
^b Sequence from databases.			
^c This sequence is from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.			
Bacterial species:	<i>Pseudomonas aeruginosa</i>		
2122	5'- <u>CCG</u> <u>AGC</u> GAA TGT AGG AGT CCA GGG TCT CTG <u>CTC</u> GG	153, 880, 2138 ^{b,c}	280-302 ^d
Bacterial species:	<i>Staphylococcus aureus</i>		
2186	5'- <u>ACG</u> <u>GCG</u> TCA AAG CAG AAG TAT ACG TAT TAT CAA AAG ACG <u>GCG</u> GT	1728	615-646
Bacterial group:	<i>Staphylococcus</i> sp. other than <i>S. aureus</i>		
1233	5'- <u>GCG</u> <u>AGC</u> GTT ACT GGT GTA GAA ATG TTC CGG <u>CTC</u> GC	878	372-394
Fungal species:	<i>Candida albicans</i>		
2073	5'- <u>CCG</u> <u>AGC</u> AAC ATG ATT GAA CCA TCC ACC AAC <u>TGG</u> <u>CTC</u> GG	408	404-429
Fungal species:	<i>Candida dubliniensis</i>		
2074	5'- <u>CCG</u> <u>AGC</u> AAC ATG ATT GAA GCT TCC ACC AAC <u>TGG</u> <u>CTC</u> GG	414	416-441
Fungal species:	<i>Candida glabrata</i>		
2110 ^b	5'- <u>GCG</u> <u>GGC</u> CCT TAA CGA TTT CAG CGA ATC TGG ATT CAG <u>CCC</u> GC	417	307-335
2111	5'- <u>GCG</u> GGC ATG TTG AAG CCA CCA CCA ACG CTT CCT GGC CCG C	417	419-447
Fungal species:	<i>Candida krusei</i>		
2112 ^b	5'- <u>GCG</u> <u>GGC</u> TTG ATG AAG TTT GGG TTT CCT TGA CAA <u>TTG</u> <u>CCC</u> GC	422	318-347
2113	5'- <u>GCG</u> <u>GGC</u> ACA AGG GTT GGA CTA AGG AAA CCA AGG CAG <u>CCC</u> GC	422	419-447
2114	5'- <u>GCG</u> <u>GGC</u> ATC GAT GCT ATT GAA CCA CCT GTC AGA CCG <u>CCC</u> GC	422	505-533

^aUnderlined nucleotides indicate the molecular beacon's stem.

TABLE 85-continued

Molecular beacon internal hybridization probes for specific detection of tuf sequences.

		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence ^a	SEQ ID NO.	Nucleotide position
^b Sequence from databases.			
^c These sequences were aligned to derive the corresponding primer.			
^d The nucleotide positions refer to the <i>P. aeruginosa</i> tuf sequence fragment (SEQ ID NO. 153).			
Fungal species: <i>Candida lusitaniae</i>			
2115 ^b	5'- <u>GCG</u> GGC GGT AAG TCC ACC GGT AAG ACC TTG TTG <u>GCC</u> <u>CGC</u>	424	304-330
2116	5' <u>GCG</u> GGC GTA AGT CAC CGG TAA GAC CTT GTT <u>GGC</u> <u>CCG</u> <u>C</u>	424	476-502
2117	5' <u>CGC</u> <u>GCG</u> GAC GCC ATT GAG CCA CCT TCG AGA <u>GCC</u> <u>CGC</u>	424	512-535
Fungal species: <i>Candida parapsilosis</i>			
2118 ^b	5'- <u>GCG</u> GGC TCC TTG ACA ATT TCT TCG TAT CTG TTC TTG <u>GCC</u> <u>CGC</u>	426	301-330
Fungal species: <i>Candida tropicalis</i>			
2119	5'- <u>GCG</u> GGC TTA CAA CCC TAA GGC TGT TCC ATT CGT <u>TGC</u> <u>CGC</u> <u>C</u>	429	357-384
2120	5'- <u>GCG</u> GGC AGA AAC CAA GGC TGG TAA GGT TAC CGG <u>AGC</u> <u>CCG</u> <u>C</u>	429	459-487
Fungal species: <i>Cryptococcus neoformans</i>			
2106	5'- <u>GCG</u> <u>AGC</u> AGA GCA CGC CCT CCT CGC <u>CGC</u> <u>TCG</u> <u>C</u>	623, 1985, 1986 ^c	226-244 ^d
2107	5'- <u>GCG</u> <u>AGC</u> TCC CCA TCT CTG GTT GGC <u>ACG</u> <u>CTC</u> <u>GC</u>	623, 1985, 1986 ^c	390-408 ^d
Bacterial genus: <i>Legionella</i> sp.			
2083	5'- <u>CCG</u> <u>CCG</u> ATG TTC CGT AAA TTA CTT GAI GAA GGT CGA GCG <u>GCG</u> <u>GG</u>	111-112 ^d	488-519 ^e
^a Underlined nucleotides indicate the molecular beacon's stem.			
^b This sequence is from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.			
^c These sequences were aligned to derive the corresponding primer.			
^d The nucleotide positions refer to the <i>C. neoformans</i> tuf (EF-1) sequence fragment (SEQ ID NO. 623).			
^e The nucleotide positions refer to the <i>L. pneumophila</i> tuf (EF-1) sequence fragment (SEQ ID NO. 112).			
Fungal genus: <i>Candida</i> sp.			
2108	5'- <u>GCG</u> GGC AAC TTC RTC AAG AAG GTT GGT TAC AAC <u>CCG</u> <u>CCC</u> <u>GC</u>	414, 417, 422, 424, 426, 429, 624 ^b	52-80 ^c
2109	5'- <u>GCG</u> GGC CCA ATC TCT GGT TGG AAY GGT GAC AAG <u>CCC</u> <u>GC</u>	Same as SEQ ID NO. 2108	100-125 ^c
Bacterial group: <i>Pseudomonads</i>			
2121	5'- <u>CGA</u> <u>CCG</u> CIA GCC GCA CAC CAA GTT <u>CCG</u> <u>GTC</u> <u>G</u>	153-155, 205, 880, 2137 ^d , 2138 ^{d,b}	598-616 ^e

^aUnderlined nucleotides indicate the molecular beacon's stem.

^bThese sequences were aligned to derive the corresponding primer.

^cThe nucleotide positions refer to the *C. albicans* tuf (EF-1) sequence fragment (SEQ ID NO. 624).

^dSequence from databases.

^eThe nucleotide positions refer to the *P. aeruginosa* tuf sequence fragment (SEQ ID NO. 153).

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TABLE 86

Molecular beacon internal hybridization probes for specific detection of ddl and mtl gene sequences.			
		Originating DNA fragment	
SEQ ID NO.Nucleotide sequence ^a		SEQ ID NO.	Nucleotide position
Bacterial species: <i>E. faecium</i> (ddl)			
1237	5'- <u>GCG</u> AGC CGC GAA ATC GAA GTT GCT GTA TTA GGG <u>CTC</u> GC	1242 ^b	334-359
Bacterial species: <i>E. faecalis</i> (mtl)			
1238	5'- <u>GCG</u> AGC GGC GTT AAT TTT GGC ACC GAA GAA GAG <u>CTC</u> GC	1243 ^b	631-656

^aUnderlined nucleotides indicate the molecular beacon's stem.^bSequence from databases.

