

Table 5.2 Biochemical differentiation of the species of the family *Enterobacteriaceae*

Test	<i>Arsenophonus nasoniae</i>	<i>Budvicia aquatica</i>	<i>Buttiauxella agrestis</i>	<i>Cedecea davisae</i>	<i>Cedecea lapagei</i>	<i>Cedecea neteri</i>	<i>Citrobacter amalonaticus</i>
Gram stain (24h)	-	-	-	-	-	-	-
Oxidase (24h)	-	-	-	-	-	-	-
Indole production	-	-	-	-	-	-	+
Methyl red	-	+	+	+	d	+	+
Voges-Proskauer	-	-	-	d	[+]	d	-
Citrate (Simmons)	a	-	+	+	+	+	[+]
Hydrogen sulfide production	-	[+]	-	-	-	-	-
Urea hydrolysis	-b	d	-	-	-	-	[+]
Phenylalanine deaminase (24h)	-	-	-	-	-	-	-
Lysine decarboxylase	-b	-	-	-	-	-	-
Arginine dihydrolase	-b	-	-	d	[+]	+	[+]
Ornithine decarboxylase	-b	-	+	+	-	-	+
Motility	-	d	+	[+]	[+]	+	+
Gelatin hydrolysis, 22°C	+	-	-	-	-	-	-
KCN, growth	-	-	[+]	[+]	+	d	+
Malonate utilization	-	-	d	+	+	+	-
D-Glucose, acid production	+	+	+	+	+	+	+
D-Glucose, gas production	-	d	+	d	+	+	+
Acid production:							
D-Adonitol	-	-	-	-	-	-	-
L-Arabinose	-	[+]	+	-	-	-	+
Celllobiose	-	-	+	+	+	+	+
Dulcitol	-	-	-	+	+	+	+
Glycerol	-	-	d	-	-	-	-
myo-Inositol	-	-	-	-	-	-	d
Lactose	-	[+]	+	[-]	d	d	d
Maltose	-	-	+	+	+	+	d
D-Mannitol	-	d	+	+	+	+	+
D-Mannose	-	-	+	+	+	+	+
Melibiose	-	-	+	+	+	+	+
α-Methyl-D-glucoside	-	-	-	-	-	-	-
Raffinose	-	-	-	-	-	-	-
L-Rhamnose	-	-	+	-	-	-	-
Salicin	-	+	+	-	-	-	+
D-Sorbitol	-	-	+	+	+	+	d
Sucrose	+	-	-	-	-	+	+
Trehalose	-	-	+	+	-	+	[-]
D-Xylose	-	+	+	+	+	+	+
Mucate	-	[-]	+	-	-	+	+
Tartrate, Jordans	-	d	d	-	-	-	+
Esculin hydrolysis	-	-	+	d	+	+	[+]
Acetate utilization	-	-	-	-	d	-	-
Nitrate reduction	-	-	-	-	d	-	-
Deoxyribonuclease, 25°C	-b	+	+	+	+	+	[+]
Lipase	-	-	-	-	-	-	+
ONPG c	-	-	-	+	+	+	-
Pigment d	-	+	+	+	+	+	-
Flagella arrangement e	-	-	-	-	-	-	+
Catalase production (24h)	-	P	P	P	P	P	P
Oxidation-fermentation f	+	+	+	+	+	+	+
	F	F	F	F	F	F	F

Footnotes are at end of table

Table 5.2 (continued)

Test	<i>Enterobacter agglomerans</i>	<i>Enterobacter amnigenus</i> biogroup 1	<i>Enterobacter amnigenus</i> biogroup 2	<i>Enterobacter asburiae</i>	<i>Enterobacter cloacae</i>	<i>Enterobacter (Erwinia) dissolvens</i>
Gram stain (24h)	-	-	-	-	-	-
Oxidase (24h)	-	-	-	-	-	-
Indole production	[+]	-	-	-	-	-
Methyl red	d	-	d	+	-	-
Voges-Proskauer	d	+	+	-	[+]	+
Citrate (Simmons)	d	d	+	+	+	+
Hydrogen sulfide production	-	-	-	-	-	-
Urea hydrolysis	[+]	-	-	d	d	+
Phenylalanine deaminase (24h)	[+]	-	-	-	-	-
Lysine decarboxylase	-	-	-	-	-	-
Arginine dihydrolase	-	-	d	[+]	+	+
Ornithine decarboxylase	-	d	+	[+]	+	+
Motility	[+]	[+]	[+]	-	[+]	[+]
Gelatin hydrolysis, 22°C	-	-	-	-	-	-
KCN, growth	d	+	+	+	+	+
Malonate utilization	d	+	+	-	[+]	+
D-Glucose, acid production	+	+	+	+	+	+
D-Glucose, gas production	[+]	+	+	+	+	+
Acid production:						
D-Adonitol	-	-	-	-	[+]	-
L-Arabinose	+	+	+	+	+	+
Celllobiose	d	+	+	+	+	+
Dulcitol	[+]	-	-	-	[+]	-
Glycerol	d	-	-	-	[+]	-
myo-Inositol	[+]	-	-	[+]	d	-
Lactose	d	d	d	[+]	[+]	d
Maltose	+	+	+	+	+	d
D-Mannitol	+	+	+	+	+	+
D-Mannose	+	+	+	+	+	+
Melibiose	d	+	+	+	+	+
α-Methyl-D-glucoside	-	d	+	-	+	+
Raffinose	d	+	-	+	[+]	+
L-Rhamnose	[+]	+	+	d	+	+
Salicin	d	+	+	-	+	+
D-Sorbitol	d	-	+	+	[+]	+
Sucrose	[+]	+	-	+	+	+
Trehalose	+	+	+	+	+	+
D-Xylose	+	+	+	+	+	+
Mucate	d	d	+	[+]	+	+
Tartrate, Jordans	[+]	-	-	d	[+]	+
Esculin hydrolysis	d	+	+	+	d	-
Acetate utilization	d	-	-	+	d	+
Nitrate reduction	[+]	+	+	[+]	[+]	+
Deoxyribonuclease, 25°C	-	-	-	+	+	+
Lipase	-	-	-	-	-	+
ONPG ^c	-	-	-	-	-	-
Pigment ^d	+	+	+	+	-	d
Flagella arrangement ^e	[+Y]	-	-	-	-	+
Catalase production (24h)	P	P	P	-	P	P
Oxidation-fermentation ^f	+	+	+	+	+	+
	F	F	F	F	F	F

