**Supplemental Table 1.** Descriptive information for the 136 bacterial protective antigens (BPAs) in the BPA training data set1.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Species** | **Gram** | **No.** | **Gene** | **Description** | **Acc. No.** | **Ref.** |
| *Bacillus anthracis* | Positive | 1 | LF[I-III] | Lethal factor (LF) domains I-III | AAR88322 | [1] |
| 2 | PA83[delta]furin | Protective antigen 83 delta furin | AAR88321 | [1] |
| *Bordetella pertussis* | Negative | 3 | fhaB | Filamentious haemagglutinin | NP\_880571 | [2] |
| 4 | prnA | Pertactin | AAK92094 | [3] |
| 5 | ptxA | Pertussis toxin S1 subunit | NP\_882282 | [4] |
| *Borrelia burgdorferi* | Negative | 6 | dbpA | Decorin-binding protein A | YP\_003110629 | [5] |
| 7 | ospA | Outer surface protein A (ospA) | NP\_045688 | [6] |
| 8 | ospB | Outer surface protein B (ospB) | NP\_045689 | [7] |
| 9 | ospC | Outer surface protein C (ospC) | YP\_002364847 | [8] |
| 10 | p66 | Outer membrane protein (Oms66) | NP\_212737 | [9] |
| 11 | VraA | Virulent strain-associated repetitive antigen A (VraA) | NP\_045547 | [10] |
| *Brucella abortus* | Negative | 12 | dnaK | Molecular chaperone DnaK | ZP\_05821969 | [11] |
| 13 | omp16 | Outer membrane protein 16 (Omp16) | P0A3S9 | [12] |
| 14 | omp19 | Outer membrane protein 19 (Omp19) | P0C109 | [12] |
| 15 | rplL | 50S ribosomal protein L7/L12 | AAD51621 | [13] |
| 16 | sodC | Superoxide dismutase [Cu-Zn] | YP\_418725 | [14] |
| 17 | surA | Periplasmic peptidyl prolyl *cis-trans* isomerase (SurA) | ZP\_05821343 | [11] |
| *Brucella melitensis* | Negative | 18 | bp26 | Periplasmic immunogenic protein (bp26) | NP\_539453 | [15] |
| 19 | ialB | Invasion associated locus B (IalB) protein | NP\_540501 | [16] |
| 20 | omp25 | Outer membran protein 25 kDa (Omp25) | NP\_540166 | [17] |
| 21 | omp31 | Outer membrane protein 31 (Omp31) | NP\_539319 | [18] |
| 22 | P39 | Periplasmic binding protein (P39) | NP\_541568 | [19] |
| 23 | tig | Trigger factor (TF) | NP\_539986 | [15] |
| *Campylobacter coli* | Negative | 24 | flaA | Flagellin FlaA | P27053 | [20] |
| *Campylobacter jejuni* | Negative | 25 | cjaA | Surface antigen (CjaA) | CAA71822 | [21] |
| *Chlamydia muridarum* | Negative | 26 | momp | Major outer membran protein (MOMP) | AAB07068 | [22] |
| *Chlamydophila pneumoniae* | Negative | 27 | Eno (CPn0800) | Phosphopyruvate hydratase, Enolase (Eno) | NP\_224995 | [23] |
| 28 | OmpH-like (CPn0301) | Outer membrane protein H-like (OmpH-like) | NP\_224506 | [23] |
| 29 | Pmp10 (CPn0449) | Probable outer membran protein 10 (Pmp10) | Q9RB65 | [23] |
| 30 | Pmp2 (CPn0013) | Polymorphic outer membrane protein G family (Pmp2) | NP\_224227 | [23] |
| *Clostridium difficile* | Positive | 31 | tcdA | Toxin A | CAA63564 | [24] |
| *Clostridium perfringens* | Positive | 32 | etx | Epsilon toxin | AAA23236 | [25] |
| 33 | plc | Phospholipase C (Alpha toxin) | YP\_694509 | [26] |
| *Clostridium tetani* | Positive | 34 | tetx | Tetanus toxin | NP\_783831 | [27] |