TABLE 87

Internal hybridization probe for specific detection of <i>S. aureus</i> sequences of unknown coding potential.			
		Originating DNA fragment	
SEQ ID NO.Nucleotide sequence		SEQ ID NO.	Nucleotide position
Bacterial species: <i>Staphylococcus aureus</i>			
1234	5'-ACT AAA TAA ACG CTC ATT CG	1244	35-54

TABLE 88

Specific and ubiquitous primers for nucleic acid amplification (antimicrobial agents resistance genes sequences).			
		Originating DNA fragment	
SEQ ID NO.Nucleotide sequence		SEQ ID NO.	Nucleotide position
Resistance gene: aac(2')-Ia			
1344	5'-AGC AGC AAC GAT GTT ACG CAG CAG	1348 ^a	163-186
1345 ^b	5'-CCC GCC GAG CAT TTC AAC TAT TG	1348 ^a	392-414
1346	5'-GAT GTT ACG CAG CAG GGC AGT C	1348 ^a	172-193
1347 ^b	5'-ACC AAG CAG GTT CGC AGT CAA GTA	1348 ^a	467-490
Resistance gene: aac(3')-Ib			
1349	5'-CAG CCG ACC AAT GAG TAT CTT GCC	1351 ^a	178-201
1350 ^b	5'-TAA TCA GGG CAG TTG CGA CTC CTA	1351 ^a	356-379
Resistance gene: aac(3')-IIb			
1352	5'-CCA CGC TGA CAG AGC CGC ACC G	1356 ^a	383-404
1353 ^b	5'-GGC CAG CTC CCA TCG GAC CCT G	1356 ^a	585-606
1354	5'-CAC GCT GAC AGA GCC GCA CCG	1356 ^a	384-404
1355 ^b	5'-ATG CCG TTG CTG TCG AAA TCC TCG	1356 ^a	606-629
Resistance gene: aac(3')-IVa			
1357	5'-GCC CAT CCA TTT GCC TTT GC	1361 ^a	295-314
1358 ^b	5'-GCG TAC CAA CTT GCC ATC CTG AAG	1361 ^a	517-540

TABLE 88-continued

Specific and ubiquitous primers for nucleic acid amplification (antimicrobial agents resistance genes sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
1359	5'-TGC CCC TGC CAC CTC ACT C	1361 ^a	356-374
1360 ^b	5'-CGT ACC AAC TTG CCA TCC TGA AGA	1361 ^a	516-539
Resistance gene: aac(3')-VIa			
1362	5'-CGC CGC CAT CGC CCA AAG CTG G	1366 ^a	285-306
1363 ^b	5'-CGG CAT ATG CGA GCG CGG TGA CTG	1366 ^a	551-574
1364	5'-TTT CTC GCC CAC GCA GGA AAA ATC	1366 ^a	502-525
1365 ^b	5'-CAT CCT CGA CGA ATA TGC CGC G	1366 ^a	681-702
Resistance gene: aac(6')-Ia			
1367	5'-CAA ATA TAC TAA CAG AAG CGT TCA	1371 ^a	56-79
1368 ^b	5'-AGG ATC TTG CCA ATA CCT TTA T	1371 ^a	269-290
1379	5'-AAA CCT TTG TTT CGG TCT GCT AAT	1371 ^a	153-176
1380 ^b	5'-AAG CGA TTC CAA TAA TAC CTT GCT	1371 ^a	320-343
Resistance gene: aac(6')-Ic			
1372	5'-GCT TTC GTT GCC TTT GCC GAG GTC	1376 ^a	157-180
1373 ^b	5'-CAC CCC TGT TGC TTC GCC CAC TC	1376 ^a	304-326
1374	5'-AGA TAT TGG CTT CGC CGC ACC ACA	1376 ^a	104-127
1375 ^b	5'-CCC TGT TGC TTC GCC CAC TCC TG	1376 ^a	301-323
Resistance gene: ant(3')-Ia			
1377	5'-GCC GTG GGT CGA TGT TTG ATG TTA	1381 ^a	100-123
1378 ^b	5'-GCT CGA TGA CGC CAA CTA CCT CTG	1381 ^a	221-244
1379	5'-AGC AGC AAC GAT GTT ACG CAG CAG	1381 ^a	127-150
1380 ^b	5'-CGC TCG ATG ACG CCA ACT ACC TCT	1381 ^a	222-245
Resistance gene: ant(4')-Ia			
1382	5'-TAG ATA TGA TAG GCG GTA AAA AGC	1386 ^a	149-172
1383 ^b	5'-CCC AAA TTC GAG TAA GAG GTA TT	1386 ^a	386-408
1384	5'-GAT ATG ATA GGC GGT AAA AAG C	1386 ^a	151-172
1385 ^b	5'-TCC CAA ATT CGA GTA AGA GGT A	1386 ^a	388-409
Resistance gene: aph(3')-Ia			
1387	5'-TTA TGC CTC TTC CGA CCA TCA AGC	1391 ^a	233-256
1388 ^b	5'-TAC GCT CGT CAT CAA AAT CAC TCG	1391 ^a	488-511
1389	5'-GAA TAA CGG TTT GGT TGA TGC GAG	1391 ^a	468-491
1390 ^b	5'-ATG GCA AGA TCC TGG TAT CGG TCT	1391 ^a	669-692
Resistance gene: aph(3')-IIa			
1392	5'-TGG GTG GAG AGG CTA TTC GGC TAT	1396 ^a	43-66
1393 ^b	5'-CAG TCC CTT CCC GCT TCA GTG AC	1396 ^a	250-272
1394	5'-GAC GTT GTC ACT GAA GCG GGA AGG	1396 ^a	244-267
1395 ^b	5'-CTT GGT CGA ATG GGC AGG TAG	1396 ^a	386-409
Resistance gene: aph(3')-IIIa			
1397	5'-GTG GGA GAA ATT GAA AAC CTA T	1401 ^a	103-124
1398 ^b	5'-ATG GAG TGA AAG AGC CTG AT	1401 ^a	355-374
1399	5'-ACC TAT GAT GTG GAA CGG GAA AAG	1401 ^a	160-183
1400 ^b	5'-CGA TGG AGT GAA AGA GCC TGA TG	1401 ^a	354-376
Resistance gene: aph(3')-VIa			
1402	5'-TAT TCA ACA ATT TAT CGG AAA CAG	1406 ^a	18-41
1403 ^b	5'-TCA GAG AGC CAA CTC AAC ATT TT	1406 ^a	175-197
1404	5'-AAA CAG CGT TTT AGA GCC AAA TAA	1406 ^a	36-59
1405 ^b	5'-TTC TCA GAG AGC CAA CTC AAC ATT	1406 ^a	177-200
Resistance gene: blaCARB			
1407	5'-CCC TGT AAT AGA AAA GCA AGT AGG	1411 ^a	351-374
1408 ^b	5'-TTG TCG TAT CCC TCA AAT CAC C	1411 ^a	556-577