Footnotes are at end of table

Table 5.2 (continued)

Test	<i>Enterobacter gergoviae</i>	<i>Enterobacter hormaechei</i>	<i>Enterobacter intermedius</i>	<i>Enterobacter (Erwinia) nimipressuralis</i>	<i>Enterobacter sakazakii</i>
Gram stain (24h)	-	-	-	-	[-]
Oxidase (24h)	-	-	+	+	-
Indole production	-	d	+	+	+
Methyl red	+	+	d	+	+
Voges-Proskauer	+	+	-	-	-
Citrate (Simmons)	+	-	-	-	-
Hydrogen sulfide production	-	[+]	-	-	d
Urea hydrolysis	+	-	-	-	-
Phenylalanine deaminase (24h)	-	-	-	-	-
Lysine decarboxylase	+	-	-	+	+
Arginine dihydrolase	-	[+]	+	+	[+]
Ornithine decarboxylase	+	+	[+]	[+]	[+]
Motility	[+]	d	-	+	-
Gelatin hydrolysis, 22°C	-	-	d	+	+
KCN, growth	-	+	-	+	[-]
Malonate utilization	+	+	+	+	+
D-Glucose, acid production	+	+	+	+	+
D-Glucose, gas production	+	[+]	+	+	+
Acid production:					
D-Adonitol	-	-	-	-	-
L-Arabinose	+	+	+	+	+
Cellobiose	+	+	+	+	+
Dulcitol	-	[+]	+	-	-
Glycerol	+	-	+	+	[-]
myo-Inositol	-	-	-	-	[+]
Lactose	d	-	+	-	[+]
Maltose	+	+	+	+	+
D-Mannitol	+	+	+	+	+
D-Mannose	+	+	+	+	+
Melibiose	+	+	+	+	+
α-Methyl-D-glucoside	+	-	+	+	+
Raffinose	-	[+]	+	+	+
L-Rhamnose	+	-	+	+	+
Salicin	+	+	+	-	[+]
D-Sorbitol	+	d	+	+	+
Sucrose	-	-	+	+	+
Trehalose	+	+	+	+	[+]
D-Xylose	+	+	d	-	-
Mucate	+	+	+	-	[+]
Tartrate, Jordans	-	+	+	+	+
Esculin hydrolysis	+	+	+	+	+
Acetate utilization	+	[-]	+	+	+
Nitrate reduction	+	-	+	-	-
Deoxyribonuclease, 25°C	+	d	+	-	-
Lipase	-	+	-	+	+
ONPG ^c	-	-	+	-	[+]
Pigment ^d	-	-	-	+	[+]
Flagella arrangement ^e	+	+	-	-	-
Catalase production (24h)	-	-	+	-	-
Oxidation-fermentation ^f	P	P	-	+	[+]
	F	+P	P	-	Y

Footnotes are at end of chapter.

Table 5.2 (continued)

Test	<i>Enterobacter taylorae</i> (<i>Enterobacter cancerogenus</i> ; <i>Erwinia cancerogena</i>)	<i>Erwinia amylovora</i>	<i>Erwinia ananas</i>	<i>Erwinia cacticida</i>	<i>Erwinia carotovora</i>	<i>Erwinia chrysanthemi</i>
Gram stain (24h)	-	-	-	-	-	-
Oxidase (24h)	-	-	-	-	-	-
Indole production	-	-	+	-	-	+
Methyl red	-					
Voges-Proskauer	+	(+)	(+)	(+)	(+)	(+)
Citrate (Simmons)	+			+		
Hydrogen sulfide production	-	-	d		+	+
Urea hydrolysis	-	-	-	-	-	-
Phenylalanine deaminase (24h)	-	-	-	-	-	-
Lysine decarboxylase	-		-	-		
Arginine dihydrolase	+		-			
Ornithine decarboxylase	+					
Motility	(+)	(+)	(+)	(+)	(+)	(+)
Gelatin hydrolysis, 22°C	-	(+)	(+)	(+)	(+)	(+)
KCN, growth	+	-	-	-	d	d
Malonate utilization	+			+		
D-Glucose, acid production	+	+	+	+	+	+
D-Glucose, gas production	+	-	-	-	d	+
Acid production:						
D-Adonitol	-	-	-	-	-	-
L-Arabinose	+	d	+	-	+	+
Cellobiose	+	-	+	-	+	+
Dulcitol	-	-	-	-	-	-
Glycerol	-	-	+	[+]	d	+
myo-Inositol	-	-	+	-	d	d
Lactose	-	-	+	[-]	+	d
Maltose	+	-	+	-	d	-
D-Mannitol	+	-	+	+	+	+
D-Mannose	+	-	+	+	+	+
Melibiose	-	-	+	-	+	+
α-Methyl-D-glucoside	-	-	-	-	d	-
Raffinose	-	-	+	-	+	+
L-Rhamnose	+	-	d	+	+	+
Salicin	+	-	+	+	+	+
D-Sorbitol	-	d	+	-	+	+
Sucrose	-			+		+
Trehalose	+	+	+	[+]	+	-
D-Xylose	+	-	+	d	+	+
Mucate	[+]					
Tartrate, Jordans	-					
Esculin hydrolysis	+			+		
Acetate utilization	d					
Nitrate reduction	+	-	-	+	+	+
Deoxyribonuclease, 25°C	-	-	-		-	-
Lipase	-					
ONPG ^c	-					+
Pigment ^d	+			+		
Flagella arrangement ^e	-	-	Y	-	-	-
Catalase production (24h)	P	P	P	P	P	P
Oxidation-fermentation ^f	+	+	+	+	+	+
	F	F	F	F	F	F

