

Draft Genome Sequence of *Halomonas hydrothermalis* MTCC 5445, Isolated from the West Coast of India

Vamsi Bharadwaj SV,^{a,b} Anupama Shrivastav,^{a*} Sonam Dubey,^a Tonmoy Ghosh,^{a,b} Chetan Paliwal,^{a,b} Rahul Kumar Maurya,^{a,b} Sandhya Mishra^{a,b}

Discipline of Salt & Marine Chemicals, CSIR-CSMCRI, Bhavnagar, Gujarat, India^a; Academy of Scientific and Innovative Research (AcSIR), CSIR-CSMCRI, Bhavnagar, Gujarat, India^b

* Present address: Anupama Shrivastav, KAIST, Daejeon, South Korea.

We announce here the draft genome sequence of *Halomonas hydrothermalis* MTCC 5445, a halophilic bacterium of the class *Gammaproteobacteria*. It was isolated from the sea coast of Aadri, Veraval, Gujarat, India. Its genome contains genes for polyhydroxybutyrate (PHB), a biodegradable polymer that can be used as a substitute for petroleum plastics.

Received 1 December 2014 Accepted 11 December 2014 Published 15 January 2015

Citation Bharadwaj SV V, Shrivastav A, Dubey S, Ghosh T, Paliwal C, Maurya R, Mishra S. 2015. Draft genome sequence of *Halomonas hydrothermalis* MTCC 5445, isolated from the west coast of India. *Genome Announc* 3(1):e01419-14. doi:10.1128/genomeA.01419-14.

Copyright © 2015 Bharadwaj SV et al. This is an open-access article distributed under the terms of the [Creative Commons Attribution 3.0 Unported license](https://creativecommons.org/licenses/by/3.0/).

Address correspondence to Sandhya Mishra, smishra@csmcri.org.

Halomonas hydrothermalis MTCC 5445 (= SMP3M) was isolated at Aadri, Veraval, Gujarat, India (20°57.584'N 70°16.659'E) (1). It is a Gram-negative, heterotrophic, halophilic, motile organism belonging to the class *Gammaproteobacteria* and is capable of growing well in salt (NaCl) concentrations up to 5%. *H. hydrothermalis* has been reported to accumulate polyhydroxybutyrate (PHB) intracellularly at about 75% of its dry cell weight (2). Moreover, it has the ability to utilize a wide variety of carbon sources, including waste glycerol, from biodiesel manufacturing processes for its growth, as well as to produce PHB (1, 3). It is able to ferment sugars, such as maltose, fructose, glucose, sucrose, and ribose. Experiments with seaweed-derived crude levulinic acid established its utility as a cofeed for the bacterium, along with other carbon sources (4). We have also tested Council of Scientific and Industrial Research-Central Salt and Marine Chemicals Research Institute (CSIR-CSMCRI) dry sea mixture as a substitute for commercially available marine bacterial media for its growth (5).

The isolate was deposited at the Microbial Type Culture Collection (MTCC), Institute of Microbial Technology (IMTECH), Chandigarh, India (1), identified as *H. hydrothermalis*, and given an accession number, MTCC 5445. The 16S rRNA sequence was submitted to GenBank (accession no. GU938192).

The microorganism, by virtue of its salt tolerance, high growth rate, and ability to consume a variety of substrates, is fit for the industrial production of polyhydroxyalkanoate (PHA).

The genome was sequenced at Anand Agricultural University, Anand, Gujarat, India, using a 454-GS FLX sequencer (6). The reads were assembled *de novo* using Newbler version 2.9. The quality analysis of the assembly was performed using QUASt (7). The assembly contained 3,848,774 nucleotides in 64 contigs of >500 bp and 33 contigs of >1,000 bp. A total of 3,467 protein-coding and 63 RNA-coding genes were observed.

The assembled contigs were submitted to the RAST annotation server for subsystem classification and functional annotation (8,

9). The protein-coding genes (CDSs) were assigned using BLASTp with the KEGG Orthology (KO) database.

The draft genome has a mean G+C content of 60.25% and 486 subsystems. Genome analysis revealed genes related to PHA production, which is in agreement with previous reports (1).

The whole-genome information is expected to aid in the metabolic engineering efforts directed toward increasing the production of commercially important products and by-products. Comparative genomic studies will also help in the analysis of diversity and the survival strategies of the bacterium in saline environments.

