WIKIPEDIA
The Free Encyclopedia

Alkalihalobacillus

Alkalihalobacillus is a genus of gram-positive or gram-variable rod-shaped bacteria in the family *Bacillaceae* from the order *Bacillales*.[2][3] The type species of this genus is *Alkalihalobacillus alcalophilus*.[4]

Alkalihalobacillus	
Scientific classification	
Domain:	Bacteria
Phylum:	Bacillota
Class:	Bacilli
Order:	Bacillales
Family:	Bacillaceae
Genus:	*Alkalihalobacillus* Patel and Gupta 2020
Species[1]	
▪ See text	

This genus comprises species formerly belonging to the genus *Bacillus*, a genus that has been recognized as displaying extensive polyphyly and phylogenetic heterogeneity due to the vague criteria[5] (such as the ability to form endospores in the presence of oxygen)[6] previously used to assign species to this clade. Multiple studies using comparative phylogenetic analyses have been published in an attempt to clarify the evolutionary relationships between *Bacillus* species, resulting in the establishment of numerous novel genera such as *Alkalihalobacillus*, *Brevibacillus, Solibacillus*, *Alicyclobacillus* and *Virgibacillus*.[2][7][8][9][10] The genus *Bacillus* is now restricted to species closely related to *Bacillus subtilis* and *Bacillus cereus*.[2][11]

The name *Alkalihalobacillus* is composed of the prefix "alkali-" (from the Arabic article and noun *al galiy,* which translates to 'the ashes of saltwort'), the prefix "halo-" (from the Greek noun *hals/halos,* meaning salt) and suffixed by "-bacillus" (from the Latin noun *bacillus,* referring to 'a small staff or rod' and *Bacillus,* a bacterial genus). Together, the name refers to bacillus living in salty or alkaline conditions, or salty and alkaline conditions.[2]

Taxonomy

This genus, as of May 2021, contains a total of 44 species, 39 of which have been validly published and have established names.[4] This genus was identified as a monophyletic clade and phylogenetically unrelated to other *Bacillus* species in studies examining the taxonomic relationships within *Bacillus*.[2] This branching pattern is also observed in the Genome Taxonomy Database (GTDB).[12]

Two additional *Bacillus* species (*Bacillus alcaliphilum* and *Bacillus alkalisoli*) are found to group with other members of *Alkalihalobacillus* in phylogenetic trees as well as share the same molecular markers in the form of conserved signature indels (CSIs).[11] However, their transfer was not officially proposed due to the lack of culture strain information. Further revision of this genus is required as additional genomes and novel species are discovered and assigned.

Accepted species

- *Alkalihalobacillus akibai*
- *Alkalihalobacillus alcalophilus*

- *Alkalihalobacillus algicola*
- *Alkalihalobacillus alkalilacus*
- *Alkalihalobacillus alkalinitrilicus*
- *Alkalihalobacillus alkalisediminis*
- *Alkalihalobacillus berkeleyi*
- *Alkalihalobacillus bogoriensis*
- *Alkalihalobacillus caeni*
- *Alkalihalobacillus clausii*
- *Alkalihalobacillus decolorationis*
- *Alkalihalobacillus gibsonii*
- *Alkalihalobacillus halodurans*
- *Alkalihalobacillus hemicellulosilyticus*
- *Alkalihalobacillus hemicentroti*
- *Alkalihalobacillus hunanensis*
- *Alkalihalobacillus hwajinpoensis*
- *Alkalihalobacillus kiskunsagensis*
- *Alkalihalobacillus krulwichiae*
- *Alkalihalobacillus ligniniphilus*
- *Alkalihalobacillus lindianensis*
- *Alkalihalobacillus lonarensis*
- *Alkalihalobacillus macyae*
- *Alkalihalobacillus marmarensis*
- *Alkalihalobacillus miscanthi*
- *Alkalihalobacillus murimartini*
- *Alkalihalobacillus nanhaiisediminis*
- *Alkalihalobacillus oceani*
- *Alkalihalobacillus okhensis*
- *Alkalihalobacillus okuhidensis*
- *Alkalihalobacillus oshimensis*
- *Alkalihalobacillus patagoniensis*
- *Alkalihalobacillus pseudalcaliphilus*
- *Alkalihalobacillus pseudofirmus*
- *Alkalihalobacillus shaceensis*
- *Alkalihalobacillus trypoxylicola*
- *Alkalihalobacillus urbisdiaboli*
- *Alkalihalobacillus wakoensis*
- *Alkalihalobacillus xiaosiensis*