Table 5.2 (continued)

Test	<i>Erwinia cypripedii</i>	<i>Erwinia mallotivora</i>	<i>Erwinia nigrifluens</i>	<i>Erwinia persicinus</i>	<i>Erwinia psidii</i>	<i>Erwinia quercina</i>	<i>Erwinia rhamontici</i>
Gram stain (24h)	-	-	-	-	-	-	-
Oxidase (24h)	-	-	-	-	-	-	-
Indole production	-						
Methyl red		+	+	+	+	+	+
Voges-Proskauer	-						
Citrate (Simmons)			+	-	+	+	
Hydrogen sulfide production	+	-	+	-	-	-	+
Urea hydrolysis	-	-	+	-	-	-	-
Phenylalanine deaminase (24h)	+	-	-	-	-	-	-
Lysine decarboxylase				-			
Arginine dihydrolase				-			
Ornithine decarboxylase				-			
Motility	+	+	+	+	+	+	+
Gelatin hydrolysis, 22°C	-	-	-	-	-	-	-
KCN, growth	+	-	-	-	-	-	+
Malonate utilization				+	-		
D-Glucose, acid production	+	+	+	+	+	+	+
D-Glucose, gas production	+	-	-	-	-	-	+
Acid production:							
D-Adonitol	-	-	-	-	-	-	
L-Arabinose	+	-	+	+	-	-	-
Cellobiose	+	-	-	+	-	-	
Dulcitol	-	-	-	+	-	-	+
Glycerol	d	-	+	-	+	-	d
myo-Inositol	+	-	+	+	-	+	
Lactose	-	-	+	+	+	-	+
Maltose	+	-	-	+	-	-	+
D-Mannitol	+	-	-	+	-	-	+
D-Mannose	+	+	+	+	-	-	+
Melibiose	+	+	+	+	+	+	+
α-Methyl-D-glucoside	+	-	+	+	+	+	+
Raffinose	-	-	-	+	-	-	+
L-Rhamnose	-	-	-	-	+	+	+
Salicin	+	-	+	+	-	-	d
D-Sorbitol	+	-	+	+	-	-	+
Sucrose	+	-	+	+	+	-	+
Trehalose			+	+	+	+	+
D-Xylose	+	+	+	+	+	+	+
Mucate	+	+	+	+	-	-	+
Tartrate, Jordans				-	-	-	+
Esculin hydrolysis				-	-	-	
Acetate utilization				-	-	-	
Nitrate reduction				-	-	-	d
Deoxyribonuclease, 25°C	+	-	-	+	-	-	
Lipase	-	-	-	-	-	-	
ONPG ^c	-	-	-	-	-	-	
Pigment ^d	-	-	-	-	-	-	
Flagella arrangement ^e	-	-	-	-	-	-	+
Catalase production (24h)	P	P	P	R	P	P	-
Oxidation-fermentation ^f	F	+F	F	P	P	P	P

Footnotes are at end of table

Table 5.2 (continued)

Test	<i>Erwinia rubrifaciens</i>	<i>Erwinia salicis</i>	<i>Erwinia stewartii</i>	<i>Erwinia tracheiphila</i>	<i>Erwinia uredovora</i>	<i>Escherichia blattae</i>	<i>Escherichia coli</i>
Gram stain (24h)	-	-	-	-	-	-	-
Oxidase (24h)	-	-	-	-	-	-	-
Indole production	-	-	-	-	+	-	+
Methyl red	-	+ (circled)	-	d	(circled) +	-	+
Voges-Proskauer	-	+ (circled)	-	-	-	-	-
Citrate (Simmons)	-	-	-	-	-	d	-
Hydrogen sulfide production	+	+	-	+	-	-	-
Urea hydrolysis	-	-	-	-	-	-	-
Phenylalanine deaminase (24h)	-	-	(circled) -	-	-	-	-
Lysine decarboxylase	-	-	-	-	-	+	+
Arginine dihydrolase	-	-	-	-	-	-	[-]
Ornithine decarboxylase	-	-	-	-	-	+	d
Motility	+	+	(circled) -	+	+	-	+
Gelatin hydrolysis, 22°C	-	-	(circled) -	-	+	-	-
KCN, growth	-	-	-	-	-	-	-
Malonate utilization	-	-	-	-	-	+	-
D-Glucose, acid production	+	+	+	+	+	+	+
D-Glucose, gas production	-	-	(circled) -	-	-	+	+
Acid production:							
D-Adonitol	-	-	-	-	+	-	-
L-Arabinose	+	-	+	-	+	+	+
Celllobiose	-	-	-	-	+	-	-
Dulcitol	-	-	-	-	-	-	d
Glycerol	d	d	-	-	+	+	d
myo-Inositol	-	+ (circled)	-	-	+	-	-
Lactose	-	(circled) -	(circled) +	-	+	-	+
Maltose	-	-	-	-	+	+	+
D-Mannitol	+	+	+	-	+	-	+
D-Mannose	+	+	+	-	+	+	+
Melibiose	-	+	+	-	+	-	[+]
α-Methyl-D-glucoside	+	-	-	-	-	-	-
Raffinose	-	+	+	-	+	-	d
L-Rhamnose	-	-	-	-	+	+	[+]
Salicin	-	+	-	-	d	-	d
D-Sorbitol	+	+	+	-	+	-	+
Sucrose	-	-	-	-	-	-	d
Trehalose	-	-	+	-	+	[+]	+
D-Xylose	-	-	+	-	+	+	+
Mucate	-	-	-	-	-	d	+
Tartrate, Jordans	-	-	-	-	-	d	+
Esculin hydrolysis	-	-	-	-	-	d	+
Acetate utilization	-	-	-	-	-	-	d
Nitrate reduction	-	-	-	-	-	-	+
Deoxyribonuclease, 25°C	-	-	-	-	+	+	+
Lipase	-	-	-	-	+	-	-
ONPG ^c	-	-	-	-	-	-	-
Pigment ^d	-	-	+ Y	-	+ Y	-	+
Flagella arrangement ^e	P	P	-	P	P	-	P
Catalase production (24h)	+	+	+	+	+	+	+
Oxidation-fermentation ^f	F	F	F	F	F	F	F

