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# Draft Genome Sequences of *Pseudomonas aeruginosa* Strain PS3 and *Citrobacter freundii* Strain SA79 Obtained from a Wound Dressing-Associated Biofilm

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**Two isolates, one from the genus *Pseudomonas* and the second from *Citrobacter*, were isolated from a wound dressing-associated biofilm. Following whole-genome sequencing, the two isolates presented genes encoding for resistance to antibiotics and those involved in exopolysaccharide production.**

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The management of infected wounds is a worldwide health care issue (1), exacerbated by the rise of antimicrobial resistance (2–4). The formation of biofilms within wounds has been implicated in the delayed healing, ineffective treatment, and prolonged infection of chronic wounds (5) through the suppression of the immune system and the reduced impact of antimicrobial agents (5–8). *Pseudomonas* spp. have previously been identified as both a pathogen and a biofilm-forming organism within a wound environment, particularly in those wounds associated with burns (9, 10). In contrast, instances of *Citrobacter* sp. wound infections are uncommon within the literature; however, there are reported instances of their pathogenicity (11, 12). Here, we present the draft genome sequences of *Pseudomonas aeruginosa* strain PS3 and *Citrobacter freundii* strain SA79, both of which were isolated from a contaminated wound dressing.

A discarded dressing from an infected wound was provided anonymously from a local skin integrity practitioner. Swabs were taken from the wound surface and transferred to 2 mL of sterile maximum recovery diluent (LabM Ltd.) and vortexed. The homogeneous suspension was then used to prepare 400- $\mu$ L spread plates upon a *Pseudomonas aeruginosa* selective medium (LAB108, with X107 supplement, LabM, United Kingdom). Single colonies were selected from the plate and purified through further subculture before total genomic DNA was isolated using a commercial kit (Ultraclean Microbial Isolation Kit, Mo-Bio, USA).

Draft whole-genome sequences were obtained using a whole-genome shotgun (WGS) sequence strategy. Paired-end 125 cycles sequence reads were generated using the Illumina HiSeq 2500 system (BaseClear, Netherlands). FASTQ sequence files were generated using the Illumina Casava pipeline version 1.8.3 and the assembly prepared using CLC Genomics Workbench version 7.0.4. The contigs were linked and placed into scaffolds or supercontigs. The orientation, order, and distance between the contigs was estimated using the insert size between the paired-end and/or mate-pair reads using the SSPACE Premium scaffold version 2.3 (13). The draft genome sequencing of *Pseudomonas aeruginosa* strain PS3 generated 165 contigs, with a sequence length of 6,799,547 bp

(66.2% G+C content). The draft genome contained a total of 6,161 coding sequences (CDSs), where 35 pseudogenes, 2 genes coding for rRNA (16S, 23S), 57 genes coding for tRNA, and 1 noncoding RNA (ncRNA) were present. *Citrobacter freundii* strain SA79 was 4,870,483 bp in length across 19 contigs with a G+C content of 51.7%. The draft genome contained a total of 4,480 CDSs, 36 pseudogenes, 3 genes coding for rRNA (5S, 16S, 23S), 72 genes coding for tRNA, and 9 ncRNAs were present. Further analysis of the two genomes using RAST (14) indicated that both organisms carried genes encoding resistance to antibiotics and toxic compounds. In addition, the presence of genes involved with exopolysaccharide and biofilm synthesis suggests that these organisms may be of further clinical interest.

**Nucleotide sequence accession numbers.** These sequences were submitted to Genbank under the accession numbers JRGP00000000 (*Pseudomonas aeruginosa* strain PS3) and LAZI00000000 (*Citrobacter freundii* strain SA79).

