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A report of 14 unrecorded bacterial species in Korea isolated in 2017

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Fourteen bacterial strains, low10-4-1, J11015, 17J27-22, 17G22-9, 17G9-4, 17Bio_15, 17gy_33, 17SD1_21, Strain8, 17Sr1_17, J21014T, H31021, 17J49-9, and 17J80-6 assigned to the phylum *Actinobacteria*, *Bacteroidetes*, *Deinococcus-Thermus*, and *Firmicutes* were isolated from soil samples. Phylogenetic analysis based on 16S rRNA gene sequence revealed that strains low10-4-1, J11015, 17J27-22, 17G22-9, 17G9-4, 17Bio_15, 17gy_33, 17SD1_21, Strain8, 17Sr1_17, J21014T, H31021, 17J49-9, and 17J80-6 were most closely related to *Marmoricola aurantiacus* (98.9%), *Calidifontibacter indicus* (99.8%), *Gordonia soli* (98.8%), *Rhodococcus globerulus* (99.5%), *Pseudarthrobacter siccitolerans* (99.1%), *Hymenobacter qilianensis* (98.7%), *Hymenobacter terrae* (99.0%), *Deinococcus yunweiensis* (99.2%), *Deinococcus proteolyticus* (99.7%), *Domibacillus indicus* (99.2%), *Exiguobacterium mexicanum* (100.0%), *Kurthia senegalensis* (99.1%), *Lysinibacillus composti* (99.6%), and *Bacillus loiseleuriae* (99.3%). These fourteen species have never been reported in Korea, therefore we report them here for the first time.

Keywords: 16S rRNA, *Actinobacteria*, bacterial diversity, *Bacteroidetes*, *Deinococcus-Thermus*, *Firmicutes*, unreported species

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Introduction

There are massive numbers of bacteria on earth uniquely adapted to many environments. We isolated species that have not been officially reported in Korea. In 2017, we collected diverse soil samples in Seoul, Jeju-do, and Gyeonggi-do in Korea and isolated unreported bacterial species. The identified bacterial species belonged to the phyla *Actinobacteria*, *Bacteroidetes*, *Deinococcus-Thermus*, and *Firmicutes*.

The *Actinobacteria* are the largest phyla and ubiquitously distributed in both aquatic and terrestrial ecosystems (Barka *et al*., 2016). They are Gram-positive filamentous bacteria with a high G+C content in their genomes. They are mostly mesophilic and can grow at temperatures between 25 and 30°C however, thermophilic *Actinobacteria* can grow at temperatures ranging from 50 to 60°C (Edwards, 1993). They have numerous potential benefits for humans as some sources of antibiotics, antifungals, anticancer agents, and their secondary metabolites are resistant to diseases (Barka *et al*., 2016).

Bacteroides are a genus of Gram-negative, rod-shaped, non-spore-forming bacteria (Madigan *et al*., 2005). They have DNA with 40-48% of GC content. *Bacteroides* are present in the environments such as in soil, sediments, sea water and in the gastrointestinal system of animals (Johnson *et al*., 2016). This genus, tends to attract more and more attention because of its abundance in the guts of human (Scarpellini *et al*., 2015). Several novel species have been recently proposed in the genus *Bacteroides* (Hayashi *et al*., 2007; Sakamoto *et al*., 2011). These taxonomic studies were mainly based on 16S rRNA gene sequence analysis (Shah *et al*., 2009).

Deinococcus-Thermus is a phylum of gram-positive bacteria, also known as extremophiles (Griffith *et al*., 2007). The group is distinguished by species that resist the lethal effects of exposure to ionizing radiation and UV light, and by species that thrive at high temperature (Battista, 2016). *Deinococcus-Thermus* is comprised of two orders, the *Deinococcales* and the *Thermales*. Generally, mesophilic species of *Deinococcales* demonstrate uncommon resistance to electromagnetic radiations (Battista, 2016). The *Thermales* are thermophilic, can grow at 60 and 80°C, but show no evidence of resistance

to electromagnetic radiation. Despite these prominent and distinctive phenotypic differences, 16S ribosomal ribonucleic acid sequences verify that members of these orders are evolved from same ancestor (Ho *et al*., 2016). So far, many *Deinococcus* sp. has been isolated based on 16S rRNA sequencing and proved for its radiation resistance (Srinivasan *et al*., 2012a; 2012b).

The phylum *Firmicutes* is one of the most predominant groups of prokaryotes in the microbiota of human's guts. They include genera of outstanding relevance in biomedicine, health care, and industry (Lanza *et al*., 2015). *Firmicutes* are gram-positive with low G+C content and has specific property to form heat resistant endo-spore (Galperin, 2015). There is a consensus that they have diverged from other bacterial phyla at an early stage (Lake *et al*., 2009). Later, the evolution of *Firmicutes* obviously included numerous events of lateral gene transfer to and from representatives of other phyla and hence certain gene families are shared *Firmicutes* with *Fusobacteria*, *Thermotogae*, and other groups (Mira *et al*., 2004).