Footnotes are at end of table

Table 5.2 (continued)

Test	<i>Escherichia coli</i> inactive	<i>E. fergusonii</i>	<i>E. hermannii</i>	<i>E. vulneris</i>	<i>Ewingella americana</i>	<i>Hafnia alvei</i>	<i>Klebsiella oxytoca</i>
Gram stain (24h)	-	-	-	-	-	-	-
Oxidase (24h)	-	-	+	-	[+]	d	+
Indole production	[+]	+	+	+	[+]	-	[+]
Methyl red	+	+	-	-	+	[+]	-
Voges-Proskauer	-	-	-	-	+	-	+
Citrate (Simmons)	-	[+]	-	-	-	-	-
Hydrogen sulfide production	-	-	-	-	-	-	+
Urea hydrolysis	-	-	-	-	-	-	-
Phenylalanine deaminase (24h)	-	-	-	[+]	-	+	-
Lysine decarboxylase	d	+	-	d	-	-	+
Arginine dihydrolase	-	-	-	-	-	-	-
Ornithine decarboxylase	[+]	+	+	-	-	+	-
Motility	-	+	+	+	d	[+]	[+]
Gelatin hydrolysis, 22°C	-	-	-	-	-	-	-
KCN, growth	-	-	+	[+]	-	+	-
Malonate utilization	-	d	-	[+]	-	d	+
D-Glucose, acid production	+	+	+	+	+	+	+
D-Glucose, gas production	-	+	+	+	X	+	+
Acid production:							
D-Adonitol	-	+	-	-	-	-	-
L-Arabinose	[+]	+	+	+	-	-	+
Cellobiose	-	+	+	+	-	+	+
Dulcitol	d	d	[+]	-	-	[+]	-
Glycerol	d	[+]	-	[+]	[+]	-	+
myo-Inositol	-	-	-	-	-	-	d
Lactose	[+]	-	-	-	-	+	+
Maltose	[+]	-	d	[+]	d	-	+
D-Mannitol	+	+	+	+	[+]	-	+
D-Mannose	+	+	+	+	+	+	+
Melibiose	+	+	+	+	+	+	+
α-Methyl-D-glucoside	d	-	+	+	+	+	+
Raffinose	-	-	-	+	-	-	+
L-Rhamnose	[+]	-	-	[+]	-	-	+
Salicin	d	+	d	+	-	-	+
D-Sorbitol	-	d	+	+	-	-	+
Sucrose	[+]	-	d	d	[+]	+	+
Trehalose	[+]	-	-	-	[+]	[+]	+
D-Xylose	+	+	d	-	-	-	+
Mucate	d	+	+	-	-	-	+
Tartrate, Jordans	d	+	+	+	+	+	+
Esculin hydrolysis	[+]	+	+	[+]	[+]	+	+
Acetate utilization	-	d	d	-	-	-	+
Nitrate reduction	d	+	d	-	d	d	+
Deoxyribonuclease, 25°C	+	+	[+]	[+]	d	d	+
Lipase	-	+	-	d	d	-	+
ONPG ^c	-	-	+	d	-	-	+
Pigment ^d	-	-	-	+	+	[+]	+
Flagella arrangement ^e	d	[+]	-	-	-	+	+
Catalase production (24h)	P	-	+Y	+	-	-	-
Oxidation-fermentation ^f	+F	P	P	dY	[+]	P	+
	F	+F	+F	P	-	P	-
ootnotes are at end of table				F	+	P	+

Table 5.2 (continued)