Biochemical characteristics and molecular signatures

Most members of this genus are aerobic or facultatively anaerobic and are found in diverse locations such as hypersaline lakes, coastal regions and soil. All species, with the exception of *Alkalihalobacillus okhensis*,[13] are able to produce endospores. Motility is variable, with some species possessing peritrichous flagella. The majority of species from this genus are alkaliphilic and halophilic/tolerant,

and thus they are able to grow in alkaline conditions, with the optimal growth rate being in the pH range of 9–10 with 1-5% NaCl.[2] Some species are obligately alkaliphilic and require very alkaline conditions to survive. A wide range of temperature (4-45 °C) can be conducive to growth; however, optimal growth occurs in the range of 25-37 °C. Some species are able to produce enzymes such as cellulases and proteases, which are used in laundry detergent manufacturing, xylanases for the pulp paper sector and cyclodextrin glucanotransferase for starch treatment.[2] In addition, *A. clausii* is diazotrophic and able to convert atmospheric nitrogen into ammonia[14] and it is also able to produce antimicrobial compounds for the manufacturing of probiotic.[15]

Through genomic analysis, ten CSIs have been identified for this genus in the following proteins: RNase adapter RapZ, flagellar basal body M-ring protein FliF, 7-carboxy-7-deazaguanine synthase QueE, peptide chain release factor 3, type I glutamate-ammonia ligase, tRNA threonyl-carbamoyladenosine dehydratase, transcription-repair coupling factor, tRNA uridine-5-carboxymethylaminomethyl (34) synthesis enzyme MnmG, 50S ribosomal protein L11 methyltransferase, and homoserine kinase.[2] These CSIs are specific for *Alkalihalobacillus* and provide a novel way to molecularly differentiate this genus from other *Bacillaceae* genera and bacteria.