Material and Methods

Bacteria were isolated from different soil samples then were suspended on distilled water and serially diluted. The aliquot was inoculated onto R2A agar and incubated at 25°C for 3 days. The designated strain name, isolation sources, growth media, and incubation conditions are summarized in Table 1. All strains were purified as single colonies and stored as 20% glycerol suspension at −80°C as well as freeze dried ampoules. Colony morphology and cell size of the strains were observed by transmission electron microscopy (LIBRA 120, Carl Zeiss) using cells grown for 3 days at 25°C on R2A agar. Transmission electron micrograph of the strains are shown in Fig. 1. Gram reaction was tested following the classic Gram procedure described by Doetsch (1981).

Biochemical characteristics were performed by using Biolog Microstation with GEN III microplate system. A single colony was selected and emulsified into 'inoculating fluid A' (Biolog) for subsequent inoculation on to the MicroPlate test plate (Biolog). More fastidious organisms, including capnophilic strains, were cultured on alternative media, according to the manufacturer's instructions, and the inoculate was prepared to a specified transmittance using a turbidimeter, as specified in the user guide. For each isolate, 100 µL of the cell suspension was inoculated into each well of the MicroPlate, using a multichannel pipette and incubated at 37°C for 24 h, according to growth characteristics. MicroPlates were read in the MicroStation semi-automated reader after 24 h and results interpreted by the identification system's software (GEN III database, version 5.2.1). The system indicates the isolates which could not be identified after 20 h, are subjected to further incubation. Consequently, such isolates were re-incubated and re-read between 3 and 6 h later (Wragg *et al*., 2014).

Genomic DNA was extracted and 16S rRNA gene was amplified by PCR with 9F and 1492R universal bacterial primers (Weisburg *et al*., 1991). The 16S rRNA gene sequences of the closely related strains were obtained from EzTaxon-e (http://eztaxon-e.ezbiocloud.net) (Kim *et al*., 2012) and edited using the BioEdit program (Hall, 1999). Multiple alignments were performed with the MUSCL program (Edgar, 2004). Using the two-parameter model (Kimura, 1983), calculated the evolutionary distances. Phylogenetic trees were constructed using the neighbor-joining (Saitou and Nei, 1987) in MEGA5 program (Tamura, 2011) with bootstrap values based on 1,000 replications (Felsenstein, 1985).

Results and Discussion

Based on 16S rRNA gene sequence similarity, four-

Table 1. List of 16S rRNA gene sequence similarity, isolation source, medium, and incubation conditions of unrecorded strains.

Strain ID	Most closely related species	Similarity (%)	Isolation source	Medium	Incubation conditions
low10-4-1	*Marmoricola aurantiacus*	98.9	Soil	R2A	25°C, 3d
J11015	*Calidifontibacter indicus*	99.8	Soil	R2A	25°C, 3d
17J27-22	*Gordonia soli*	98.8	Soil	R2A	25°C, 3d
17G22-9	*Rhodococcus globerulus*	99.5	Soil	R2A	25°C, 3d
17G9-4	*Pseudarthrobacter siccitolerans*	99.1	Soil	R2A	25°C, 3d
17Bio_15	*Hymenobacter qilianensis*	98.7	Soil	R2A	25°C, 3d
17gy_33	*Hymenobacter terrae*	99.0	Soil	R2A	25°C, 3d
17SD1_21	*Deinococcus yunweiensis*	99.2	Soil	R2A	25°C, 3d
Strain8	*Deinococcus proteolyticus*	99.7	Soil	R2A	25°C, 3d
17Sr1_17	*Domibacillus indicus*	99.2	Soil	R2A	25°C, 3d
J21014T	*Exiguobacterium mexicanum*	100.00	Soil	R2A	25°C, 3d
H31021	*Kurthia senegalensis*	99.13	Soil	R2A	25°C, 3d
17J49-9	*Lysinibacillus composti*	99.66	Soil	R2A	25°C, 3d
17J80-6	*Bacillus loiseleuriae*	99.32	Soil	R2A	25°C, 3d