Test	<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>
Gram stain (24h)	-	-	-	-	-	-
Oxidase (24h)	-	-	-	-	-	-
Indole production	[+]	-	-	-	-	+
Methyl red	+	+	[+]	+	d	+
Voges-Proskauer	+	-	+	-	+	-
Citrate (Simmons)	[+]	d	[+]	-	d	+
Hydrogen sulfide production	-	-	-	-	-	-
Urea hydrolysis	+	-	+	-	-	-
Phenylalanine deaminase (24h)	[+]	-	-	-	-	-
Lysine decarboxylase	[+]	d	+	-	+	+
Arginine dihydrolase	-	-	-	-	-	-
Ornithine decarboxylase	-	-	-	-	[+]	+
Motility	-	-	-	-	-	-
Gelatin hydrolysis, 22°C	-	-	-	-	-	+
KCN, growth	+	[+]	+	-	-	-
Malonate utilization	+	-	+	[+]	+	+
D-Glucose, acid production	+	+	+	+	+	+
D-Glucose, gas production	[+]	d	[+]	-	[+]	+
Acid production:						
D-Adonitol	+	+	+	+	+	-
L-Arabinose	+	+	+	+	+	+
Cellobiose	+	+	+	+	+	+
Dulcitol	[+]	-	d	+	+	+
Glycerol	+	d	+	-	[+]	[+]
myo-Inositol	+	d	[+]	d	+	d
Lactose	[+]	d	[+]	[+]	[+]	-
Maltose	[+]	+	[+]	-	+	+
D-Mannitol	+	+	+	+	+	+
D-Mannose	+	+	+	+	+	+
Melibiose	+	+	+	+	+	+
α-Methyl-D-glucoside	+	d	+	-	+	+
Raffinose	+	+	+	-	+	+
L-Rhamnose	+	d	+	+	+	+
Salicin	+	+	+	+	+	+
D-Sorbitol	+	d	+	+	+	+
Sucrose	+	[+]	+	[+]	+	d
Trehalose	+	+	+	[+]	+	+
D-Xylose	+	+	+	+	+	+
Mucate	+	[+]	+	-	+	+
Tartrate, Jordans	+	d	+	d	+	d
Esculin hydrolysis	+	[+]	+	d	+	+
Acetate utilization	d	-	[+]	-	[+]	+
Nitrate reduction	+	[+]	+	+	-	+
Deoxyribonuclease, 25°C	-	-	-	-	-	-
Lipase	-	-	-	-	-	-
ONPG ^c	-	-	-	-	-	-
Pigment ^d	+	[+]	+	-	+	+
Flagella arrangement ^e	-	-	-	-	-	-
Catalase production (24h)	+	+	+	+	+	+
Oxidation-fermentation ^f	F	F	F	F	F	F

Footnotes are at end of table

Table 5.2 (continued)

Footnotes are at end of table

Table 5.2 (continued)

Test	<i>Obesumbacterium proteus</i>	<i>Pantoea agglomerans</i>	<i>Pantoea dispersa</i>	<i>Pragia fontium</i>	<i>Proteus mirabilis</i>	<i>Proteus myxofaciens</i>
Gram stain (24h)	-	-	-	-	/-	-
Oxidase (24h)	-	-	-	-	/-	-
Indole production	-	-	-	-	/-	-
Methyl red	[+]	d	d	+	/+	+
Voges-Proskauer	-	+	+	-	/d	- ↙
Citrate (Simmons)	-	+	+	[+]	- d	+
Hydrogen sulfide production	-	-	-	-	/+	-
Urea hydrolysis	-	-	-	+	/+	+
Phenylalanine deaminase (24h)	-	[+]	-	[-]	/d /- ↙	+
Lysine decarboxylase	+	-	-	-	-	-
Arginine dihydrolase	-	-	-	-	-	-
Ornithine decarboxylase	+	d	-	-	/+	-
Motility	-	+	+	+	/+	+
Gelatin hydrolysis, 22°C	-	-	-	-	+/	+
KCN, growth	-	[+]	+	-	+	+
Malonate utilization	-	+	-	-	-	-
D-Glucose, acid production	+	+	-	-	-	-
D-Glucose, gas production	-	-	+	+	/+	+
Acid production:						
D-Adonitol	-	-	-	-	-	-
L-Arabinose	-	+	d	-	-	-
Celllobiose	-	d	d	-	-	-
Dulcitol	-	-	-	-	-	-
Glycerol	-	-	[+]	-	-	-
myo-Inositol	-	-	d	-	d	+
Lactose	-	[+]	-	-	-	-
Maltose	d	+	+	-	/- ↙	-
D-Mannitol	-	+	+	-	-	+
D-Mannose	[+]	+	+	-	-	-
Melibiose	-	-	-	-	-	-
α-Methyl-D-glucoside	-	-	-	-	-	-
Raffinose	-	-	-	-	-	+
L-Rhamnose	[+]	+	+	-	-	-
Salicin	-	+	-	[+]	-	-
D-Sorbitol	-	-	-	-	-	-
Sucrose	-	+	+	-	-	-
Trehalose	[+]	+	+	-	- ↙	+
D-Xylose	[+]	+	+	-	+	+
Mucate	-	-	d	-	+	-
Tartrate, Jordans	[+]	-	d	-	[+]	+
Esculin hydrolysis	-	+	-	[+]	-	-
Acetate utilization	-	-	-	-	-	-
Nitrate reduction	-	-	d	+	/-	-
Deoxyribonuclease, 25°C	+	+	d	+	/+	+
Lipase	-	-	-	-	/d ↙	+
ONPG ^c	-	-	-	-	/+	+
Pigment ^d	-	+	+	-	-	-
Flagella arrangement ^e	-	+Y	dY	-	-	-
Catalase production (24h)	-	P	P	P	P	P
Oxidation-fermentation ^f	+	+	+	+	/+	+
F	F	F	F	F	F	F

Footnotes are at end of table

Table 5.2 (continued)