Nucleotide sequence accession numbers. This whole-genome shotgun project has been deposited at DDBJ/EMBL/GenBank under the accession no. [JTDR000000000](https://www.ncbi.nlm.nih.gov/nuccore/JTDR000000000). The version described in this paper is version JTDR01000000.

ACKNOWLEDGMENTS

This study was financed through a CSIR-MoES-NMITLI multi-institutional project (TLP 0096). V.B.S.V., T.G., C.P., and R.M. acknowledge CSIR and AcSIR, New Delhi, for financial support and Ph.D. registration, respectively. S.D. acknowledges CSIR network project CSC 0203 for financial support. We gratefully acknowledge the constant encouragement of Arvind Kumar, DC, SMC.

This paper has been assigned CSIR-CSMCRI registration no. 206, dated 30 November 2014.

REFERENCES

- Shrivastav A, Mishra SK, Shethia B, Pancha I, Jain D, Mishra S. 2010. Isolation of promising bacterial strains from soil and marine environment for polyhydroxyalkanoates (PHAs) production utilizing *Jatropha* biodiesel byproduct. *Int J Biol Macromol* 47:283–287. <http://dx.doi.org/10.1016/j.jbiomac.2010.04.007>.
- Shrivastav A. 2011. Production, purification and characterisation of the biopolymer (PHAs) from biodiesel byproduct (glycerol) by microbes. Bhavnagar University, Bhavnagar, India.
- Ghosh PK, Mishra S, Gandhi MR, Upadhyay SC, Paul P, Anand PS, Popat KM, Shrivastav AV, Mishra SK, Ondhiya N, Maru RD, Dyal G, Brahmabhatt H, Boricha V, Chaudhary DR, Rebarry B, Zala KS. 2010.

- Integrated process for the production of Jatropha methyl ester and by products. International application no. PCT/IN2010/000192.
4. Bera A, Dubey S, Bhayani K, Mondal D, Mishra S, Ghosh PK. 2015. Microbial synthesis of polyhydroxyalkanoate using seaweed-derived crude levulinic acid as co-nutrient. *Int J Biol Macromol* 72:487–494. <http://dx.doi.org/10.1016/j.ijbiomac.2014.08.037>.
 5. Ghosh PK, Upadhyay SC, Mishra SC, Mohandas VP, Srivastava DN, Shahi VK, Sanghavi RJ, Thampy S, Makwana BS, Pancha I. 2013. A process for the preparation of natural salt formulations for seawater substitution, mineral fortification. International application no. PCT/IN2012/000857.
 6. Margulies M, Egholm M, Altman WE, Attiya S, Bader JS, Bemben LA, Berka J, Braverman MS, Chen Y-J, Chen Z, Dewell SB, Du L, Fierro JM, Gomes XV, Godwin BC, He W, Helgesen S, Ho CH, Irzyk GP, Jando SC, Alenquer MLI, Jarvie TP, Jirage KB, Kim J-B, Knight JR, Lanza JR, Leamon JH, Lefkowitz SM, Lei M, Li J, Lohman KL, Lu H, Makhijani VB, McDade KE, McKenna MP, Myers EW, Nickerson E, Nobile JR, Plant R, Puc BP, Ronan MT, Roth GT, Sarkis GJ, Simons JF, Simpson JW, Srinivasan M, Tartaro KR, Tomasz A, Vogt KA, Volkmer GA, Wang SH, Wang Y, Weiner MP, Yu P, Begley RF, Rothberg JM. 2005. Genome sequencing in microfabricated high-density picolitre reactors. *Nature* 437:376–380. <http://dx.doi.org/10.1038/nature03959>.
 7. Gurevich A, Saveliev V, Vyahhi N, Tesler G. 2013. QUAST: quality assessment tool for genome assemblies. *Bioinformatics* 29:1072–1075. <http://dx.doi.org/10.1093/bioinformatics/btt086>.
 8. 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>.
 9. Overbeek R, Olson R, Pusch GD, Olsen GJ, Davis JJ, Disz T, Edwards RA, Gerdes S, Parrello B, Shukla M, Vonstein V, Wattam AR, Xia F, Stevens R. 2013. The SEED and the rapid annotation of microbial genomes using subsystems technology (RAST). *Nucleic Acids Res* 42:D206–D214. <http://dx.doi.org/10.1093/nar/gkt1226>.