TABLE 88-continued

Specific and ubiquitous primers for nucleic acid amplification (antimicrobial agents resistance genes sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
1409	5'-TGG GAT TAC AAT GGC AAT CAG CG	1411 ^a	205-227
1410 ^b	5'-GGG GAA TAG GTC ACA AGA TCT GCT T	1411 ^a	329-353
Resistance gene: blaCMY-2			
1412	5'-GAG AAA ACG CTC CAG CAG GGC	1416 ^a	793-813
1413 ^b	5'-CAT GAG GCT TTC ACT GCG GGG	1416 ^a	975-995
1414	5'-TAT CGT TAA TCG CAC CAT CAC	1416 ^a	90-110
1415 ^b	5'-ATG CAG TAA TGC GGC TTT ATC	1416 ^a	439-459
Resistance genes: blaCTX-M-1, blaCTX-M-2			
1417	5'-TGG TTA ACT AYA ATC CSA TTG CGG A	1423 ^a	314-338
1418 ^b	5'-ATG CTT TAC CCA GCG TCA GAT T	1423 ^a	583-604
Resistance gene: blaCTX-M-1			
1419	5'-CGA TGA ATA AGC TGA TTT CTC ACG	1423 ^a	410-433
1420 ^b	5'-TGC TTT ACC CAG CGT CAG ATT ACG	1423 ^a	580-603
1421	5'-AAT TAG AGC GGC AGT CGG GAG GAA	1423 ^a	116-139
1422 ^b	5'-GAA ATC AGC TTA TTC ATC GCC ACG	1423 ^a	405-428
Resistance gene: blaCTX-M-2			
1424	5'-GTT AAC GGT GAT GGC GAC GCT AC	1428 ^a	30-52
1425 ^b	5'-GAA TTA TCG GCG GTG TTA ATC AGC	1428 ^a	153-176
1426	5'-CAC GCT CAA TAC CGC CAT TCC A	1428 ^a	510-531
1427 ^b	5'-TTA TCG CCC ACT ACC CAT GAT TTC	1428 ^a	687-710
Resistance gene: blaIMP			
1429	5'-TTT ACG GCT AAA GAT ACT GAA AAG T	1433 ^a	205-229
1430 ^b	5'-GTT TAA AAC AAC CAC CGA ATA AT	1433 ^a	513-538
1431	5'-TAA TTG ACA CTC CAT TTA CGG CTA A	1433 ^a	191-215
1432 ^b	5'-ACC GAA TAA TAT TTT CCT TTC AGG CA	1433 ^a	497-522
Resistance gene: blaOXA2			
1434	5'-CAC AAT CAA GAC CAA GAT TTG CGA T	1438 ^a	319-343
1435 ^b	5'-GAA AGG GCA GCT CGT TAC GAT AGA G	1438 ^a	532-556
Resistance gene: blaOXA10			
1436	5'-CAG CAT CAA CAT TTA AGA TCC CCA	1439 ^a	194-217
1437 ^b	5'-CTC CAC TTG ATT AAC TGC GGA AAT TC	1439 ^a	479-504
Resistance gene: blaPER-1			
1440	5'-AGA CCG TTA TCG TAA ACA GGG CTA AG	1442 ^a	281-306
1441 ^b	5'-TTT TTT GCT CAA ACT TTT TCA GGA TC	1442 ^a	579-604
Resistance gene: blaPER-2			
1443	5'-CTT CTG CTC TGC TGA TGC TTG GC	1445 ^a	32-54
1444 ^b	5'-GGC GAC CAG GTA TTT TGT AAT ACT GC	1445 ^a	304-329
Resistance genes: blaPER-1, blaPER-2			
1446	5'-GGC CTG YGA TTT GTT ATT TGA ACT GGT	1442 ^a	414-440
1447 ^b	5'-CGC TST GGT CCT GTG GTG GTT TC	1442 ^a	652-674
1448	5'-GAT CAG GTG CAR TAT CAA AAC TGG AC	1442 ^a	532-557
1449 ^b	5'-AGC WGG TAA CAA YCC TTT TAA CCG CT	1442 ^a	671-696
Resistance gene: blaSHV			
1883	5'-AGC CGC TTG AGC AAA TTA AAC TA	1900 ^a	71-93
1884 ^b	5'-GTA TCC CGC AGA TAA ATC ACC AC	1900 ^a	763-785
1885	5'-AGC GAA AAA CAC CTT GCC GAC	1900 ^a	313-333
1884 ^b	5'-GTA TCC CGC AGA TAA ATC ACC AC	1900 ^a	763-785

TABLE 88-continued

Specific and ubiquitous primers for nucleic acid amplification (antimicrobial agents resistance genes sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Resistance gene: blaTEM			
1906	5'-CCT TAT TCC CTT TTT TGC GG	1927 ^a	27-46
1907 ^b	5'-CAC CTA TCT CAG CGA TCT GTC T	1927 ^a	817-838
1908	5'-AAC AGC GGT AAG ATC CTT GAG AG	1927 ^a	148-170
1907 ^b	5'-CAC CTA TCT CAG CGA TCT GTC T	1927 ^a	817-838
Resistance gene: catI			
2145	5'-GCA AGA TGT GGC GTG TTA CGG T	2147 ^a	363-384
2146 ^b	5'-GGG GCG AAG AAG TTG TCC ATA TT	2147 ^a	484-506
Resistance gene: catII			
2148	5'-CAG ATT AAA TGC GGA TTC AGC C	2150 ^a	67-88
2149 ^b	5'-ATC AGG TAA ATC ATC AGC GGA TA	2150 ^a	151-173
Resistance gene: catIII			
2151	5'-ATA TTT CAG CAT TAC CTT GGG TT	2153 ^a	419-441
2152 ^b	5'-TAC ACA ACT CTT GTA GCC GAT TA	2153 ^a	603-625
Resistance gene: catP			
2154	5'-CGC CAT TCA GAG TTT AGG AC	2156 ^a	178-197
2155 ^b	5'-TTC CAT ACC GTT GCG TAT CAC TT	2156 ^a	339-361
Resistance gene: cat			
2157	5'-CCA CAG AAA TTG ATA TTA GTG TTT TAT	2159 ^a	89-115
2158 ^b	5'-TCG CTA TTG TAA CCA GTT CTA	2159 ^a	201-221
2160	5'-TTT TGA ACA CTA TTT TAA CCA GC	2162 ^a	48-70
2161 ^b	5'-GAT TTA ACT TAT CCC AAT AAC CT	2162 ^a	231-253
Resistance gene: dfrA			
1450	5'-ACC ACT GGG AAT ACA CTT GTA ATG GC	1452 ^a	106-131
1451 ^b	5'-ATC TAC CTG GTC AAT CAT TGC TTC GT	1452 ^a	296-321
Resistance gene: dhfrIa			
1457	5'-CAA AGG TGA ACA GCT CCT GTT T	1461 ^a	75-96
1458 ^b	5'-TCC GTT ATT TTC TTT AGG TTG GTT AAA	1461 ^a	249-275
1459	5'-AAG GTG AAC AGC TCC TGT TT	1461 ^a	77-96
1560 ^b	5'-GAT CAC TAC GTT CTC ATT GTC A	1461 ^a	207-228
Resistance genes: dhfrIa, dhfrXV			
1453	5'-ATC GAA GAA TGG AGT TAT CGG RAA TG	1461 ^a	27-52
1454 ^b	5'-CCT AAA AYT RCT GGG GAT TTC WGG A	1461 ^a	384-408
1455	5'-CAG GTG GTG GGG AGA TAT ACA AAA	1461 ^a	290-313
1456 ^b	5'-TAT GTT AGA SRC GAA GTC TTG GKT AA	1461 ^a	416-441
Resistance gene: dhfrIb			
1466	5'-AAG CAT TGA CCT ACA ATC AGT GT	1470 ^a	98-120
1467 ^b	5'-AAT ACA ACT ACA TTG TCA TCA TTT GAT	1470 ^a	204-230
1468	5'-CGT TAC CCG CTC AGG TTG GAC ATC AA	1470 ^a	183-208
1469 ^b	5'-CAT CCC CCT CTG GCT CGA TGT CG	1470 ^a	354-376
Resistance gene: dhfrV			
1471	5'-GAT AAT GAC AAC GTA ATA GTA TTC CC	1475 ^a	208-233
1472 ^b	5'-GCT CAA TAT CAA TCG TCG ATA TA	1475 ^a	342-364
1473	5'-TTA AAG CCT TGA CGT ACA ACC AGT GG	1475 ^a	95-120
1474 ^b	5'-TGG GCA ATG TTT CTC TGT AAA TCT CC	1475 ^a	300-325