References

1. Information based on LPSN 2021
2. Patel, Sudip; Gupta, Radhey S. (2020-01-01). "A phylogenomic and comparative genomic framework for resolving the polyphyly of the genus Bacillus: Proposal for six new genera of Bacillus species, Peribacillus gen. nov., Cytobacillus gen. nov., Mesobacillus gen. nov., Neobacillus gen. nov., Metabacillus gen. nov. and Alkalihalobacillus gen. nov" (https://doi.org/10.1099%2Fijsem.0.003775). *International Journal of Systematic and Evolutionary Microbiology*. **70** (1): 406–438. doi:10.1099/ijsem.0.003775 (https://doi.org/10.1099%2Fijsem.0.003775). ISSN 1466-5026 (https://www.worldcat.org/issn/1466-5026). PMID 31617837 (https://pubmed.ncbi.nlm.nih.gov/31617837).
3. Brenner, Don J.; Krieg, Noel R.; Staley, James T.; Garrity, George M.; Boone, David R.; De Vos, Paul; Goodfellow, Michael; Rainey, Fred A.; Schleifer, Karl-Heinz, eds. (2005). *Bergey's Manual® of Systematic Bacteriology* (https://dx.doi.org/10.1007/0-387-28022-7). doi:10.1007/0-387-28022-7 (https://doi.org/10.1007%2F0-387-28022-7). ISBN 978-0-387-24144-9.
4. "Genus: Alkalihalobacillus" (https://lpsn.dsmz.de/genus/alkalihalobacillus). *lpsn.dsmz.de*. Retrieved 2021-05-18.
5. Ash, Carol; Farrow, J.A.E.; Wallbanks, Sally; Collins, M.D. (2008-06-28). "Phylogenetic heterogeneity of the genus Bacillus revealed by comparative analysis of small-subunit-ribosomal RNA sequences" (https://dx.doi.org/10.1111/j.1472-765x.1991.tb00608.x). *Letters in Applied Microbiology*. **13** (4): 202–206. doi:10.1111/j.1472-765x.1991.tb00608.x (https://doi.org/10.1111%2Fj.1472-765x.1991.tb00608.x). ISSN 0266-8254 (https://www.worldcat.org/issn/0266-8254). S2CID 82988953 (https://api.semanticscholar.org/CorpusID:82988953).
6. Logan, N. A.; Berge, O.; Bishop, A. H.; Busse, H.-J.; De Vos, P.; Fritze, D.; Heyndrickx, M.; Kampfer, P.; Rabinovitch, L.; Salkinoja-Salonen, M. S.; Seldin, L. (2009-06-30). "Proposed minimal standards for describing new taxa of aerobic, endospore-forming bacteria" (https://dx.doi.org/10.1099/ijs.0.013649-0). *International Journal of Systematic and Evolutionary Microbiology*. **59** (8): 2114–2121. doi:10.1099/ijs.0.013649-0 (https://doi.org/10.1099%2Fijs.0.013649-0). ISSN 1466-5026 (https://www.worldcat.org/issn/1466-5026). PMID 19567583 (https://pubmed.ncbi.nlm.nih.gov/19567583).