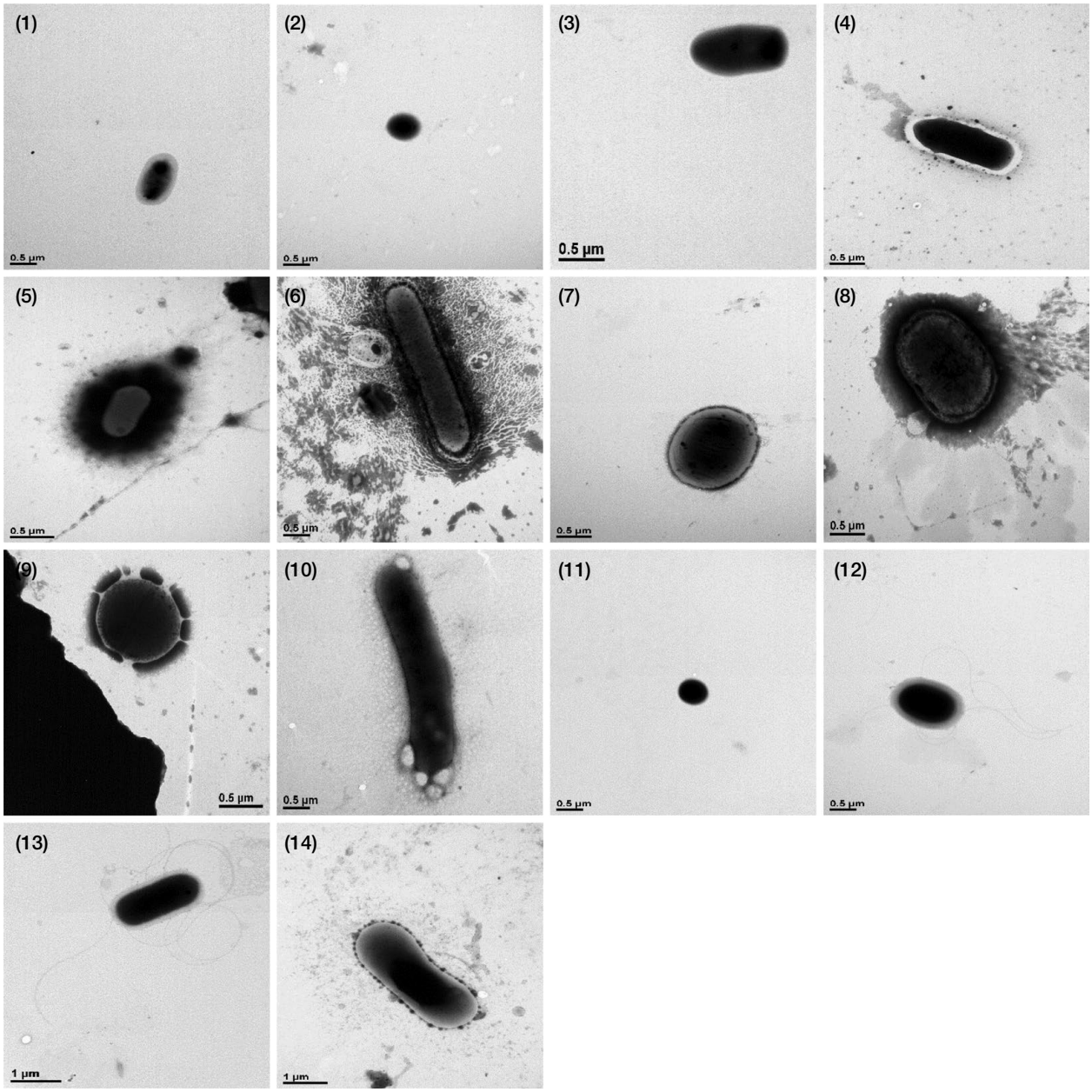

Fig. 1. Transmission electron micrographs of the strains isolated in this study. Strains: 1, low10-4-1; 2, J11015; 3, 17J27-22; 4, 17G22-9; 5, 17G9-4; 6, 17Bio_15; 7, 17gy_33; 8, 17SD1_21; 9, Strain8; 10, 17Sr1_17; 11, J21014T; 12, H31021; 13, 17J49-9; 14, 17J80-6.

teen of previously unreported bacterial species were identified. The taxonomic composition and identification results were summarized in Table 1. Five strains belonged to the family *Nocardioidaceae* (1 strain), *Dermacoccaceae* (1 strain), *Nocardiaceae* (2 strain), and *Micrococcaceae* (1 strain) of the phylum *Actinobacteria*. Two strain belongs to the family *Hymenobacteraceae* (2 strain) of the phylum *Bacteroidetes*. Two strain belongs to the family *Deinococcaceae* (2 strain) of the phylum *Deinococcus-Thermus*. The other four strains were assigned to the family *Planococcaceae* (3 strain), *Exiguobacteriaceae* (1 strain), and *Bacillaceae* (1 strain) of the phylum *Firmicutes*. At generic level, the strains belonged to 12 different genera: *Marmoricola* (1 species), *Calidifontibacter* (1 species), *Gordonia* (1 species), *Rhodococcus* (1 species), *Pseudarthrobacter* (1 species), *Hymenobacter* (2 species), *Deinococcus* (2 species), *Domibacillus* (1 species), *Exiguobacterium* (1 species), *Kurthia* (1 species), *Lysinibacillus* (1 species), and *Bacillus* (1 species). The identification of the new strains based on sequence similarity were supported by the phylogenetic trees. The neighbor-joining trees showed the

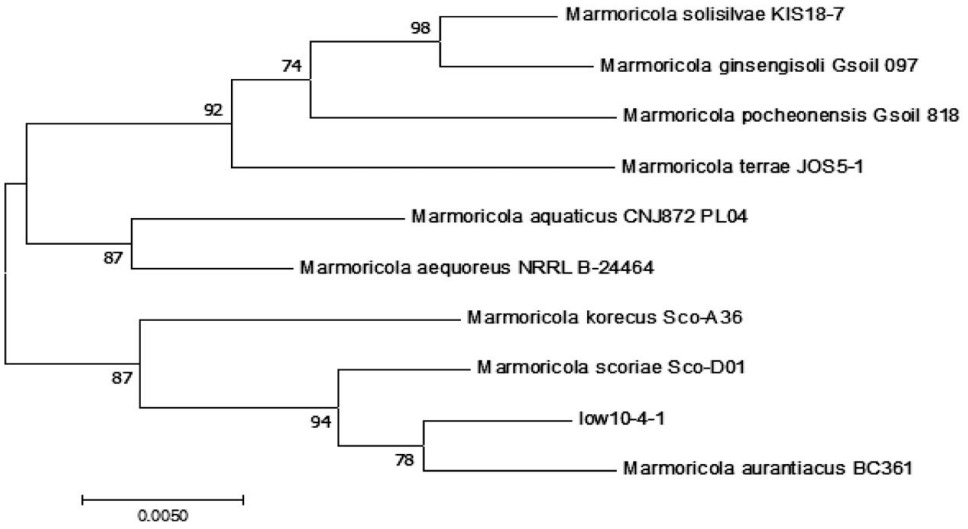

Fig. 2. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Marmoricola*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