TABLE 88-continued

Specific and ubiquitous primers for nucleic acid amplification (antimicrobial agents resistance genes sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Resistance genes: dhfrIb, dhfrV			
1462	5'-GCA CTC CCY AAT AGG AAA TAC GC	1470 ^a	157-179
1463 ^b	5'-AGT GTT GCT CAA AAA CAA CTT CG	1470 ^a	405-427
1464	5'-ACG TTY GAA TCT ATG GGM GCA CT	1470 ^a	139-161
1465 ^b	5'-GTC GAT AAG TGG AGC GTA GAG GC	1470 ^a	328-350
Resistance gene: dhfrVI			
1476	5'-GGC GAG CAG CTC CTA TTC AAA G	1480 ^a	79-100
1477 ^b	5'-TAG GTA AGC TAA TGC CGA TTC AAC A	1480 ^a	237-261
1478	5'-GAG AAT GGA GTC ATT GGC TCT GGA TT	1480 ^a	31-56
1479 ^b	5'-GCG AAA TAC ACA ACA TCA GGG TCA T	1480 ^a	209-233
Resistance gene: dhfrVII			
1485	5'-AAA ATG GCG TAA TCG GTA ATG GC	1489 ^a	32-54
1486 ^b	5'-CAT TTG AGC TTG AAA TTC CTT TCC TC	1489 ^a	189-214
1487	5'-AAT CGA AAA TAT GCA GTA GTG TCG AG	1489 ^a	166-191
1488 ^b	5'-AGA CTA TTG TAG ATT TGA CCG CCA	1489 ^a	294-317
Resistance genes: dhfrVII, dhfrXVII			
1481	5'-RTT ACA GAT CAT KTA TAT GTC TCT	1489 ^a	268-291
1482 ^b	5'-TAA TTT ATA TTA GAC AWA AAA AAC TG	1489 ^a	421-446
1483	5'-CAR YGT CAG AAA ATG GCG TAA TC	1489 ^a	23-45
1484 ^b	5'-TKC AAA GCR WTT TCT ATT GAA GGA AA	1489 ^a	229-254
Resistance gene: dhfrVIII			
1490	5'-GAC CTA TGA GAG CTT GCC CGT CAA A	1494 ^a	144-168
1491 ^b	5'-TCG CCT TCG TAC AGT CGC TTA ACA AA	1494 ^a	376-401
1492	5'-CAT TTT AGC TGC CAC CGC CAA TGG TT	1494 ^a	18-43
1493 ^b	5'-GCG TCG CTG ACG TTG TTC ACG AAG A	1494 ^a	245-269
Resistance gene: dhfrIX			
1495	5'-TCT CTA AAC ATG ATT GTC GCT GTC	1499 ^a	7-30
1496 ^b	5'-CAG TGA GGC AAA AGT TTT TCT ACC	1499 ^a	133-156
1497	5'-CGG ACG ACT TCA TGT GGT AGT CAG T	1499 ^a	171-195
1498 ^b	5'-TTT GTT TTC AGT AAT GGT CGG GAC CT	1499 ^a	446-471
Resistance gene: dhfrXII			
1500	5'-ATC GGG TTA TTG GCA ATG GTC CTA	1504 ^a	50-73
1501 ^b	5'-GCG GTA GTT AGC TTG GCG TGA GAT T	1504 ^a	201-225
1502	5'-GCG GGC GGA GCT GAG ATA TAC A	1504 ^a	304-325
1503 ^b	5'-AAC GGA GTG GGT GTA CGG AAT TAC AG	1504 ^a	452-477
Resistance gene: dhfrXIII			
1505	5'-ATT TTT CGC AGG CTC ACC GAG AGC	1507 ^a	106-129
1506 ^b	5'-CGG ATG AGA CAA CCT CGA ATT CTG CTG	1507 ^a	413-439
Resistance gene: dhfrXV			
1508	5'-AGA ATG TAT TGG TAT TTC CAT CTA TCG	1512 ^a	215-241
1509 ^b	5'-CAA TGT CGA TTG AAA TAT GTA AA	1512 ^a	336-361
1510	5'-TGG AGT GCC AAA GGG GAA CAA T	1512 ^a	67-88
1511 ^b	5'-CAG ACA CAA TCA CAT GAT CCG TTA TCG	1512 ^a	266-292
Resistance gene: dhfrXVII			
1513	5'-TTC AAG CTC AAA TGA AAA CGT CC	1517 ^a	201-223
1514 ^b	5'-GAA ATT CTC AGG CAT TAT AGG GAA T	1517 ^a	381-405
1515	5'-GTG GTC AGT AAA AGG TGA GCA AC	1517 ^a	66-88
1516 ^b	5'-TCT TTC AAA GCA TTT TCT ATT GAA GG	1517 ^a	232-257