Test	<i>Proteus penneri</i>	<i>Proteus vulgaris</i>	<i>Providencia alcalifaciens</i>	<i>Providencia heimbachae</i>	<i>Providencia rettgeri</i>	<i>Providencia rustigianii</i>
Gram stain (24h)	-	-	-	-	-	-
Oxidase (24h)	-	-	-	-	+	+
Indole production	-	+	+	[+]	+	d
Methyl red	+	+	+	-	-	-
Voges-Proskauer	-	-	-	-	+	[+]
Citrate (Simmons)	-	[+]	+	-	-	-
Hydrogen sulfide production	d	+	-	-	+	-
Urea hydrolysis	+	+	-	-	+	+
Phenylalanine deaminase (24h)	+	+	+	+	-	-
Lysine decarboxylase	-	-	-	-	-	-
Arginine dihydrolase	-	-	-	-	-	-
Ornithine decarboxylase	-	-	-	-	-	-
Motility	[+]	[+]	+	d	+	d
Gelatin hydrolysis, 22°C	d	+	-	-	-	-
KCN, growth	-	-	-	-	-	-
Malonate utilization	+	+	+	-	+	+
D-Glucose, acid production	-	-	-	-	-	-
D-Glucose, gas production	+	+	+	+	+	+
Acid production:	d	[+]	[+]	-	-	d
D-Adonitol	-	-	+	+	+	-
L-Arabinose	-	-	-	-	-	-
Cellobiose	-	-	-	-	-	-
Dulcitol	-	-	-	-	-	-
Glycerol	-	-	-	-	-	-
myo-Inositol	d	d	[+]	-	-	-
Lactose	-	-	-	d	d	-
Maltose	-	-	-	d	+	-
D-Mannitol	+	+	-	-	-	-
D-Mannose	-	-	-	d	-	-
Melibiose	-	-	-	-	-	-
α-Methyl-D-glucoside	-	-	+	+	+	-
Raffinose	[+]	d	-	-	-	+
L-Rhamnose	-	-	-	-	-	-
Salicin	-	-	-	-	-	-
D-Sorbitol	-	d	-	+	-	-
Sucrose	-	-	-	-	d	-
Trehalose	+	+	-	-	d	-
D-Xylose	d	d	[+]	-	-	-
Mucate	+	+	-	-	[+]	-
Tartrate, Jordans	-	-	-	-	-	d
Esculin hydrolysis	[+]	[+]	-	-	-	-
Acetate utilization	-	d	+	-	-	-
Nitrate reduction	-	[+]	-	d	-	-
Deoxyribonuclease, 25°C	+	-	d	-	+	-
Lipase	d	+	-	-	d	d
ONPG ^c	d	[+]	+	-	d	-
Pigment ^d	d	[+]	-	+	+	[+]
Flagella arrangement ^e	-	-	-	-	-	+
Catalase production (24h)	P	P	-	-	-	-
Oxidation-fermentation ^f	F	+	P	-	-	P
	F	F	F	+ F	+ P	+ F

Footnotes are at end of table

Table 5.2 (continued)

Test	<i>Providencia stuartii</i>	<i>Rahnella aquatilis</i>	<i>Salmonella bongori</i>	<i>Salmonella choleraesuis</i> subsp. <i>arizonaee</i>	<i>Salmonella choleraesuis</i> subsp. <i>choleraesuis</i>	<i>Salmonella choleraesuis</i> subsp. <i>diarizonae</i>
Gram stain (24h)	-	-	-	-	-	-
Oxidase (24h)	-	-	-	-	-	-
Indole production	+	-	-	-	-	-
Methyl red	+	[+]	+	-	-	-
Voges-Proskauer	-	+	-	-	-	-
Citrate (Simmons)	+	[+]	+	-	-	-
Hydrogen sulfide production	-	(-)	(+)	-	-	-
Urea hydrolysis	d	-	-	-	-	-
Phenylalanine deaminase (24h)	+	(+)	-	-	-	-
Lysine decarboxylase	-	-	+	-	-	-
Arginine dihydrolase	-	-	+	+	+	+
Ornithine decarboxylase	-	(-)	+	d	d	d
Motility	[+]	-	+	+	+	+
Gelatin hydrolysis, 22°C	-	-	-	+	+	+
KCN, growth	+	-	+	-	-	-
Malonate utilization	-	+	-	-	-	-
D-Glucose, acid production	+	+	+	+	-	+
D-Glucose, gas production	-	(+)	[+]	+	+	+
Acid production:						
D-Adonitol	-	-	-	-	-	-
L-Arabinose	-	+	+	+	+	+
Celllobiose	-	+	-	-	-	-
Dulcitol	-	[+]	+	-	-	-
Glycerol	d	[+]	-	-	+	-
myo-Inositol	+	-	(-)	-	d	-
Lactose	(-)	(+)	-	(-)	-	[+]
Maltose	-	+	+	+	+	+
D-Mannitol	-	+	+	+	+	+
D-Mannose	+	+	+	+	+	+
Melibiose	-	+	[+]	+	+	+
α-Methyl-D-glucoside	-	-	-	-	-	-
Raffinose	-	+	-	-	-	-
L-Rhamnose	-	+	+	+	+	+
Salicin	-	+	-	-	-	-
D-Sorbitol	-	+	+	+	+	+
Sucrose	d	+	(-)	-	-	-
Trehalose	+	+	+	+	+	+
D-Xylose	-	+	+	+	+	+
Mucate	-	d	+	+	+	d
Tartrate, Jordans	+	(-)	-	-	+	(-)
Esculin hydrolysis	-	+	-	-	-	-
Acetate utilization	[+]	-	+	+	+	[+]
Nitrate reduction	+	+	+	+	+	+
Deoxyribonuclease, 25°C	-	-	-	-	-	-
Lipase	-	-	-	-	-	-
ONPG ^c	-	-	-	-	-	-
Pigment ^d	-	+	+	+	-	+
Flagella arrangement ^e	P	P	P	P	P	P
Catalase production (24h)	+	+	+	+	+	+
Oxidation-fermentation ^f	F	F	F	F	F	F

Footnotes are at end of table

Table 5.2 (continued)