close relationship of the new strains and the type strains of validly published species (Figs. 2-15). The detailed morphological and physiological characteristics were given in the strain descriptions. There is no official report that these 14 species have been isolated in Korea. Hence the strains low10-4-1, J11015, 17J27-22, 17G22-9, 17G9-4, 17Bio_15, 17gy_33, 17SD1_21, Strain8, 17Sr1_17, J21014T, H31021, 17J49-9, and 17J80-6 are proposed to be unreported species of *Marmoricola aurantiacus*, *Calidifontibacter indicus*, *Gordonia soli*, *Rhodococcus globerulus*, *Pseudarthrobacter siccitolerans*, *Hymenobacter qilianensis*, *Hymenobacteterrae*, *Deinococcus yunweiensis*, *Deinococcus proteolyticus*, *Domibacillus indicus*, *Exiguobacterium mexicanum*, *Kurthia senegalensis*, *Lysinibacillus composti*, and *Bacillus loiseleuriae*.

Description of *Marmoricola aurantiacus* low10-4-1

Cells are Gram-stain-negative and short rod-shaped. Colonies are yellow-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, D-trehalose, D-cellobiose, gentiobiose, sucrose, stachyose, D-raffinose, D-galactose, inosine, D-sorbitol, glycerol, D-serine, L-alanine, L-arginine, L-aspartic acid, L-serine, D-gluconic acid, D-glucuronic acid, glucuronamide, and propionic acid are utilized as sole carbon source. But acetoacetic acid, *N*-acetyl-D-mannosamine, dextrin, D-fructose, D-fructose 6-PO_4, L-galactonic acid lactone, D-galacturonic acid, gelatin, α-D-glucose, L-glutamic acid, α-keto-glutaric acid, L-malic acid, D-maltose, D-mannitol, D-mannose, D-melibiose, β-methyl-D-glucoside, 3-methyl glucose, myo-inositol, pectin, glycyl-L-proline, L-pyroglutamic acid, quinic acid, L-rhamnose, D-turanose acetic acid, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, *N*-acetyl-D-glucosamine, γ-amino-butryric acid, D-arabitol, D-aspartic acid, bromo-succinic acid, citric acid, formic acid, D-fucose, L-fucose, D-glucose-6-PO_4, L-histidine, α-hydroxybutyric acid, β-hydroxy-D,L-butyric acid, *p*-hydroxy-phenylacetic acid, α-keto-butyric acid, L-lactic acid, D-lactic acid methyl ester, α-D-lactose, D-malic acid, methyl pyruvate, mucic acid, D-saccharic acid, D-salicin, and tween 40 are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of potassium tellurite and aztreonam, but not 1% NaCl, 1% sodium lactate, 4% NaCl, 8% NaCl, guanidine HCl, lithium chloride, pH 6, D-serine, sodium butyrate, tetrazolium violet fusidic acid, lincomycin, minocycline, nalidixic acid, niaproof 4, pH 5, rifamycin SV, sodium bromate, tetrazolium blue, troleandomycin, and vancomycin.

Indole production is negative (API 20NE). In the API 20NE and ID 32GN systems, positive for reduction of nitrates (NO_3) to nitrogen (N_2), arginine dihydrolase, urease, esculin hydrolysis, gelatin hydrolysis, β-galactosidase, D-ribose, D-saccharose (sucrose), D-maltose, suberic acid, sodium malonate, sodium acetate, lactic acid, L-alanine, glycogen, L-serine, D-mannitol, D-Glucose, salicin, L-arabinose, propionic acid, valeric acid, L-histidine, potassium 2-ketogluconate, 3-hydroxybutyric acid, 4-hydroxybenzoic acid, and L-proline. Negative for reduction of nitrates (NO_3) to nitrite (NO_2^-), glucose fermentation, *N*-acetyl-D-glucosamine, capric acid, adipic acid, trisodiumcitrate, phenylacetic acid, L-rhamnose,