TABLE 88-continued

Specific and ubiquitous primers for nucleic acid amplification (antimicrobial agents resistance genes sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Resistance gene: embB			
2102	5'-CAC CTT CAC CCT GAC CGA CG	2105 ^a	822-841
2103 ^b	5'-CGA ACC AGC GGA AAT AGT TGG AC	2105 ^a	948-970
Resistance genes: ereA, ereA2			
1528	5'-AAC TTG AGC GAT TTT CGG ATA CCC TG	1530 ^a	80-105
1529 ^b	5'-TTG CCG ATG AAA TAA CCG CCG ACT	1530 ^a	317-340
Resistance gene: ereB			
1531	5'-TCT TTT TGT TAC GAC ATA CGC TTT T	1535 ^a	152-176
1532 ^b	5'-AGT GCT TCT TTA TCC GCT GTT CTA	1535 ^a	456-479
1533	5'-CAG CGG ATA AAG AAG CAC TAC ACA TT	1535 ^a	461-486
1534 ^b	5'-CCT CCT GAA ATA AAG CCC GAC AT	1535 ^a	727-749
Resistance gene: gyrA			
1340	5'-GAA CAA GGT ATG ACA CCG GAT AAA T	1299 ^a	163-188
1341 ^b	5'-GAT AAC TGA AAT CCT GAG CCA TAC G	1299 ^a	274-299
1936	5'-TAC CAC CCG CAC GGC	1954 ^a	205-219
1937 ^b	5'-CGG AGT CGC CGT CGA TG	1954 ^a	309-325
1942	5'-GAC TGG AAC AAA GCC TAT AAA AAA TCA	1954 ^a	148-174
1937 ^b	5'-CGG AGT CGC CGT CGA TG	1954 ^a	309-325
2040	5'-TGT GAC CCC AGA CAA ACC C	2054 ^a	33-51
2041 ^b	5'-GTT GAG CGG CAG CAC TAT CT	2054 ^a	207-226
Resistance gene: inhA			
2098	5'-CTG AGT CAC ACC GAC AAA CGT C	2101 ^a	910-931
2099 ^b	5'-CCA GGA CTG AAC GGG ATA CGA A	2101 ^a	1074-1095
Resistance genes: linA, linA'			
1536	5'-AGA TGT ATT AAC TGG AAA ACA ACA A	1540 ^a	99-123
1537 ^b	5'-CTT TGT AAT TAG TTT CTG AAA ACC A	1540 ^a	352-376
1538	5'-TTA GAA GAT ATA GGA TAC AAA ATA GAA G	1540 ^a	187-214
1539 ^b	5'-GAA TGA AAA AGA AGT TGA GCT T	1540 ^a	404-425
Resistance gene: linB			
1541	5'-TGA TAA TCT TAT ACG TGG GGA ATT T	1545 ^a	246-270
1542 ^b	5'-ATA ATT TTC TAA TTG CCC TGT TTC AT	1545 ^a	359-384
1543	5'-GGG CAA TTA GAA AAT TAT TTA TCA GA	1545 ^a	367-392
1544 ^b	5'-TTT TAC TCA TGT TTA GCC AAT TAT CA	1545 ^a	579-604
Resistance gene: mefA			
1546	5'-CAA GAA GGA ATG GCT GTA CTA C	1548 ^a	625-646
1547 ^b	5'-TAA TTC CCA AAT AAC CCT AAT AAT AGA	1548 ^a	816-842
Resistance gene: mefE			
1549	5'-GCT TAT TAT TAG GAA GAT TAG GGG GC	1551 ^a	815-840
1550 ^b	5'-TAG CAA GTG ACA TGA TAC TTC CGA	1551 ^a	1052-1075
Resistance genes: mefA, mefE			
1552	5'-GGC AAG CAG TAT CAT TAA TCA CTA	1548 ^a	50-73
1553 ^b	5'-CAA TGC TAC GGA TAA ACA ATA CTA TC	1548 ^a	318-343
1554	5'-AGA AAA TTA AGC CTG AAT ATT TAG GAC	1548 ^a	1010-1035
1555 ^b	5'-TAG TAA AAA CCA ATG ATT TAC ACC G	1548 ^a	1119-1143
Resistance genes: mphA, mphK			
1556	5'-ACT GTA CGC ACT TGC AGC CCG ACA T	1560 ^a	33-57
1557 ^b	5'-GAA CGG CAG GCG ATT CTT GAG CAT	1560 ^a	214-237
1558	5'-GTG GTG CAT GGC GAT CTC T	1560 ^a	583-604
1559 ^b	5'-GCC GCA GCG AGG TAC TCT TCG TTA	1560 ^a	855-878

TABLE 88-continued

Specific and ubiquitous primers for nucleic acid amplification (antimicrobial agents resistance genes sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Resistance gene: mupA			
2142	5'-GCC TTA ATT TCG GAT AGT GC	2144 ^a	1831-1850
2143 ^b	5'-GAG AAA GAG CCC AAT TAT CTA ATG T	2144 ^a	2002-2026
Resistance gene: parC			
1342	5'-GAT GTT ATT GGT CAA TAT CAT CCA	1321 ^a	205-229
1343 ^b	5'-AAG AAA CTG TCT CTT TAT TAA TAT CAC GT	1321 ^a	396-425
1934	5'-GAA CGC CAG CGC GAA ATT CAA AAA G	1781	67-91
1935 ^b	5'-AGC TCG CCA TAC TTC GAC AGG	1781	277-297
2044	5'-ACC GTA AGT CGG CCA AGT CA	2055 ^a	176-195
2045 ^b	5'-GTT CTT TCT CCG TAT CGT C	2055 ^a	436-454
Resistance gene: ppf1o-like			
2163	5'-ACC TTC ATC CTA CCG ATG TGG GTT	2165 ^a	922-945
2164 ^b	5'-CAA CGA CAC CAG CAC TGC CAT TG	2165 ^a	1136-1158
Resistance gene: rpoB			
2065	5'-CCA GGA CGT GGA GGC GAT CAC A	2072 ^a	1218-1239
2066 ^b	5'-CAC CGA CAG CGA GCC GAT CAG A	2072 ^a	1485-1506
Resistance gene: satG			
1581	5'-AAT TGG GGA CTA CAC CTA TTA TGA TG	1585 ^a	93-118
1582 ^b	5'-GGC AAA TCA GTC AGT TCA GGA GT	1585 ^a	310-332
1583	5'-CGA TTG GCA ACA ATA CAC TCC TG	1585 ^a	294-316
1584 ^b	5'-TCA CCT ATT TTT ACG CCT GGT AGG AC	1585 ^a	388-413
Resistance gene: sulII			
1961	5'-GCT CAA GGC AGA TGG CAT TCC C	1965 ^a	222-243
1962 ^b	5'-GGA CAA GGC GGT TGC GTT TGA T	1965 ^a	496-517
1963	5'-CAT TCC CGT CTC GCT CGA CAG T	1965 ^a	237-258
1964 ^b	5'-ATC TGC CTG CCC GTC TTG C	1965 ^a	393-411
Resistance gene: tetB			
1966	5'-CAT GCC AGT CTT GCC AAC G	1970 ^a	66-84
1967 ^b	5'-CAG CAA TAA GTA ATC CAG CGA TG	1970 ^a	242-264
1968	5'-GGA GAG ATT TCA CCG CAT AG	1970 ^a	457-476
1969 ^b	5'-AGC CAA CCA TCA TGC TAT TCC A	1970 ^a	721-742
Resistance gene: tetM			
1586	5'-ATT CCC ACA ATC TTT TTT ATC AAT AA	1590 ^a	361-386
1587 ^b	5'-CAT TGT TCA GAT TCG GTA AAG TTC	1590 ^a	501-524
1588	5'-GTT TTT GAA GTT AAA TAG TGT TCT T	1590 ^a	957-981
1589 ^b	5'-CTT CCA TTT GTA CTT TCC CTA	1590 ^a	1172-1192
Resistance gene: vatB			
1609	5'-GCC CTG ATC CAA ATA GCA TAT A	1613 ^a	11-32
1610 ^b	5'-CCT GGC ATA ACA GTC ACA TTC TG	1613 ^a	379-401
1611	5'-TGG GAA AAA GCA ACT CCA TCT C	1613 ^a	301-322
1612 ^b	5'-ACA ACT GAA TTC GCA GCA ACA AT	1613 ^a	424-446
Resistance gene: vatC			
1614	5'-CCA ATC CAG AAG AAA TAT ACC C	1618 ^a	26-47
1615 ^b	5'-ATT AGT TTA TCC CCA ATC AAT TCA	1618 ^a	177-200
1616	5'-ATA ATG AAT GGG GCT AAT CAT CGT AT	1618 ^a	241-266
1617 ^b	5'-GCC AAC AAC TGA ATA AGG ATC AAC	1618 ^a	463-486