| *Corynebacterium pseudotuberculosis* | Positive | 35 | pld | Phospholipase D | P20626 | [28] |
| *Escherichia coli* | Negative | 36 | c1275 | Hypothetical protein c1275 | AAN79749 | [29] |
| 37 | c5321 | Hypothetical protein c5321 | NP\_757168 | [29] |
| 38 | ECOK1\_0290 | Bacterial Ig-like domain (group 1) protein | ADE88959 | [29] |
| 39 | ECOK1\_3374 | General secretion pathway protein K | ADE91828 | [29] |
| 40 | ECOK1\_3385 | Putative lipoprotein | ADE89421 | [29] |
| 41 | ECOK1\_3457 | TonB-dependent siderophore receptor | ADE91247 | [29] |
| 42 | ecp\_3827 | Hemolysin A | YP\_671699 | [29] |
| 43 | fepA | Outer membrane receptor (FepA) | YP\_003076587 | [30] |
| 44 | stxB2 | Shiga toxin 2 subunit B | NP\_049501 | [31] |
| 45 | eltB | Heat-labile enterotoxin B subunit | YP\_003293996 | [32] |
| 46 | fimH | FimH adhesin of type 1 fimbriae | ACZ17766 | [33] |
| *Haemophilus influenzae* | Negative | 47 | omp1 (fadL) | Outer membrane protein P1 (Omp1) | NP\_438563 | [34] |
| 48 | Hap | Hap adhesin, autotransporter protein | AAN37923 | [35] |
| 49 | omp26 | Outer membrane protein 26 (Omp26) | AAD23967 | [36] |
| 50 | TbpB | transferrin binding protein B | YP\_248692 | [37] |
| 51 | ompP5 | Outer membrane protein P5 (OmpP5) | YP\_248824 | [38] |
| 52 | ompP6 (pal) | Outer membrane protein P6 (OmpP6) | NP\_438542 | [39] |
| *Helicobacter pylori* | Negative | 53 | cagA | Cytotoxin-associated antigen (CagA) | AAF17598 | [40] |
| 54 | gltA | Citrate synthase | NP\_222744 | [41] |
| 55 | katA | Catalase (KatA) | AAC16068 | [42] |
| 56 | napA | Neutrophil activatin protein (NapA) | AAA67928 | [43] |
| 57 | ureB | Urease B | P69996 | [44] |
| 58 | VacA | Vacuolating cytotoxin (VacA) | AAD04290 | [40] |
| 59 | groES | Heat shock protein 10 kDa  ( Hsp10, GroES) | NP\_222731 | [45] |
| *Legionella pneumophila* | Negative | 60 | groEL | Heat shock protein 60 kDa (Hsp60, GroEL) | YP\_094724 | [46] |
| 61 | OmpS | Outer membrane protein S (OmpS) | YP\_096954 | [46] |
| 62 | MSP | Major secretory protein (MSP), zinc metalloprotease | YP\_094511 | [47] |
| *Listeria monocytogenes* | Positive | 63 | hly | Listeriolysin O (Hly) | ZP\_05300691 | [48] |
| *Mycobacterium avium* | Mycobacterium | 64 | groEL | Heat shock protein 65 kDa (Hsp65, GroEL) | AAA99670 | [49] |
| *Mycobacterium bovis* | Mycobacterium | 65 | fbpA | Fibronectin binding protein antigen (FbpA, Ag85A) | CAA37206 | [49] |
| *Mycobacterium tuberculosis* | Mycobacterium | 66 | esxA | Early secretory antigenic target, 6 kDa (ESAT-6) | YP\_178023 | [50] |
| 67 | fbpB | Fibronectin binding protein antigen B (FbpB, Ag85B) | NP\_216402 | [51] |
| 68 | hbha | Heparin-binding hemagglutinin (Hbha) | NP\_214989 | [52] |
| 69 | katG | Catalase-peroxidase-peroxynitritase T (KatG) | NP\_216424 | [50] |
| 70 | mpt63 | Immunogenic protein (MPT63) | NP\_216442 | [53] |
| 71 | mpt64 | Immunogenic protein (MPT-64) | NP\_216496 | [54] |
| 72 | mpt83 | Immunogenic protein (MPT-83) | NP\_217389 | [53] |
| 73 | PstS-2 | Phosphate-binding protein 2 (PstS-2) | CAA88137 | [55] |
