

Paenibacillus solisilvae sp. nov., isolated from birch forest soil

Delong Kong^{1†}, Qi Zhang^{2†}, Xu Jiang^{1†}, Qingyun Ma¹, Xiaoyan Han¹, Yiqing Zhou¹, Huiying Xue³, Yuqin Zhang⁴, Wei Zhang^{2,*} and Zhiyong Ruan^{1,3,*}

Abstract

A Gram-stain-positive, motile, rod-shaped bacterium, designated strain LAM7113^T, was isolated from soil sample collected from a birch forest in Xinjiang Uygur Autonomous Region, PR China. Strain LAM7113^T grew optimally at pH 8.0, 30 °C and in the presence of 1.0 % NaCl (w/v). Phylogenetic analysis based on 16S rRNA gene sequences showed that strain LAM7113^T was closely related to members of the genus *Paenibacillus*, with the highest similarity to *Paenibacillus baekrokdamsoli* Back-11^T (96.2 %). The genomic DNA G+C content was 43.4 mol%. The values of average nucleotide identity and DNA–DNA hybridization were 66.1 and 27.0 %, respectively, by comparing the draft genome sequences of strain LAM7113^T and *P. baekrokdamsoli* Back-11^T. Anteiso-C_{15:0} and iso-C_{15:0} were identified as the major cellular fatty acids. Menaquinone-7 was detected as the predominant respiratory quinone. The major polar lipids were found to be diphosphatidylglycerol, phosphatidylethanolamine, phosphatidylglycerol, phosphatidylinositol, three unidentified aminophospholipids, three unidentified glycolipids, one unidentified phospholipid and two unknown polar lipids. Based on its phenotypic, phylogenetic and chemotaxonomic characteristics, strain LAM7113^T is proposed to represent a novel species of the genus *Paenibacillus* with the name *Paenibacillus solisilvae* sp. nov. The type strain is LAM7113^T (=CGMCC 1.16619^T=JCM 32513^T).

The genus *Paenibacillus* belongs to the family *Paenibacillaceae* and was proposed by Ash *et al.* in 1993 [1]. At the time of writing in October 2019, there are over 249 recognized species and four subspecies (www.bacterio.net/paenibacillus.html) [2]. Species of the genus *Paenibacillus* have been isolated from diverse habitats, such as soil [3–6], fresh water [7, 8], human faeces [9], pit mud [10], saline silt [11], warm springs [12], lake sediment [13] and plant rhizosphere [14–16]. Members of the genus *Paenibacillus* share the common characteristics of having spore-forming cells containing menaquinone 7 as a major or sole respiratory quinone and anteiso-C_{15:0} as the major fatty acid. The genomic DNA G+C content of the genus ranges from 39.0 to 54.9 mol% [17]. Here, we report a polyphasic taxonomic study of strain LAM7113^T, which was isolated from soil sample collected from a birch forest in Xinjiang Uygur Autonomous Region, PR China (48° 04' N 86° 20' E) for degrading sulfonyleureas herbicides using an isolation

medium of tryptic soy agar (TSA; Difco) supplemented with 100 mg l⁻¹ nicosulfuron, cinosulfuron and chlorimuron-ethyl. After incubation at 30 °C for 2 days, separated colonies were picked and serially streaked onto TSA plates incubating at 30 °C to obtain single colonies. The purified culture was maintained on TSA slants at 4 °C and as glycerol suspensions (25 %, v/v) at –80 °C. Type strains *Paenibacillus baekrokdamsoli* KCTC 33723^T (=Back-11^T) and *Paenibacillus rhizoryzae* ACCC 19782^T (=1ZS3-5^T) were obtained from the Korean Collection for Type Cultures (KCTC) and Agricultural Culture Collection of China (ACCC), respectively, for comparisons under the same conditions.

Morphology of cells in exponentially growing phase was examined under light microscope (Nikon 80i) and transmission electron microscope (Hitachi 7500) [18]. Physiological characteristics were examined by growing the isolate under various conditions. The temperature range for growth was

Author affiliations: ¹Institute of Agricultural Resources and Regional Planning, CAAS, Beijing 100081, PR China; ²College of Life Science, Xinjiang Normal University, Urumqi, XinJiang, 830046, PR China; ³College of Resources and Environment, Tibet Agricultural and Animal Husbandry University, Linzhi 860000, Tibet, PR China; ⁴Chinese Academy of Medical Sciences and Peking Union Medical College, Institute of Medicinal Biotechnology, Beijing 100050, PR China.

***Correspondence:** Zhiyong Ruan, ruanzhiyong@caas.cn; Wei Zhang, zw0991@sohu.com

Keywords: *Paenibacillus*; 16S rRNA gene; polyphasic taxonomy; birch forest soil.

Abbreviations: ANI, average nucleotide identity; DDH, DNA–DNA hybridization; ML, maximum-likelihood; MP, maximum-parsimony; NJ, neighbour-joining; TSA, tryptic soy agar; TSB, tryptic soy broth.

The GenBank/EMBL/DBJ accession number for the 16S rRNA gene sequence of strain LAM7113^T is MF784349. The GenBank accession number for the draft genome sequence of strain LAM7113^T is RICA000000000.

†These authors contributed equally to this work

Five supplementary figures are available with the online version of this article.