TABLE 88-continued

Specific and ubiquitous primers for nucleic acid amplification (antimicrobial agents resistance genes sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Resistance gene: vga			
1619	5'-AAG GCA AAA TAA AAG GAG CAA AGC	1623 ^a	641-664
1620 ^b	5'-TGT ACC CGA GAC ATC TTC ACC AC	1623 ^a	821-843
1621	5'-AAT TGA AGG ACG GGT ATT GTG GAA AG	1623 ^a	843-868
1622 ^b	5'-CGA TTT TGA CAG ATG GCG ATA ATG AA	1623 ^a	975-1000
Resistance gene: vgaB			
1624	5'-TTC TTT AAT GCT CGT AGA TGA ACC TA	1628 ^a	354-379
1625 ^b	5'-TTT TCG TAT TCT TGT TGC TTT C	1628 ^a	578-602
1626	5'-AGG AAT GAT TAA GCC CCC TTC AAA AA	1628 ^a	663-688
1627 ^b	5'-TTA CAT TGC GAC CAT GAA ATT GCT CT	1628 ^a	849-874
Resistance genes: vgb, vgh			
1629	5'-AAG GGG AAA GTT TGG ATT ACA CAA CA	1633 ^a	73-98
1630 ^b	5'-GAA CCA CAG GGC ATT ATC AGA ACC	1633 ^a	445-468
1631	5'-CGA CGA TGC TTT ATG GTT TGT	1633 ^a	576-596
1632 ^b	5'-GTT AAT TTG CCT ATC TTG TCA CAC TC	1633 ^a	850-875
Resistance gene: vgbB			
1634	5'-TTA ACT TGT CTA TTC CCG ATT CAG G	1882 ^a	23-47
1635 ^b	5'-GCT GTG GCA ATG GAT ATT CTG TA	1882 ^a	267-289
1636	5'-TTC CTA CCC CTG ATG CTA AAG TGA	1882 ^a	155-178
1637 ^b	5'-CAA AGT GCG TTA TCC GAA CCT AA	1882 ^a	442-464
Sequencing primers			
Resistance gene: gyrA			
1290	5'-GAY TAY GCI ATG ISI GTI ATH GT	1299 ^a	70-83
1292 ^b	5'-ARI SCY TCI ARI ATR TGI GC	1299 ^a	1132-1152
1291	5'-GCI YTI CCI GAY GTI MGI GAY GG	1299 ^a	100-123
1292 ^b	5'-ARI SCY TCI ARI ATR TGI GC	1299 ^a	1132-1152
1293	5'-ATG GCT GAA TTA CCT CAA TC	1299 ^a	1-21
1294 ^b	5'-ATG ATT GTT GTA TAT CTT CTT CAA C	1299 ^a	2626-2651
1295 ^b	5'-CAG AAA GTT TGA AGC GTT GT	1299 ^a	1255-1275
1296	5'-AAC GAT TCG TGA GTC AGA TA	1299 ^a	1188-1208
1297	5'-CGG TCA ACA TTG AGG AAG AGC T	1300 ^a	29-51
1298 ^b	5'-ACG AAA TCG ACC GTC TCT TTT TC	1300 ^a	415-437
Resistance gene: gyrB			
1301	5'-GTI MGI AWI MGI CCI GSI ATG TA	1307 ^a	82-105
1302 ^b	5'-TAI ADI GGI GGI KKI GCI ATR TA	1307 ^a	1600-1623
1303	5'-GGI GAI GAI DYI MGI GAR GG	1307 ^a	955-975
1304 ^b	5'-CIA RYT TIK YIT TIG TYT G	1307 ^a	1024-1043
1305	5'-ATG GTG ACT GCA TTG TCA GAT G	1307 ^a	1-23
1306 ^b	5'-GTC TAC GGT TTT CTA CAA CGT C	1307 ^a	1858-1888
Resistance gene: parC			
1308	5'-ATG TAY GTI ATI ATG GAY MGI GC	1320 ^a	67-90
1309 ^b	5'-ATI ATY TTR TTI CCY TTI CCY TT	1320 ^a	1993-2016
1310	5'-ATI ATI TSI ATI ACY TCR TC	1320 ^a	1112-1132
1311 ^b	5'-GAR ATG AAR ATI MGI GGI GAR CA	1320 ^a	1288-1311
1312	5'-AAR TAY ATI ATI CAR GAR MGI GC	1321 ^a	67-90
1313 ^b	5'-AMI AYI CKR TGI GGI TTI TTY TT	1321 ^a	2212-2235
1314	5'-TAI GAI TTY ACI GAI SMI CAR GC	1321 ^a	1228-1251
1315 ^b	5'-ACI ATI GCI TCI GCY TGI KSY TC	1321 ^a	1240-1263
1316	5'-GTG AGT GAA ATA ATT CAA GAT T	1321 ^a	1-23
1317 ^b	5'-CAC CAA AAT CAT CTG TAT CTA C	1321 ^a	2356-2378
1318	5'-ACC TAY TCS ATG TAC GTR ATC ATG GA	1320 ^a	58-84
1319 ^b	5'-AGR TCG TCI ACC ATC GGY AGY TT	1320 ^a	832-855

TABLE 88-continued

Specific and ubiquitous primers for nucleic acid amplification (antimicrobial agents resistance genes sequences).			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID	Nucleotide position
Resistance gene: parE			
1322	5'-RTI GAI AAY ISI GTI GAY GAR G	1328 ^a	133-155
1325 ^b	5'-RTT CAT YTC ICC IAR ICC YTT	1328 ^a	1732-1752
1323	5'-ACI AWR SAI GGI GGI ACI CAY G	1328 ^a	829-850
1324 ^b	5'-CCI CCI GCI SWR TCI CCY TC	1328 ^a	1280-1302
1326	5'-TGA TTC AAT ACA GGT TTT AGA G	1328 ^a	27-49
1327 ^b	5'-CTA GAT TTC CTC CTC ATC AAA T	1328 ^a	1971-1993

^aSequence from databases.^bThese sequences are from the complementary DNA strand of the sequence of the originating fragment given in the Sequence Listing.