| 74 | PstS-3 | Phosphate-binding protein 3 (PstS-3) | CAA88138 | [55] |
| 75 | esxB | Culture filtrate antigen 10 kDa (CFP10, EsxB) | NP\_218391 | [56] |
| 76 | fbpD | Fibronectin binding protein, MPT51/MPB51 antigen 85 complex C | YP\_002646905 | [57] |
| 77 | hspX | Heat shock protein (hspX), 14 kDa antigen | NP\_216547 | [58] |
| 78 | Mtb8.4 | low molecular weight T-cell antigen (Mtb8.4) | NP\_215690 | [59] |
| 79 | PPE14 | PPE family protein (PPE14, Mtb41) | NP\_854596 | [60] |
| 80 | PPE44 | PPE family protein (PPE44) | CAE55522 | [61] |
| 81 | PstS-1 | Phosphate-binding protein 1 (PstS-1) | YP\_177770 | [62] |
| *Neisseria meningitidis* | Negative | 82 | LolB (NMB0873) | Outer membrane lipoprotein (LolB) | NP\_273914 | [63] |
| 83 | NMB1163 | Putative periplasmic lipoprotein | NP\_274190 | [63] |
| 84 | nspA | Outer-membrane associated protein (NspA) | AAC36000 | [64] |
| 85 | tbpA | transferrin binding protein (TbpA) | AAF81744 | [65] |
| 86 | tbpB | transferrin binding protein (TbpB) | AAF81745 | [65] |
| *Orientia tsutsugamushi* | Negative | 87 | Bor56 | 56-kDa type-specific antigen (Bor56) | YP\_001248444 | [66] |
| *Pasteurella multocida* | Negative | 88 | ToxA | Pasteurella multocida toxin (PMT, ToxA) | P17452 | [67] |
| *Porphyromonas gingivalis* | Negative | 89 | PG32 | Immunoreactive 43kD antigen (PG32) | AAD51067 | [68] |
| 90 | PG33 | Immunoreactive 42kD antigen (PG33) | AAD51068 | [68] |
| *Pseudomonas aeruginosa* | Negative | 91 | pcrV | Type III secretion protein (PcrV) | NP\_250397 | [69] |
| 92 | toxAmut2 | Exotoxin A mutant | AAB59097 | [70] |
| 93 | oprF | Outer membrane porin F (OprF) | NP\_250468 | [71] |
| *Rickettsia rickettsii* | Negative | 94 | ompA | Outer membrane protein A (OmpA) | AAA26380 | [72] |
| 95 | ompB | Outer membrane protein B (OmpB) | CAA34403 | [73] |
| *Salmonella paratyphi A* | Negative | 96 | h1a | Flagellum antigen phase 1a (H1a) | ACF35754 | [74] |
| 97 | spaO | Surface presentation of antigens protein (SpaO) | ACF35726 | [74] |
| *Salmonella typhimurium* | Negative | 98 | iicA | putative cytoplasmic protein (IicA) | AAD45811 | [75] |
| 99 | mig-14 | putative transcriptional activator (Mig-14) | AAG31201 | [75] |
| 100 | sseB | Secretion system effector B (SseB) | AAC28879 | [75] |
| *Staphylococcus aureus* | Positive | 101 | cna | Collagen adhesin (Cna) | AAA20874 | [76] |
| 102 | mecA | Penicillin-binding protein 2 prime (MecA) | NP\_373278 | [77] |
| 103 | seamut | Enterotoxin type A | 1DYQ\_A | [78] |
| 104 | clfa | Clumping factor A (Clfa), Fibrinogen binding protein | YP\_001331790 | [79] |
| *Streptococcus agalactiae* | Positive | 105 | ap1-2a | Ancillary protein 1 of pilus 2a (AP1-2a) | NP\_688406 | [80] |
| 106 | ap1-2b | Ancillary protein 1 of pilus 2b, subtilase (AP1-2b) | ZP\_00785378 | [80] |
| 107 | bp-2a | Backbone protein of pilus 2a (BP-2a) | NP\_688405 | [80] |
| 108 | bp-2b | Backbone protein of pilus 2b (Bp-2b) | ZP\_00785385 | [80] |
| 109 | GBS104 (SAG0649) | Cell wall surface anchor family protein, putative (SAG0649) | AAM99541 | [81] |