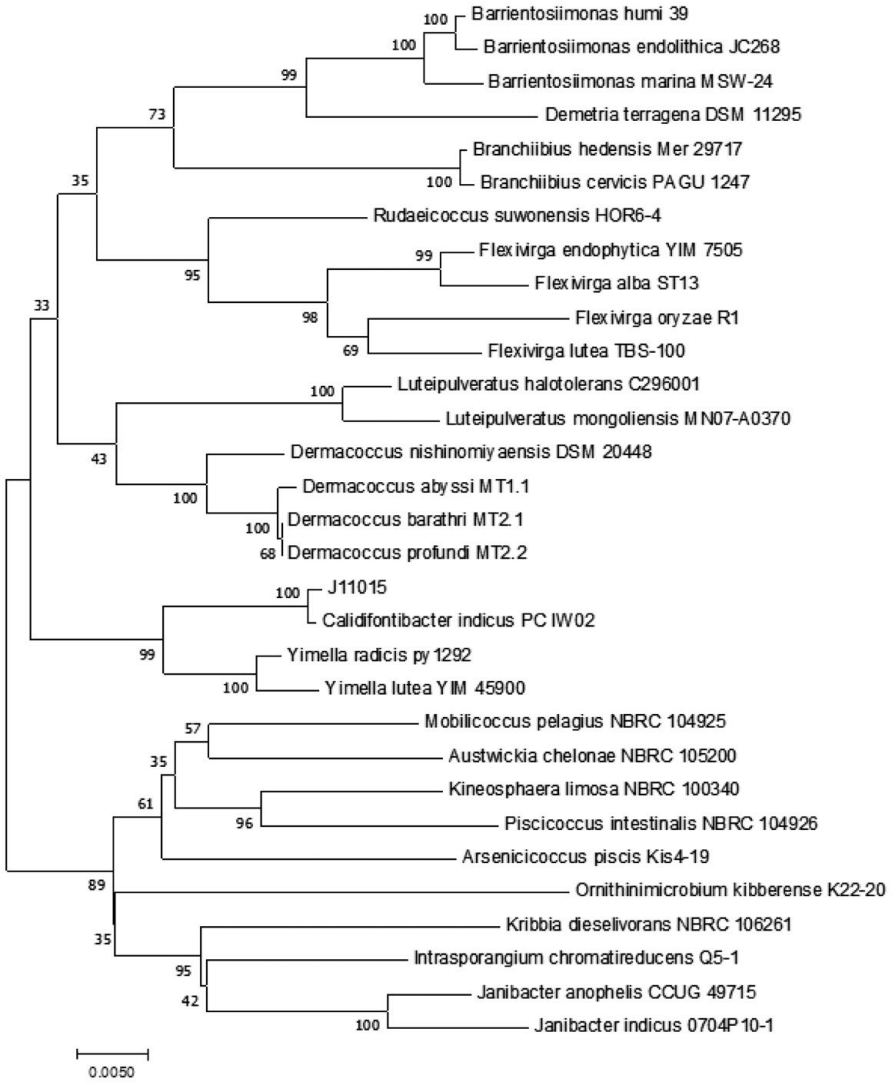

Fig. 3. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Calidifontibacter*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

N-acetyl-glucosamine, inositol, itaconic acid, potassium 5-ketogluconate, 3-hydroxybenzoic acid, D-melibiose, D-fucose, D-sorbitol, capric acid, and trisodium citrate.

Strain low10-4-1 (=NIBRBAC000500523) was isolated from a soil sample, Seoul, Nowon-gu, Gongneung-dong, Korea.

Description of *Calidifontibacter indicus* J11015

Cells are Gram-stain-positive and cocci-shaped. Colonies are yellow-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, gentiobiose, sucrose, D-trehalose, D-cellobiose, stachyose, D-raffinose, D-galactose, D-sorbitol, glycerol, D-serine, L-alanine, L-arginine, L-aspartic acid, L-serine, D-gluconic acid, glucuronamide, and propionic acid are utilized as sole carbon source. But D-glucuronic acid, inosine, acetoacetic acid, *N*-acetyl-D-mannosamine, dextrin, D-fructose, D-fructose 6-PO_4, L-galactonic acid lactone, D-galacturonic acid, gelatin, α-D-glucose, L-glutamic acid, α-keto-glutaric acid, L-malic acid, D-maltose, D-mannitol, D-mannose, D-melibiose, β-methyl-D-glucoside, 3-methyl glucose, myo-inositol, pectin, glycyl-L-proline, L-pyroglutamic acid, quinic acid, L-rhamnose, D-turanose acetic acid, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, *N*-acetyl-D-glucosamine, γ-amino-butryric acid, D-arabitol, D-aspartic acid, bromo-succinic acid, citric acid, formic acid, D-fucose, L-fucose, D-glucose-6-PO_4, L-histidine, α-hydroxybutyric acid, β-hydroxy-D, L-butyric acid, *p*-hydroxy-phenylacetic acid,