TABLE 89

Internal hybridization probes for specific detection of antimicrobial agents resistance genes sequences.			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID	Nucleotide position
Resistance gene: aph3'VIA			
2252	5'-CCA CAT ACA GTG TCT CTC	1406 ^a	149-166
Resistance gene: blaSHV			
1886	5'-GAC GCC CGC GCC ACC ACT	1900 ^a	484-501
1887	5'-GAC GCC CGC GAC ACC ACT A	1899 ^a	514-532
1888	5'-GAC GCC CGC AAC ACC ACT A	1901 ^a	514-532
1889	5'-GTT CGC AAC TGC AGC TGC TG	1899 ^a	593-612
1890	5'-TTC GCA ACG GCA GCT GCT G	1899 ^a	594-612
1891	5'-CCG GAG CTG CCG AIC GGG	1902 ^a	692-709
1892	5'-CGG AGC TGC CAA RCG GGG	1903 ^a	693-710
1893	5'-GGA GCT GGC GAR CGG GGT	1899 ^a	694-711
1894	5'-GAC CGG AGC TAG CGA RCG	1904 ^a	690-707
1895	5'-CGG AGC TAG CAA RCG GGG T	1905 ^a	693-711
1896	5'-GAA ACG GAA CTG AAT GAG GCG	1899 ^a	484-504
1897	5'-CAT TAC CAT GGG CGA TAA CAG	1899 ^a	366-386
1898	5'-CCA TTA CCA TGA GCG ATA ACAG	1899 ^a	365-386
Resistance gene: blaTEM			
1909	5'-ATG ACT TGG TTA AGT ACT CAC C	1928 ^a	293-314
1910	5'-ATG ACT TGG TTG AGT ACT CAC C	1927 ^a	293-314
1911	5'-CCA TAA CCA TGG GTG ATA ACA C	1928 ^a	371-392
1912	5'-CCA TAA CCA TGA GTG ATA ACA C	1927 ^a	371-392
1913	5'-CGC CTT GAT CAT TGG GAA CC	1928 ^a	475-494
1914	5'-CGC CTT GAT CGT TGG GAA CC	1927 ^a	475-494
1915	5'-CGC CTT GAT AGT TGG GAA CC	1929 ^a	475-494
1916	5'-CGT GGG TCT TGC GGT ATC AT	1927 ^a	712-731
1917	5'-CGT GGG TCT GGC GGT ATC AT	1930 ^a	712-731
1918	5'-GTG GGT CTC ACG GTA TCA TTG	1927 ^a	713-733
1919	5'-CGT GGG TCT CTC GGT ATC ATT	1931 ^a	712-732
1920	5'-CGT GGI TCT CGC GGT ATC AT	1927 ^a	712-731
1921	5'-CGT GGG TCT AGC GGT ATC ATT	1932 ^a	713-733
1922	5'-GTT TTC CAA TGA TTA GCA CTT TTA	1927 ^a	188-211
1923	5'-GTT TTC CAA TGA TAA GCA CTT TTA	1927 ^a	188-211
1924	5'-GTT TTC CAA TGC TGA GCA CTT TT	1932 ^a	188-210
1925	5'-CGT TTT CCA ATG ATG AGC ACT TT	1927 ^a	187-209
1926	5'-GTT TTC CAA TGG TGA GCA CTT TT	1933 ^a	188-210
2006	5'-TGG AGC CGG TGA GCG TGG	1927 ^a	699-716
2007	5'-TGG AGC CAG TGA GCG TGG	2010 ^a	699-716
2008	5'-TCT GGA GCC GAT GAG CGT G	1929 ^a	697-715

TABLE 89-continued

Internal hybridization probes for specific detection of antimicrobial agents resistance genes sequences.			
Originating DNA fragment			
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
2009	5'-CTG GAG CCA GTA AGC GTG G	2011 ^a	698-716
2141	5'-CAC CAG TCA CAG AAA AGC	1927 ^a	311-328
Resistance gene: dhfrIa			
2253	5'-CAT TAC CCA ACC GAA AGT A	1461 ^a	158-176
Resistance gene: embB			
2104	5'-CTG GGC ATG GCI CGA GTC	2105 ^a	910-927
Resistance gene: gyrA			
1333	5'-TCA TGG TGA CTT ATC TAT TTA TG	1299 ^a	240-263
1334	5'-CAT CTA TTT ATA AAG CAA TGG TA	1299 ^a	251-274
1335	5'-CTA TTT ATG GAG CAA TGG T	1299 ^a	254-273
1940	5'-GTA TCG TTG GTG ACG TAA T	1299 ^a	206-224
1943	5'-GCT GGT GGA CGG CCA G	1954 ^a	279-294
1945	5'-CGG CGA CTA CGC GGT AT	1954 ^a	216-232
1946	5'-CGG CGA CTT CGC GGT AT	1954 ^a	216-232
1947	5'-CGG TAT ACG GCA CCA TCG T	1954 ^a	227-245
1948	5'-GCG GTA TAC AAC ACC ATC G	1954 ^a	226-244
1949	5'-CGG TAT ACG CCA CCA TCG T	1954 ^a	227-245
2042	5'-CAC GGG GAT TTC TCT ATT TA	2054 ^a	103-122
2043	5'-CAC GGG GAT TAC TCT ATT TA	2054 ^a	103-122
Resistance gene: inhA			
2100	5'-GCG AGA CGA TAG GTT GTC	2101 ^a	1017-1034
Resistance gene: parC			
1336	5'-TGG AGA CTA CTC AGT GT	1321 ^a	232-249
1337	5'-TGG AGA CTT CTC AGT GT	1321 ^a	232-249
1338	5'-GTG TAC GGA GCA ATG	1321 ^a	245-260
1339	5'-CCA GCG GAA ATG CGT	1321 ^a	342-357
1941	5'-GCA ATG GTC CGT TTA AGT	1321 ^a	253-270
1944	5'-TTT CGC CGC CAT GCG TTA C	1781	247-265
1950	5'-GGC GAC ATC GCC TGC	1781	137-151
1951	5'-GGC GAC AGA GCC TGC TA	1781	137-153
1952	5'-CCT GCT ATG GAG CGA TGG T	1781	147-165
1953	5'-CGC CTG CTA TAA AGC GAT GGT	1781	145-165
2046	5'-ACG GGG ATT TTT CTA TCT AT	2055 ^a	227-246
Resistance gene: rpoB			
2067	5'-AGC TGA GCC AAT TCA TGG	2072 ^a	1304-1321
2068	5'-ATT CAT GGA CCA GAA CAA C	2072 ^a	1314-1332
2069	5'-CGC TGT CGG GGT TGA CCC	2072 ^a	1334-1351
2070	5'-GTT GAC CCA CAA GCG CCG	2072 ^a	1344-1361
2071	5'-CGA CTG TCG GCG CTG GGG	2072 ^a	1360-1377
Resistance gene: tetM			
2254	5'-ACC TGA ACA GAG AGA AAT G	1590 ^a	1062-1080

^aSequence from databases.

