

Whole-Genome Sequences of *Staphylococcus aureus* ST398 Strains of Animal Origin

David Hernandez, Nathalie van Der Mee-Marquet, Jan Kluytmans,
Pierre-Yves Donnio, Roland Quentin, Anna-Rita Corvaglia, Patrice François

► **To cite this version:**

David Hernandez, Nathalie van Der Mee-Marquet, Jan Kluytmans, Pierre-Yves Donnio, Roland Quentin, et al.. Whole-Genome Sequences of *Staphylococcus aureus* ST398 Strains of Animal Origin. Genome Announcements, American Society for Microbiology, 2013, 1 (5), pp.e00689–13. 10.1128/genomeA.00689-13 . hal-01188857

HAL Id: hal-01188857

<https://hal-univ-rennes1.archives-ouvertes.fr/hal-01188857>

Submitted on 28 May 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Whole-Genome Sequences of *Staphylococcus aureus* ST398 Strains of Animal Origin

David Hernandez,^a Nathalie van der Mee-Marquet,^{b,c} Jan Kluytmans,^d Pierre-Yves Donnio,^{e,f} Roland Quentin,^b Anna-Rita Corvaglia,^a Patrice François^a

Genomic Research Laboratory, University of Geneva Hospitals, Geneva, Switzerland^a; Service de Bactériologie et Hygiène, Centre Hospitalier Régional Universitaire, Tours, France^b; Réseau des Hygiénistes du Centre, Centre Hospitalier Universitaire, Tours, France^c; Laboratory for Microbiology and Infection Control, Amphia Hospital, Breda, and VU University Medical Center, Amsterdam, The Netherlands^d; Service de Bactériologie et Hygiène Hospitalière, Centre Hospitalier Universitaire, Rennes, France^e; EA1254 Microbiologie-Risques Infectieux, Université de Rennes 1, Rennes, France^f

***Staphylococcus aureus* sequence type 398 (ST398) was originally associated with animal infections. We announce the complete genome sequences of two ST398 methicillin-susceptible *S. aureus* strains from the livestock environment. These genome sequences assist in the characterization of interesting ST398 features relying on host tropism and epidemiological settings.**

Received 5 August 2013 Accepted 30 August 2013 Published 26 September 2013

Citation Hernandez D, van der Mee-Marquet N, Kluytmans J, Donnio P-Y, Quentin R, Corvaglia A-R, François P. 2013. Whole-genome sequences of *Staphylococcus aureus* ST398 strains of animal origin. *Genome Announc.* 1(5):e00689-13. doi:10.1128/genomeA.00689-13.

Copyright © 2013 Hernandez et al. This is an open-access article distributed under the terms of the [Creative Commons Attribution 3.0 Unported license](http://creativecommons.org/licenses/by/3.0/).

Address correspondence to Patrice François, patrice.francois@genomic.ch.

Staphylococcus aureus sequence type 398 (ST398) was originally described in livestock (1) but is currently reported as the causative agent of severe infections in humans (2). We recently reported the emergence of a specific subpopulation of ST398 showing specific bacteriophage content and appearing to be adapted to humans (2). We report here the genome sequences of two *S. aureus* strains colonizing humans in an animal environment.

S. aureus strains S1 and S130 were recovered from cows and pigs, respectively. S1 and S130 were isolated from feces samples during the course of epidemiological studies from healthy farmers conducted in 2008 in France and 2010 in the Netherlands, respectively. Purified genomic DNA was subjected to whole-genome shotgun sequencing by using a MiSeq system (Illumina, Inc). Following fragmentation, end reparation, and sample tagging, the sequencer produced 10.0 million 100-bp paired reads for each strain, yielding appreciable and identical coverages of around 360×. Assembly was performed using Edena 3.0 (3) and resulted in 60 and 42 contigs for strains S1 and S130, respectively. The larger contigs of 475,000 bp for strain S1 and 567,000 bp for strain S130 were assembled. The overall assembly values were satisfactory (strain S1 sum, 2.82 Mbp, and N₅₀, 241,000 bp; strain S130 sum, 2.78 Mbp, and N₅₀, 140,000 bp). In strains S1 and S130, a total of 2,618 and 2,595 predicted coding sequences (CDSs), respectively, were detected by Rapid Annotations using Subsystems Technology (RAST) (4). Using Cd-hit (5), we found that the majority of genes ($n = 2,470$) were common to both strains (identity, >80%). More than 53% of the genes were assigned to specific subsystem categories by RAST (4). In addition to CDSs, RAST identified 78 structural genes, including 59 tRNA and 19 rRNA genes, for the chromosome of S1 and 76 structural genes, including 59 tRNA and 17 rRNA genes, for the chromosome of S130. Note that the assembly results showed that strain S130 harbors one 9.0-kb circular plasmid in 3 copies/cell, whereas S1 harbors 4 circular plasmids. The sizes of these plasmids are 4.90, 3.99, 2.75, and 2.46 kb with copy numbers/cell of around 10, 12, 20, and 8, respectively.

The two *S. aureus* genomes are highly similar in terms of an-

notations and contain known virulence factors, such as genes for enterotoxin and hemolysins, as well as 30 open reading frames (ORFs) from a prophage origin. Annotation allowed for the detection of numerous bacterial adhesins that allow interaction with host tissues and also numerous resistance determinants. Interestingly, both strains are missing the type IV restriction system but harbor a type I restriction-modification system with a sequence similar to that of functional systems in the reference isolates.

We conclude that *S. aureus* shows important genome features specific to its host and epidemiological settings.

Nucleotide sequence accession numbers. The whole-genome sequences of *S. aureus* S1 and S130 were deposited in DDBJ/EMBL/GenBank under accession no. [AUPS00000000](https://www.ncbi.nlm.nih.gov/nuccore/AUPS00000000) and [AUPT00000000](https://www.ncbi.nlm.nih.gov/nuccore/AUPT00000000), respectively.

ACKNOWLEDGMENTS

This study was supported in part by the University Hospital of Tours.

We thank the technicians for their dedicated help.

REFERENCES

1. Witte W, Strommenger B, Stanek C, Cuny C. 2007. Methicillin-resistant *Staphylococcus aureus* ST398 in humans and animals, Central Europe. *Emerg. Infect. Dis.* 13:255–258.
2. Mee-Marquet N, Corvaglia AR, Valentin AS, Hernandez D, Bertrand X, Girard M, Kluytmans J, Donnio PY, Quentin R, François P. 2013. Analysis of prophages harbored by the human-adapted subpopulation of *Staphylococcus aureus* CC398. *Infect. Genet. Evol.* 18:299–308.
3. Hernandez D, François P, Farinelli L, Osterås M, Schrenzel J. 2008. *De novo* bacterial genome sequencing: millions of very short reads assembled on a desktop computer. *Genome Res.* 18:802–809.
4. Aziz RK, Bartels D, Best AA, DeJongh M, Disz T, Edwards RA, Formisano 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, Reich C, Stevens R, Vassieva O, Vonstein V, Wilke A, Zagnitko O. 2008. The RAST server: rapid annotations using subsystems technology. *BMC Genomics* 9:75. doi:10.1186/1471-2164-9-75.
5. Li W, Godzik A. 2006. Cd-hit: a fast program for clustering and comparing large sets of protein or nucleotide sequences. *Bioinformatics* 22:1658–1659.