Test	<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>Serratia entomophila</i>	<i>Serratia ficaria</i>	<i>Serratia fonticola</i>
Gram stain (24h)	-	-	-	-	-	-
Oxidase (24h)	-	-	-	[+]	d	+
Indole production	-	+	+	+	d	-
Methyl red	+	-	-	+	+	+
Voges-Proskauer	-	-	+	+	-	+
Citrate (Simmons)	+	[+]	+	-	-	-
Hydrogen sulfide production	+	+	+	-	-	[+]
Urea hydrolysis	-	-	-	-	-	-
Phenylalanine deaminase (24h)	-	-	-	-	-	+
Lysine decarboxylase	+	+	+	-	-	-
Arginine dihydrolase	d	d	+	-	-	+
Ornithine decarboxylase	+	+	+	[+]	[+]	[+]
Motility	+	+	+	[+]	[+]	[+]
Gelatin hydrolysis, 22°C	-	-	-	+	+	-
KCN, growth	+	-	-	+	d	d
Malonate utilization	-	-	+	-	-	[+]
D-Glucose, acid production	+	+	+	+	+	+
D-Glucose, gas production	+	+	+	-	-	[+]
Acid production:						
D-Adonitol	-	-	-	-	-	+
L-Arabinose	+	+	+	-	+	+
Cellobiose	d	-	-	-	+	-
Dulcitol	-	d	+	-	-	-
Glycerol	-	d	[+]	-	-	+
myo-Inositol	-	d	[+]	-	-	[+]
Lactose	-	-	-	-	d	d
Maltose	-	[+]	-	-	[+]	[+]
D-Mannitol	+	+	+	+	+	+
D-Mannose	+	+	+	+	+	+
Melibiose	+	+	+	+	+	+
α-Methyl-D-glucoside	+	[+]	-	-	+	+
Raffinose	-	-	-	-	d	+
L-Rhamnose	-	-	-	-	-	+
Salicin	+	-	-	-	d	+
D-Sorbitol	d	-	+	-	d	+
Sucrose	+	-	-	+	d	[+]
Trehalose	-	-	+	-	+	+
D-Xylose	+	-	-	-	+	+
Mucate	+	+	+	+	+	+
Tartrate, Jordans	-	+	+	+	+	+
Esculin hydrolysis	d	+	+	d	+	+
Acetate utilization	-	+	d	-	-	-
Nitrate reduction	d	-	d	-	-	-
Deoxyribonuclease, 25°C	+	[+]	[+]	+	[+]	d
Lipase	-	+	+	+	+	+
ONPG ^c	-	-	+	[+]	d	[+]
Pigment ^d	-	-	-	+	+	+
Flagella arrangement ^e	-	d	-	+	+	-
Catalase production (24h)	P	P	-	+	P	-
Oxidation-fermentation ^f	+	F	P	P	P	P
	F	F	F	F	F	F

Footnotes are at end of table

Table 5.2 (continued)

Test	<i>Serratia grimesii</i>	<i>Serratia liquefaciens</i>	<i>Serratia marcescens</i>	<i>Serratia odorifera</i> biogroup 1	<i>Serratia odorifera</i> biogroup 2	<i>Serratia plymuthica</i>
Gram stain (24h)	-	-	-	-	-	-
Oxidase (24h)	-	-	-	-	-	-
Indole production	-	-	-	d	d	-
Methyl red	[+]	+	[−]	+	d	+
Voges-Proskauer	d	+	+	d	+	[+]
Citrate (Simmons)	+	+	+	+	+	d
Hydrogen sulfide production	-	-	-	-	-	-
Urea hydrolysis	-	-	[−]	-	-	-
Phenylalanine deaminase (24h)	-	-	-	-	-	-
Lysine decarboxylase	+	+	+	+	+	-
Arginine dihydrolase	+	-	-	-	-	-
Ornithine decarboxylase	[+]	+	+	+	-	-
Motility	[+]	[+]	[+]	+	+	d
Gelatin hydrolysis, 22°C	[+]	[+]	[+]	+	+	d
KCN, growth	+	+	+	d	[−]	d
Malonate utilization	-	-	-	-	-	-
D-Glucose, acid production	+	+	+	-	-	-
D-Glucose, gas production	+	[+]	d	-	[−]	d
Acid production:						
D-Adonitol	-	-	d	d	d	-
L-Arabinose	+	+	-	+	+	+
Celllobiose	-	-	-	+	+	[+]
Dulcitol	-	-	-	-	-	-
Glycerol	+	+	d	d	d	d
myo-Inositol	d	[+]	+	+	+	d
L-Lactose	-	-	-	d	+	[+]
Maltose	+	+	+	+	+	+
D-Mannitol	+	+	+	+	+	+
D-Mannose	+	+	+	+	+	+
Melibiose	+	[+]	-	+	+	+
α-Methyl-D-glucoside	-	-	-	-	-	d
Raffinose	+	[+]	-	+	-	+
L-Rhamnose	-	[−]	-	+	+	-
Salicin	+	+	+	+	d	+
D-Sorbitol	+	+	+	+	+	+
Sucrose	+	+	+	+	+	d
Trehalose	+	+	+	+	-	+
D-Xylose	+	+	-	+	+	+
Mucate	-	-	-	-	-	-
Tartrate, Jordans		[+]	[+]	+	+	+
Esculin hydrolysis	+	+	+	+	d	[+]
Acetate utilization		d	d	d	d	d
Nitrate reduction	+	+	+	+	+	+
Deoxyribonuclease, 25°C	+	[+]	+	+	+	+
Urase	+	[+]	+	+	+	+
ONPG ^c	+	[+]	+	d	d	d
Pigment ^d	+	+	+	+	+	d
Flagella arrangement ^e	-	-	dR	-	-	dR
Catalase production (24h)	P	P	P	P	P	P
Oxidation-fermentation ^f	+	+	+	+	+	+
	F	F	F	F	F	F

Footnotes are at end of table

Table 5.2 (continued)

