

Draft Genome Sequence of *Campylobacter corcagiensis* Strain CIT045^T, a Representative of a Novel *Campylobacter* Species Isolated from Lion-Tailed Macaques (*Macaca silenus*)

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***Campylobacter corcagiensis* CIT045^T (=CCUG 64942^T, LMG 27932^T), a new member of the *Campylobacter* genus, has recently been isolated from lion-tailed macaques in Cork, Ireland. To further characterize this new species and its potential pathogenicity, the genome sequence of *C. corcagiensis* was determined and is presented here.**

Received 4 March 2014 Accepted 28 March 2014 Published 17 April 2014

Citation Koziel M, Lucid A, Bullman S, Corcoran GD, Lucey B, Sleator RD. 2014. Draft genome sequence of *Campylobacter corcagiensis* strain CIT045^T, a representative of a novel *Campylobacter* species isolated from lion-tailed macaques (*Macaca silenus*). *Genome Announc.* 2(2):e00248-14. doi:10.1128/genomeA.00248-14.

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The *Campylobacter* genus currently includes 25 species and 8 subspecies that have been isolated from humans, birds, and domestic animals (1). Many of the *Campylobacter* spp. described to date have been shown to cause disease in both humans and animals (1). *Campylobacter corcagiensis* was isolated by our research group from captive primates. The taxonomic position of this species is currently being described; however, its virulence and pathogenicity are as yet unknown. Preliminary studies in our lab have shown that *C. corcagiensis* possesses some interesting phenotypic characteristics, such as bile and salt tolerance, as well as resistance to certain antibiotics, such as metronidazole and nalidixic acid (unpublished data). To further elucidate its pathogenic potential, whole-genome sequencing of this strain was performed.

C. corcagiensis strain CIT045^T (=CCUG 64942^T, LMG 27932^T) was sequenced using Illumina MiSeq with 250-bp paired-end reads. The sequencing generated 794,990 reads in pairs and an estimated genome coverage of approximately 200×. The reads were assembled *de novo* using the Velvet (version 1.2.10) assembly tool (2) into 21 contigs. The total draft genome size is 1,676,909 bp, and the estimated G+C content is 31.9 mol%. The genome was annotated using the automated annotation server RAST (3). A total of 1,748 coding sequences (CDS) were identified, with 578 assigned as hypothetical, accounting for 33% of all CDS. From those, a total of 125 proteins were predicted to be secreted using SignalP 4.1 (4).

Among the predicted CDS, several putative virulence factors were identified, including genes encoding putative efflux pumps involved in conferring antibiotic resistance, such as the *cmeABC* operon and the macrolide-specific efflux operon *macAB* (5, 6). Moreover, putative genetic loci that have been associated with resistance to quaternary ammonium compounds (*sugE*) have been found in the genome (7).

The genome of *C. corcagiensis* also contains other putative virulence genes associated with the formation of type IV pili (*pilT*, *pilQ*) (8), adhesion (fibronectin-fibrinogen binding protein gene) (9), invasion (*ciaB*) (10), or increased intestinal permeability (zonula occludens toxin gene) (11). These are potentially involved

in promoting gastrointestinal pathogenicity; however, further studies are required to investigate the true virulence and pathogenic potential of this strain.

Nucleotide sequence accession numbers. This whole-genome shotgun project has been deposited at DDBJ/EMBL/GenBank under the accession no. [JFAP010000000](https://www.ncbi.nlm.nih.gov/nuccore/JFAP010000000). The version described in this paper is version JFAP010000000.

ACKNOWLEDGMENTS

We thank Pat O'Doherty, veterinary surgeon, and the staff at Gilabbey Veterinary Hospital, Cork, for providing the samples.

M.K., A.L., and S.B. are recipients of Ph.D. fellowships from the Irish Research Council: RS/2011/264, RS/2012/219, and RS/2009/1670, respectively. R.D.S. is the coordinator of the EU FP7 Marie Curie IAPP project ClouDx-i. We acknowledge the financial assistance of Serosep Ltd., Ireland.

REFERENCES

1. Man SM. 2011. The clinical importance of emerging *Campylobacter* species. *Nat. Rev. Gastroenterol. Hepatol.* 8:669–685. <http://dx.doi.org/10.1038/nrgastro.2011.191>.
2. Zerbino DR, Birney E. 2008. Velvet: algorithms for *de novo* short read assembly using de Bruijn graphs. *Genome Res.* 18:821–829. <http://dx.doi.org/10.1101/gr.074492.107>.
3. 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, 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. <http://dx.doi.org/10.1186/1471-2164-9-75>.
4. Petersen TN, Brunak S, von Heijne G, Nielsen H. 2011. SignalP 4.0: discriminating signal peptides from transmembrane regions. *Nat. Methods* 8:785–786. <http://dx.doi.org/10.1038/nmeth.1701>.
5. Kobayashi N, Nishino K, Yamaguchi A. 2001. Novel macrolide-specific ABC-type efflux transporter in *Escherichia coli*. *J. Bacteriol.* 183:5639–5644. <http://dx.doi.org/10.1128/JB.183.19.5639-5644.2001>.
6. Lin J, Michel LO, Zhang Q. 2002. CmeABC functions as a multidrug efflux system in *Campylobacter jejuni*. *Antimicrob. Agents Chemother.* 46:2124–2131. <http://dx.doi.org/10.1128/AAC.46.7.2124-2131.2002>.
7. Chung YJ, Saier MH, Jr. 2002. Overexpression of the *Escherichia coli sugE* gene confers resistance to a narrow range of quaternary ammonium com-

- pounds. *J. Bacteriol.* 184:2543–2545. <http://dx.doi.org/10.1128/JB.184.9.2543-2545.2002>.
8. Lux R, Shi W. 2004. Chemotaxis-guided movements in bacteria. *Crit. Rev. Oral Biol. Med.* 15:207–220. <http://dx.doi.org/10.1177/154411130401500404>.
 9. Konkel ME, Larson CL, Flanagan RC. 2010. *Campylobacter jejuni* FlpA binds fibronectin and is required for maximal host cell adherence. *J. Bacteriol.* 192:68–76. <http://dx.doi.org/10.1128/JB.00969-09>.
 10. Christensen JE, Pacheco SA, Konkel ME. 2009. Identification of a *Campylobacter jejuni*-secreted protein required for maximal invasion of host cells. *Mol. Microbiol.* 73:650–662. <http://dx.doi.org/10.1111/j.1365-2958.2009.06797.x>.
 11. Fasano A, Fiorentini C, Donelli G, Uzzau S, Kaper JB, Margaretten K, Ding X, Guandalini S, Comstock L, Goldblum SE. 1995. Zonula occludens toxin modulates tight junctions through protein kinase C-dependent actin reorganization, *in vitro*. *J. Clin. Invest.* 96:710–720. <http://dx.doi.org/10.1172/JCI118114>.