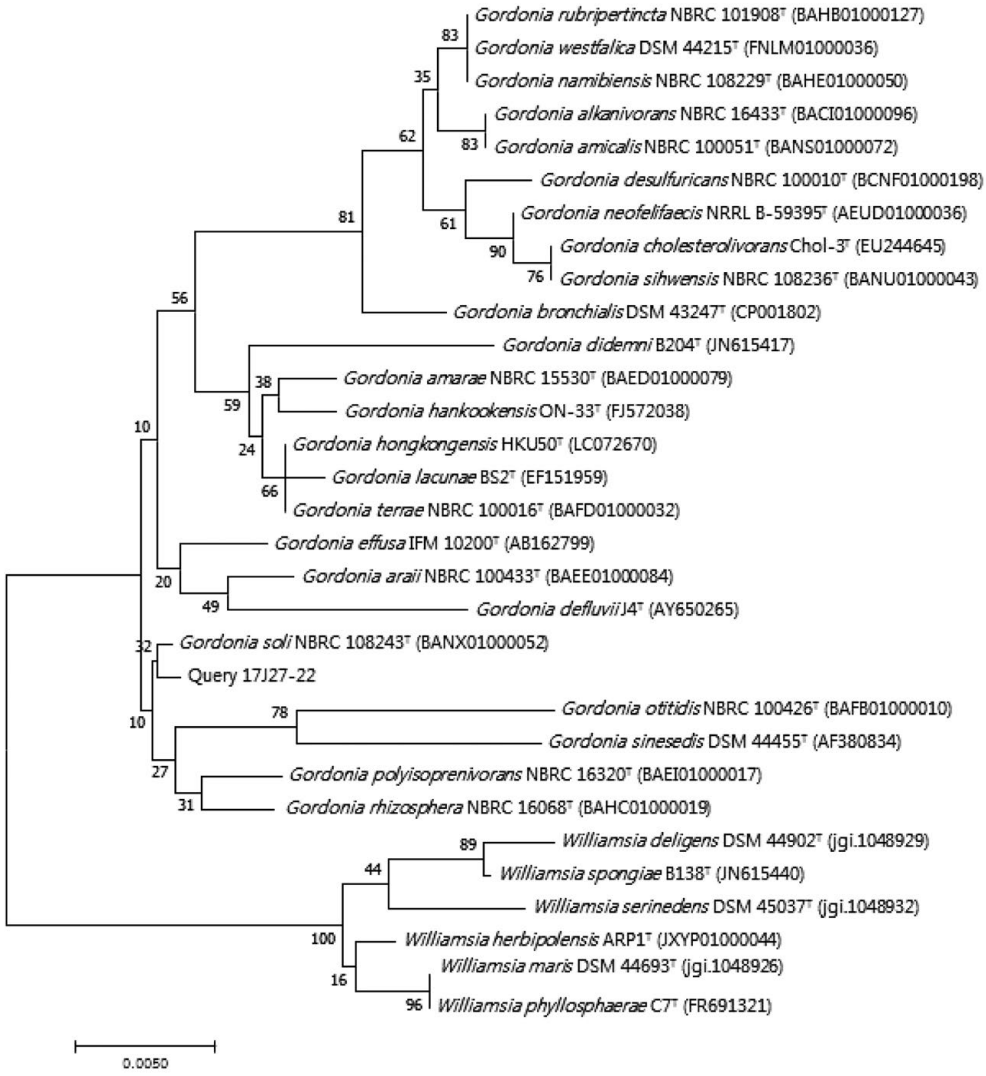

Fig. 4. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Gordonia*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

α-keto-butyric acid, L-lactic acid, D-lactic acid methyl ester, α-D-lactose, D-malic acid, methyl pyruvate, D-saccharic acid, D-salicin, and tween 40 are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of potassium tellurite, aztreonam but 1% NaCl, 1% sodium lactate, 4% NaCl, 8% NaCl, guanidine HCl, lithium chloride, pH 6, D-serine, sodium butyrate, tetrazolium violet fusidic acid, lincomycin, minocycline, nalidixic acid, niaproof 4, pH 5, rifamycin SV, sodium bromate, tetrazolium blue, troleandomycin, and vancomycin.

Indole production is negative (API 20NE). In the API 20NE and ID 32GN systems, positive for reduction of nitrates (NO_3) to nitrite (NO_2^-), arginine dihydrolase, urease, esculin hydrolysis, gelatin hydrolysis, D-saccharose (sucrose), D-maltose, suberic acid, sodium acetate, lactic acid, L-alanine, L-serine, D-glucose, D-sorbitol, L-arabinose, propionic acid, 3-hydroxybutyric acid, and L-proline. Negative for reduction of nitrates (NO_3) to nitrogen (N_2), indole production on tryptophan, glucose fermentation, β-galactosidase, L-arabinose, *N*-acetyl-D-glucosamine, D-maltose, capric acid, adipic acid, malic acid, trisodium citrate, L-rhamnose, *N*-acetyl-glucosamine, D-ribose, inositol, itaconic acid, sodium malonate, potassium 5-ketogluconate, glycogen, 3-hydroxybenzoic acid, D-mannitol, salicin, D-melibiose, D-fucose, valeric acid, trisodium citrate, L-histidine, potassium 2-ketogluconate, and 4-hydroxybenzoic acid.

Strain J11015 (=NIBRBAC000500524) was isolated from a soil sample, Seoul, Nowon-gu, Gongneung-dong,