TABLE 90

Molecular beacon internal hybridization
probes for specific detection of *atpD* sequences.

SEQ ID NO.	Nucleotide sequence ^a	Originating DNA fragment	
		SEQ ID NO.	Nucleotide position
Bacterial species: <i>Bacteroides fragilis</i>			
2136	5'- <u>CCA</u> ACG CGT CCT CAA TCA TTT CTA ACT TCT ATG GCC <u>GCC</u> GTT <u>GG</u>	929	353-382
Bacterial species: <i>Bordetella pertussis</i>			
2182	5'- <u>GCG</u> CGC CAA CGA CTT CTA CCA CGA AAT GGA AGA GTC <u>GCG</u> CGC	1672	576-605
Bacterial group: <i>Campylobacter jejuni</i> and <i>C. coli</i>			
2133	5'- <u>CCA</u> CGC ACA WAA ACT TGT TTT AGA AGT AGC AGC WCA <u>GCG</u> TGG	1576, 1600,1849, 1863,2139 ^{b,c}	44-73 ^d
Fungal species: <i>Candida glabrata</i>			
2078	5'- <u>CCG</u> AGC CTT GGT CTT CGG CCA AAT GAA <u>CGC</u> <u>TCG</u> G	463	442-463
Fungal species: <i>Candida krusei</i>			
2075	5'- <u>CCG</u> AGC CAG GTT CTG AAG TCT CTG CAT TAT TAG GTG <u>CTC</u> GG	468	720-748
Fungal species: <i>Candida lusitaniae</i>			
2080	5'- <u>CCG</u> AGC CGA AGA GGG CCA AGA TGT <u>CGC</u> TCG G	470	520-538
Fungal species: <i>Candida parapsilosis</i>			
2079	5'- <u>CCG</u> AGC GTT CAG TTA CTT CAG TCC AAG CCG GCT <u>CGG</u>	472	837-860
Fungal species: <i>Candida tropicalis</i>			
2077	5'- <u>CCG</u> AGC AAC CGA TCC AGC TCC AGC TAC <u>GCT</u> CGG	475	877-897
Bacterial species: <i>Klebsiella pneumoniae</i>			
2281	5'- <u>CCC</u> CCA GCT GGG CGG CGG TAT CGA <u>TGG</u> GGG	317	40-59
Fungal genus: <i>Candida</i> sp.			
2076	5'- <u>CCG</u> AGC YGA YAA CAT TTT CAG ATT CAC CCA RGC <u>GCT</u> CGG	460-478, 663 ^b	697-723 ^c

^aUnderlined nucleotides indicate the molecular beacon's stem.

^bSequence from databases.

^cThese sequences were aligned to derive the corresponding primer.

^dThe nucleotide positions refer to the *C. jejuni* *atpD* sequence fragment (SEQ ID NO. 1576).

Fungal genus: *Candida* sp.

2076 5'-CCG AGC YGA YAA CAT TTT CAG ATT CAC CCA 460-478,
RGC GCT CGG 663^b 697-723^c

^aUnderlined nucleotides indicate the molecular beacon's stem.

^bThese sequences were aligned to derive the corresponding primer.

^cThe nucleotide positions refer to the *C. albicans* *atpD* sequence fragment (SEQ ID NO. 460).

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TABLE 91

Internal hybridization probes for specific detection of <i>atpD</i> sequences.			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial species: <i>Acinetobacter baumannii</i>			
2169	5'-CCC GTT TGC GAA AGG TGG	243	304-321
Bacterial species: <i>Klebsiella pneumoniae</i>			
2167	5'-CAG CAG CTG GGC GGC GGT	317	36-53

TABLE 92

Internal hybridization probes for specific detection of <i>ddl</i> and <i>mtl</i> sequences.			
		Originating DNA fragment	
SEQ ID NO.	Nucleotide sequence	SEQ ID NO.	Nucleotide position
Bacterial species: <i>Enterococcus faecium</i> (<i>ddl</i>)			
2286	5'-AGT TGC TGT ATT AGG AAA TG	2288 ^a	784-803
2287	5'-TCG AAG TTG CTG TAT TAG GA	2288 ^a	780-799
Bacterial species: <i>Enterococcus faecalis</i> (<i>mtl</i>)			
2289	5'-CAC CGA AGA AGA TGA AAA AA	1243 ^a	264-283
2290	5'-TGG CAC CGA AGA AGA TGA	1243 ^a	261-278
2291	5'-ATT TTG GCA CCG AAG AAG A	1243 ^a	257-275

^aSequence from databases.

SEQUENCE LISTING

The patent contains a lengthy "Sequence Listing" section. A copy of the "Sequence Listing" is available in electronic form from the USPTO web site (<http://seqdata.uspto.gov/?pageRequest=docDetail&DocID=US08182996B2>). An electronic copy of the "Sequence Listing" will also be available from the USPTO upon request and payment of the fee set forth in 37 CFR 1.19(b)(3).

What is claimed is:

1. A composition for the detection of *Klebsiella pneumoniae* in a sample using a nucleic acid amplification assay, comprising an amplification primer pair, said amplification primer pair consisting of an oligonucleotide consisting of SEQ ID NO: 1331 or the complement thereof, and an oligonucleotide consisting of SEQ ID NO: 1332 or the complement thereof, or variants of either SEQ ID NO: 1331 or 1332, or both,

wherein said variants differ from SEQ ID NO: 1331 or 1332 in that they have up to three nucleotide changes compared to SEQ ID NO: 1331 or 1332, wherein said variants are capable of hybridizing to and amplifying *K. pneumoniae* nucleic acids in said nucleic acid amplification assay and wherein each oligonucleotide optionally includes a detectable moiety.

50 2. The composition of claim 1, further comprising a probe that hybridizes to a portion of the *atpD* gene amplified by said amplification primer pair.

3. The composition of claim 2, wherein said probe comprises a fluorescent moiety.

55 4. The composition of claim 2, wherein said probe is a molecular beacon.

5. A method of detecting *Klebsiella pneumoniae* in a sample comprising:

60 a) contacting the sample with the composition according to claim 1;

b) amplifying target nucleic acid in the sample of a) to generate amplification product(s); and

c) detecting the presence or amount of amplification product(s) as an indication of the presence of the *Klebsiella pneumoniae* in said sample.

65 6. The method of claim 5, wherein amplification step comprises a method selected from the group consisting of:

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- (a) polymerase chain reaction (PCR),
- (b) ligase chain reaction,
- (c) nucleic acid sequence-based amplification,
- (d) self-sustained sequence replication,
- (e) strand displacement amplification,
- (f) branched DNA signal amplification,
- (g) nested PCR, and
- (h) multiplex PCR.

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7. The method of claim **6**, wherein said amplification step comprises PCR.

8. The method of claim **5**, further comprising contacting the sample with a probe that hybridizes to a portion of the ⁵ atpD gene amplified by said amplification primer pair.

9. The method of claim **8**, wherein said probe comprises a fluorescent moiety.

* * * * *