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## REFERENCES

- European Wound Management Association (EWMA). 2008. Hard-to-heal wounds: a holistic approach. European Wound Management Association, MEP Ltd, London, United Kingdom.
- Gottrup F, Apelqvist J, Bjarnsholt T, Cooper R, Moore Z, Peters EJ, Probst S. 2013. EWMA document: antimicrobials and non-healing wounds. Evidence, controversies and suggestions. *J Wound Care* 22: S1–S92. <http://dx.doi.org/10.12968/jowc.2013.22.Sup5.S1>.
- Percival SL, Bowler PG, Russell D. 2005. Bacterial resistance to silver in wound care. *J Hosp Infect* 60:1–7. <http://dx.doi.org/10.1016/j.jhin.2004.11.014>.
- Silver S, Phung LT, Silver G. 2006. Silver as biocides in burn and wound dressings and bacterial resistance to silver compounds. *J Ind Microbiol Biotechnol* 33:627–634. <http://dx.doi.org/10.1007/s10295-006-0139-7>.
- Percival SL, Hill KE, Williams DW, Hooper SJ, Thomas DW, Costerton JW. 2012. A review of the scientific evidence for biofilms in wounds. *Wound Repair Regen* 20:647–657. <http://dx.doi.org/10.1111/j.1524-475X.2012.00836.x>.
- Mah TF, O'Toole GA. 2001. Mechanisms of biofilm resistance to anti-

- icrobial agents. *Trends Microbiol* 9:34–39. [http://dx.doi.org/10.1016/S0966-842X\(00\)01913-2](http://dx.doi.org/10.1016/S0966-842X(00)01913-2).
7. Davies D. 2003. Understanding biofilm resistance to antibacterial agents. *Nat Rev Drug Discov* 2:114–122. <http://dx.doi.org/10.1038/nrd1008>.
  8. Donlan RM, Costerton JW. 2002. Biofilms: survival mechanisms of clinically relevant microorganisms. *Clin Microbiol Rev* 15:167–193. <http://dx.doi.org/10.1128/CMR.15.2.167-193.2002>.
  9. Estahbanati HK, Kashani PP, Ghanaatpisheh F. 2002. Frequency of *Pseudomonas aeruginosa* serotypes in burn wound infections and their resistance to antibiotics. *Burns* 28:340–348. [http://dx.doi.org/10.1016/S0305-4179\(02\)00024-4](http://dx.doi.org/10.1016/S0305-4179(02)00024-4).
  10. Harrison-Balestra C, Cazzaniga AL, Davis SC, Mertz PM. 2003. A wound-isolated *Pseudomonas aeruginosa* grows a biofilm *in vitro* within 10 hours and is visualized by light microscopy. *Dermatol Surg* 29:631–635.
  11. Drelichman V, Band JD. 1985. Bacteremias due to *Citrobacter diversus* and *Citrobacter freundii*. Incidence, risk factors, and clinical outcome. *Arch Intern Med* 145:1808–1810.
  12. Tschäpe H, Prager R, Streckel W, Fruth A, Tietze E, Böhme G. 1995. Verotoxinogenic *Citrobacter freundii* associated with severe gastroenteritis and cases of haemolytic uraemic syndrome in a nursery school: green butter as the infection source. *Epidemiol Infect* 114:441–450. <http://dx.doi.org/10.1017/S0950268800052158>.
  13. Boetzer M, Henkel CV, Jansen HJ, Butler D, Pirovano W. 2011. Scaffolding pre-assembled contigs using SSPACE. *Bioinformatics* 27:578–579. <http://dx.doi.org/10.1093/bioinformatics/btq683>.
  14. Aziz RK, Bartels D, Best AA, DeJongh M, Disz T, Edwards RA, Formsma K, Gerdes S, Glass EM, Kubal M, Meyer F, Olsen GJ, Olson R, Osterman AL, Overbeek RA, McNeil LK, Paarmann D, Paczian T, Parrello B, Pusch GD. 2008. The RAST server: Rapid Annotations using Subsystems Technology. *BMC Genomics* 9:75. <http://dx.doi.org/10.1186/1471-2164-9-75>.