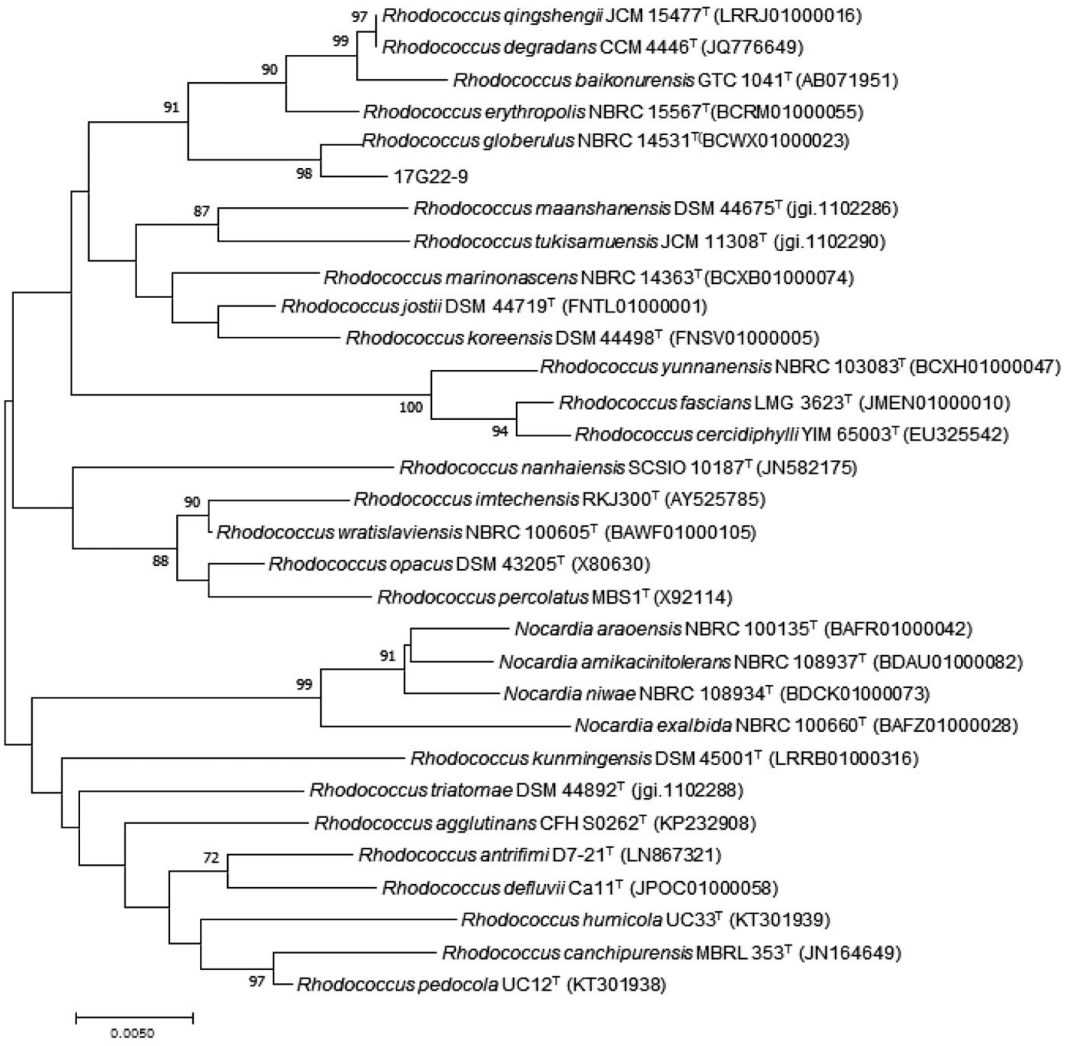

Fig. 5. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Rhodococcus*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

Korea.

Description of *Gordonia soli* 17J27-22

Cells are Gram-stain-positive and oval-shaped. Colonies are orange-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, D-fucose, Pectin, D-sorbitol, acetoacetic acid, D-trehalose, L-malic acid, D-mannitol, L-rhamnose, D-arabitol, citric acid, β-hydroxy-phenylacetic acid, α-keto-butyric acid, D-malic acid, methyl pyruvate, tween 40 are utilized as sole carbon source. But D-cellobiose, gentiobiose, sucrose, stachyose, D-raffinose, D-galactose, inosine, glycerol, D-serine, L-alanine, L-arginine, L-aspartic acid, L-serine, D-gluconic acid, D-glucuronic acid, glucuronamide, propionic acid, *N*-acetyl-D-mannosamine, dextrin, D-fructose 6-PO_4, L-galactonic acid lactone, D-galacturonic acid, gelatin, α-D-glucose, L-glutamic acid, α-keto-glutaric acid, D-maltose, D-mannose, D-melibiose, β-methyl-D-glucoside, 3-methyl glucose, myo-inositol, glycyl-L-proline, L-pyroglutamic acid, quinic acid, D-turanose acetic acid, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, *N*-acetyl-D-glucosamine, γ-amino-butryric acid, D-aspartic acid, bromo-succinic acid, formic acid, L-fucose, D-glucose-6-PO_4, L-histidine, α-hydroxybutyric acid, β-hydroxy-D, L-butyric acid, L-lactic acid, D-lactic acid methyl ester, α-D-lactose, mucic acid, D-saccharic acid, D-salicin are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of potassium tellurite, aztreonam, 1% NaCl, 1% sodium lactate, 4% NaCl, 8% NaCl, lithium chloride, pH 6, sodium butyrate, nalidixic acid, rifamycin SV, lin-