| 110 | GBS80 (SAG0645) | Cell wall surface anchor family protein (SAG0645) | AAM99537 | [81] |
| 111 | sip | Surface immunogenic protein (Sip) | AAG18474 | [82] |
| *Streptococcus pneumoniae* | Positive | 112 | cbpA | choline binding protein A (CbpA) | YP\_817402 | [83] |
| 113 | pdb | pneumolysin (Pdb) | YP\_817150 | [83] |
| 114 | prtA (Sp130) | Serine protease (PrtA) | NP\_345151 | [84] |
| 115 | psaA | Pneumococcal surface adhesin A (PsaA) | AAB09440 | [85] |
| 116 | pspA | Pneumococcal surface protein A (PspA) | NP\_357715 | [85] |
| 117 | lytB (Sp46) | Putative endo-beta-N-acetylglucosaminidase (LytB) | AAK19156 | [84] |
| 118 | PhpA | histidine triad protein (PhpA) | AAK26629 | [86] |
| 119 | phtA (Sp36) | histidine triad protein (PhtA) | AAK19155 | [84] |
| 120 | lytC (Sp91) | 1,4-beta-N-acetylmuramidase (LytC) | YP\_873931 | [84] |
| 121 | pvaA (Sp101) | Pneumococcal vaccine antigen A (pvaA), PXO2-08 | AAK19158 | [84] |
| *Streptococcus pyogenes* | Positive | 122 | fbpA | Fibronectin-binding protein (FbpA) | BAB62098 | [87] |
| 123 | sfb | Fibronectin-binding protein 1 (Sfb) | CAA48133 | [88] |
| *Streptococcus suis serotype 2* | Positive | 124 | esa | Epidermal surface antigen (Esa) | ABP90422 | [89] |
| 125 | ibp | IgG-binding protein (Ibp) | ABP89196 | [89] |
| 126 | rfeA | RTX family exoprotein A (RfeA) | ABP89149 | [89] |
| 127 | sly | Suilysin (Sly) | ABP90369 | [89] |
| *Treponema pallidum* | Negative | 128 | glpQ | Glycerophosphodiester phosphodiesterase (GlpQ) | NP\_218698 | [90] |
| 129 | tmpB | treponemal membrane protein (TmpB) | NP\_219206 | [91] |
| 130 | tprK | tpr protein K (tprK) | AAF45140 | [92] |
| 131 | tpF1 | Bacterioferrin antigen (TpF1) | NP\_219475 | [93] |
| *Yersinia pestis* | Negative | 132 | caf1 | Capsular antigen F1 (Caf1) | NP\_395430 | [94] |
| 133 | lcrV | low calcium response protein V (LcrV), V antigen | NP\_395165 | [95] |
| 134 | yapF (YPO0606) | Autotransporter protein (YapF) | YP\_002345675 | [96] |
| 135 | ybtQ (YPO1914) | Inner membrane ABC-transporter (YbtQ) | YP\_002346905 | [96] |
| 136 | yscF | Needle complex major subunit (yscF) | NP\_857727 | [97] |

1*Gene*, refers to the gene symbol for the antigen; *Gram*, refers to Gram stain and is not applicable (NA) for antigens from *M. tuberculosis*; *Acc. No.*, refers to the accession number at the National Center of Biotechnology Information (NCBI, http://www.ncbi.nlm.nih.gov/) for the protein sequence of the antigen; *Ref.*, refers to the literature reference from which descriptive information was curated for each bacterial protective antigen (BPA). Shading is for display purposes only.

2Sequence data for *toxAmut* was obtained by manually editing the sequence data for the *toxA* protein of *P. aeruginosa* (strain PA103) available from GenBank with accession number AAB59097. Residue 553 was deleted and the histidine at residue 426 was replaced with lysine to convert *toxA* to *toxAmu*t as described by Denis-Mize *et al.* [70].

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