7. SHIDA, O.; TAKAGI, H.; KADOWAKI, K.; KOMAGATA, K. (1996-10-01). "Proposal for Two New Genera, Brevibacillus gen. nov. and Aneurinibacillus gen. nov" (https://doi.org/10.1099%2F00207713-46-4-939). *International Journal of Systematic Bacteriology*. **46** (4): 939–946. doi:10.1099/00207713-46-4-939 (https://doi.org/10.1099%2F00207713-46-4-939). ISSN 0020-7713 (https://www.worldcat.org/issn/0020-7713). PMID 8863420 (https://pubmed.ncbi.nlm.nih.gov/8863420).
8. Wisotzkey, J. D.; Jurtshuk, P.; Fox, G. E.; Deinhard, G.; Poralla, K. (1992-04-01). "Comparative Sequence Analyses on the 16S rRNA (rDNA) of Bacillus acidocaldarius, Bacillus acidoterrestris, and Bacillus cycloheptanicus and Proposal for Creation of a New Genus, Alicyclobacillus gen. nov" (https://dx.doi.org/10.1099/00207713-42-2-263). *International Journal of Systematic Bacteriology*. **42** (2): 263–269. doi:10.1099/00207713-42-2-263 (https://doi.org/10.1099%2F00207713-42-2-263). ISSN 0020-7713 (https://www.worldcat.org/issn/0020-7713). PMID 1374624 (https://pubmed.ncbi.nlm.nih.gov/1374624).
9. Mual, Poonam; Singh, Nitin Kumar; Verma, Ashish; Schumann, Peter; Krishnamurthi, Srinivasan; Dastager, Syed; Mayilraj, Shanmugam (2016-05-01). "Reclassification of Bacillus isronensis Shivaji et al. 2009 as Solibacillus isronensis comb. nov. and emended description of genus Solibacillus Krishnamurthi et al. 2009" (https://doi.org/10.1099%2Fijsem.0.000982). *International Journal of Systematic and Evolutionary Microbiology*. **66** (5): 2113–2120. doi:10.1099/ijsem.0.000982 (https://doi.org/10.1099%2Fijsem.0.000982). ISSN 1466-5026 (https://www.worldcat.org/issn/1466-5026). PMID 26907585 (https://pubmed.ncbi.nlm.nih.gov/26907585).
10. Heyndrickx, M.; Lebbe, L.; Kersters, K.; Hoste, B.; De Wachter, R.; De Vos, P.; Forsyth, G.; Logan, N. A. (1999-07-01). "Proposal of Virgibacillus proomii sp. nov. and emended description of Virgibacillus pantothenticus (Proom and Knight 1950) Heyndrickx et al. 1998" (https://doi.org/10.1099%2F00207713-49-3-1083). *International Journal of Systematic and Evolutionary Microbiology*. **49** (3): 1083–1090. doi:10.1099/00207713-49-3-1083 (https://doi.org/10.1099%2F00207713-49-3-1083). ISSN 1466-5026 (https://www.worldcat.org/issn/1466-5026). PMID 10425765 (https://pubmed.ncbi.nlm.nih.gov/10425765).
11. Gupta, Radhey S.; Patel, Sudip; Saini, Navneet; Chen, Shu (2020-11-01). "Robust demarcation of 17 distinct Bacillus species clades, proposed as novel Bacillaceae genera, by phylogenomics and comparative genomic analyses: description of Robertmurraya kyonggiensis sp. nov. and proposal for an emended genus Bacillus limiting it only to the members of the Subtilis and Cereus clades of species" (https://www.microbiologyresearch.org/content/journal/ijsem/10.1099/ijsem.0.004475). *International Journal of Systematic and Evolutionary Microbiology*. **70** (11): 5753–5798. doi:10.1099/ijsem.0.004475 (https://doi.org/10.1099%2Fijsem.0.004475). ISSN 1466-5026 (https://www.worldcat.org/issn/1466-5026). PMID 33112222 (https://pubmed.ncbi.nlm.nih.gov/33112222).
12. "GTDB - Tree" (https://gtdb.ecogenomic.org/tree?r=d__Bacteria). *gtdb.ecogenomic.org*. Retrieved 2021-05-28.
13. Nowlan, Bianca; Dodia, Mital S.; Singh, Satya P.; Patel, B. K. C. (2006-05-01). "Bacillus okhensis sp. nov., a halotolerant and alkalitolerant bacterium from an Indian saltpan" (https://doi.org/10.1099%2Fijs.0.63861-0). *International Journal of Systematic and Evolutionary Microbiology*. **56** (5): 1073–1077. doi:10.1099/ijs.0.63861-0 (https://doi.org/10.1099%2Fijs.0.63861-0). ISSN 1466-5026 (https://www.worldcat.org/issn/1466-5026). PMID 16627657 (https://pubmed.ncbi.nlm.nih.gov/16627657).

14. Madhaiyan, Munusamy; Poonguzhali, Selvaraj; Lee, Jung-Sook; Lee, Keun-Chul; Hari, Kuppusamy (2011-06-14). "Bacillus rhizosphaerae sp. nov., an novel diazotrophic bacterium isolated from sugarcane rhizosphere soil" (https://dx.doi.org/10.1007/s10482-011-9600-3). *Antonie van Leeuwenhoek*. **100** (3): 437–444. doi:10.1007/s10482-011-9600-3 (https://doi.org/10.1007%2Fs10482-011-9600-3). ISSN 0003-6072 (https://www.worldcat.org/issn/0003-6072). PMID 21671194 (https://pubmed.ncbi.nlm.nih.gov/21671194). S2CID 11105863 (https://api.semanticscholar.org/CorpusID:11105863).
15. Nielsen, P.; Fritze, D.; Priest, F. G. (1995-07-01). "Phenetic diversity of alkaliphilic Bacillus strains: proposal for nine new species" (https://doi.org/10.1099%2F13500872-141-7-1745). *Microbiology*. **141** (7): 1745–1761. doi:10.1099/13500872-141-7-1745 (https://doi.org/10.1099%2F13500872-141-7-1745). ISSN 1350-0872 (https://www.worldcat.org/issn/1350-0872).