Test	<i>Serratia proteamaculans</i>	<i>Serratia rubidaea</i>	<i>Shigella boydii</i> , <i>S. dysenteriae</i> , and <i>S. flexneri</i>	<i>Shigella sonnei</i>	<i>Tatumella ptyseos</i>	" <i>Xenorhabdus beddingij</i> "
Gram stain (24h)	-	-	-	-	-	-
Oxidase (24h)	-	-	d	+	-	-
Indole production	-	-	+	-	-	-
Methyl red	d	[+]	-	-	-	-
Voges-Proskauer	[+]	+	-	-	-	-
Citrate (Simmons)	+	+	-	-	-	-
Hydrogen sulfide production	-	-	-	-	-	-
Urea hydrolysis	-	-	-	-	+	-
Phenylalanine deaminase (24h)	-	-	-	-	-	-
Lysine decarboxylase	+	d	-	-	-	-
Arginine dihydrolase	-	-	-	+	-	-
Ornithine decarboxylase	+	-	-	-	-	-
Motility	[+]	[+]	-	-	-	+
Gelatin hydrolysis, 22°C	+	+	-	-	-	+
KCN, growth	+	[+]	-	-	-	+
Malonate utilization	-	+	-	-	-	-
D-Glucose, acid production	+	+	+	+	+	-
D-Glucose, gas production	+	d	-	-	-	-
Acid production:						
D-Adonitol	-	-	-	-	-	-
L-Arabinose	-	+	-	-	-	-
Cellobiose	+	+	d	+	-	-
Dulcitol	-	+	-	-	-	-
Glycerol	-	-	-	-	-	-
myo-Inositol		[+]	-	[+]	-	d
Lactose		[+]	-	-	-	-
Maltose	-	+	-	-	-	-
D-Mannitol	+	+	d	+	-	-
D-Mannose	+	+	+	+	-	+
Melibiose	+	+	+	+	-	-
α-Methyl-D-glucoside	+	+	d	[+]	d	+
Raffinose	-	-	-	-	-	-
L-Rhamnose	+	+	d	-	-	-
Salicin	d	-	d	-	-	[+]
D-Sorbitol	d	-	-	[+]	-	-
Sucrose	[+]	+	-	[+]	-	-
Trehalose	+	-	d	-	d	[+]
D-Xylose	+	+	-	-	-	-
Mucate	+	+	[+]	-	-	-
Tartrate, Jordans	-	+	-	+	+	+
Esculin hydrolysis						
Acetate utilization	d	d	d	-	-	-
Nitrate reduction		+ d	d	-	-	-
Deoxyribonuclease, 25°C		[+]	-	-	-	-
Lipase	+	-	-	-	-	+
ONPG ^c	+	+	-	-	-	-
Pigment ^d	+	+	+	-	-	-
Flagella arrangement ^e	+	+	-	-	+	-
Catalase production (24h)	-	+R	-	-	-	+
Oxidation-fermentation ^f	P	P	-	+	-	-
	F	+ F	- +	-	-	+B P L F
Footnotes are at end of table						

Table 5.2 (continued)

Test	"Xenorhabdus bovienii"	"Xenorhabdus luminescens"	"Xenorhabdus nematophilus"	"Xenorhabdus poeniarii"	"Yersinia aldovae"	"Yersinia bercovieri"
Gram stain (24h)	-	-	-	-	-	-
Oxidase (24h)	-	-	-	-	-	-
Indole production	d	d	d	-	-	-
Methyl red	-	-	-	-	+	+
Voges-Proskauer	-	-	-	-	-	-
Citrate (Simmons)	-	d	-	-	-	-
Hydrogen sulfide production	-	-	-	-	-	-
Urea hydrolysis	-	[+]	-	-	[+]	d
Phenylalanine deaminase (24h)	-	-	-	-	-	-
Lysine decarboxylase	-	-	-	-	-	-
Arginine dihydrolase	-	-	-	-	-	-
Ornithine decarboxylase	-	-	-	-	d	[+]
Motility	+	+	+	+	-	-
Gelatin hydrolysis, 22°C	-	d	[+]	-	-	-
KCN, growth	-	-	-	-	-	-
Malonate utilization	-	-	-	-	-	-
D-Glucose, acid production	+	[+]	[+]	-	+	+
D-Glucose, gas production	-	-	-	-	-	-
Acid production:						
D-Adonitol	-	-	-	-	-	-
L-Arabinose	-	-	-	-	d	+
Cellobiose	-	-	-	-	-	+
Dulcitol	-	-	-	-	-	+
Glycerol	-	-	-	-	-	-
myo-Inositol	-	-	-	-	-	-
Lactose	-	-	-	-	-	-
Maltose	-	[+]	-	-	-	[+]
D-Mannitol	-	-	-	-	-	+
D-Mannose	-	[+]	[+]	-	[+]	+
Melibiose	-	-	-	-	+	+
α -Methyl-D-glucoside	-	-	-	-	-	-
Raffinose	-	-	-	-	-	-
L-Rhamnose	-	-	-	-	-	-
Salicin	-	-	-	-	-	-
D-Sorbitol	-	-	-	-	-	[+]
Sucrose	-	-	-	-	d	+
Trehalose	-	-	-	-	[+]	+
D-Xylose	-	-	-	-	[+]	+
Mucate	-	-	-	-	d	+
Tartrate, Jordans	-	d	d	-	-	-
Esculin hydrolysis	-	-	-	-	+	+
Acetate utilization	-	-	-	-	-	[+]
Nitrate reduction	-	-	-	-	-	-
DNAse	d	-	[+]	-	+	+
Deoxyribonuclease, 25°C	-	-	[+]	-	-	-
Lipase	-	-	[+]	-	-	-
ONPG ^c	-	-	-	-	-	-
Pigment ^d	-	-	-	-	-	-
Flagella arrangement ^e	+Y	+Y,O,R	dy	+B	-	[+]
Catalase production (24h)	P	P	P	P	P	P
Oxidation-fermentation ^f	-	+	-	-	+	+

Footnotes are at end of table