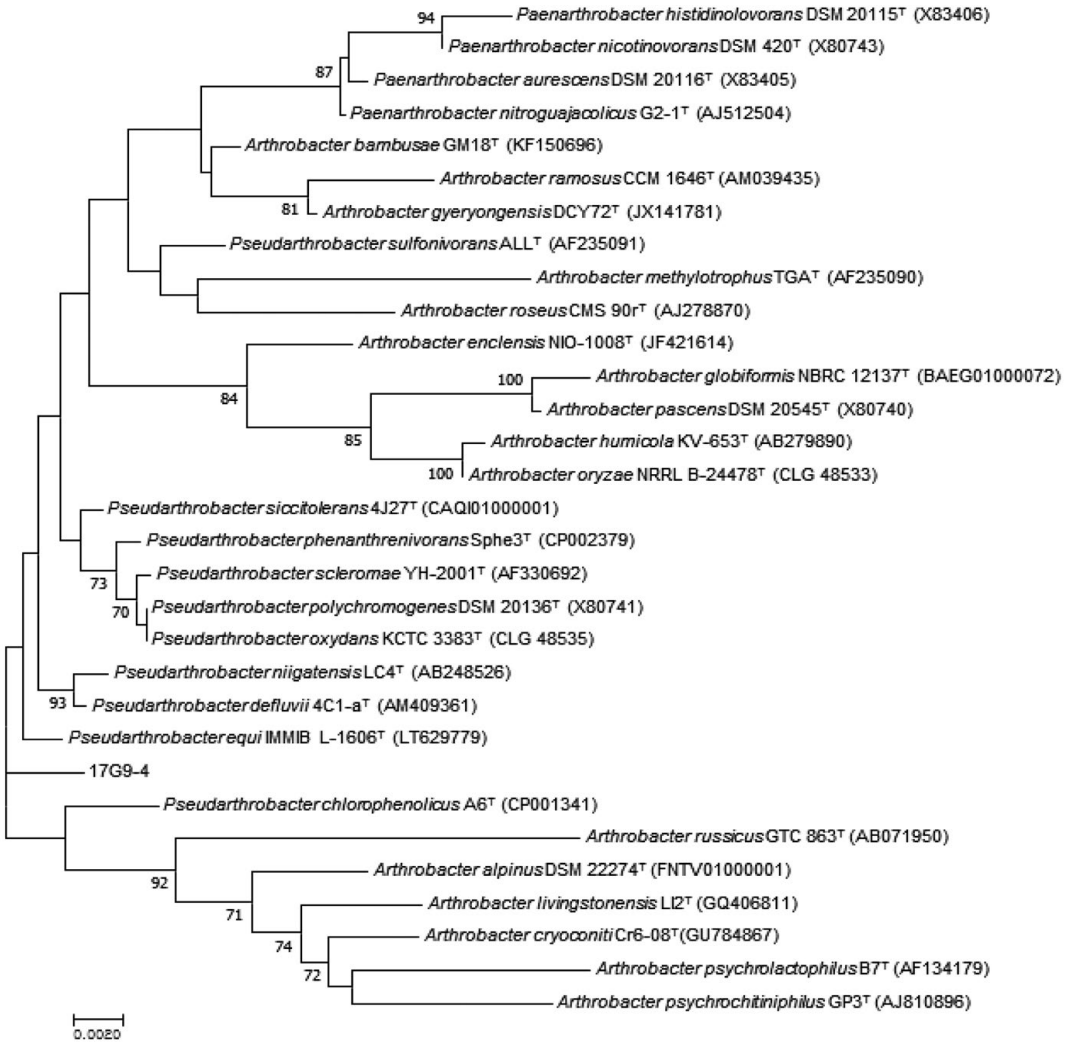

Fig. 6. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Pseudarthrobacter*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

comycin but not guanidine HCl, D-serine, tetrazolium violet fusidic acid, minocycline, niaproof 4, pH 5, sodium bromate, tetrazolium blue, troleandomycin, and vancomycin.

In the API 20NE systems, positive for reduction of nitrates (NO_3) to nitrite (NO_2^-), and arginine dihydrolase, urease. Negative for reduction of nitrates (NO_3) to nitrogen (N_2), indole production on tryptophan, glucose fermentation, gelatin hydrolysis, and capric acid.

Strain 17J27-22 (=NIBRBAC000500527) was isolated from a soil sample, Jeju-do, Korea.

Description of *Rhodococcus globerulus* 17G22-9

Cells are Gram-stain-positive, non-flagellated, and long rod-shaped. Colonies are white-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, *N*-glucosamine, β-mannosamin, D-fructose, glyctl-L-proline, L-arginine, L-histidine, pyroglutamic acid, D-gluconic acid, methyl pyruvate, L-lactic acid, L-malic acid, succinic acid, γ-butryric acid, α-butryric acid, β-butryric acid, acetoacetic acid, propionic acid, and acetic acid are utilized as sole carbon source. But dextrin, D-maltose, D-trehalose, D-cellobiolose, gentiobiose, sucrose, D-turanose, stachyose, D-raffinose, α-D-lactose, D-melibiose, β-D-glucoside, D-salicin, *N*-galactosamin, neuraminic acid, α-D-glucose, D-mannose, D-galactose, 6-methyl-glucose, D-fucose, L-fucose, L-rhamnose, inosine, D-sorbitol, D-mannitol, D-arabitol, myo-Inositol, glycerol, D-glucose, D-fructose, D-aspartic acid, D-serine, gelatin, L-alanine, L-aspartic acid, L-glutamic acid, L-serine, pectin, galacturonic acid, L-galactonic lactone,

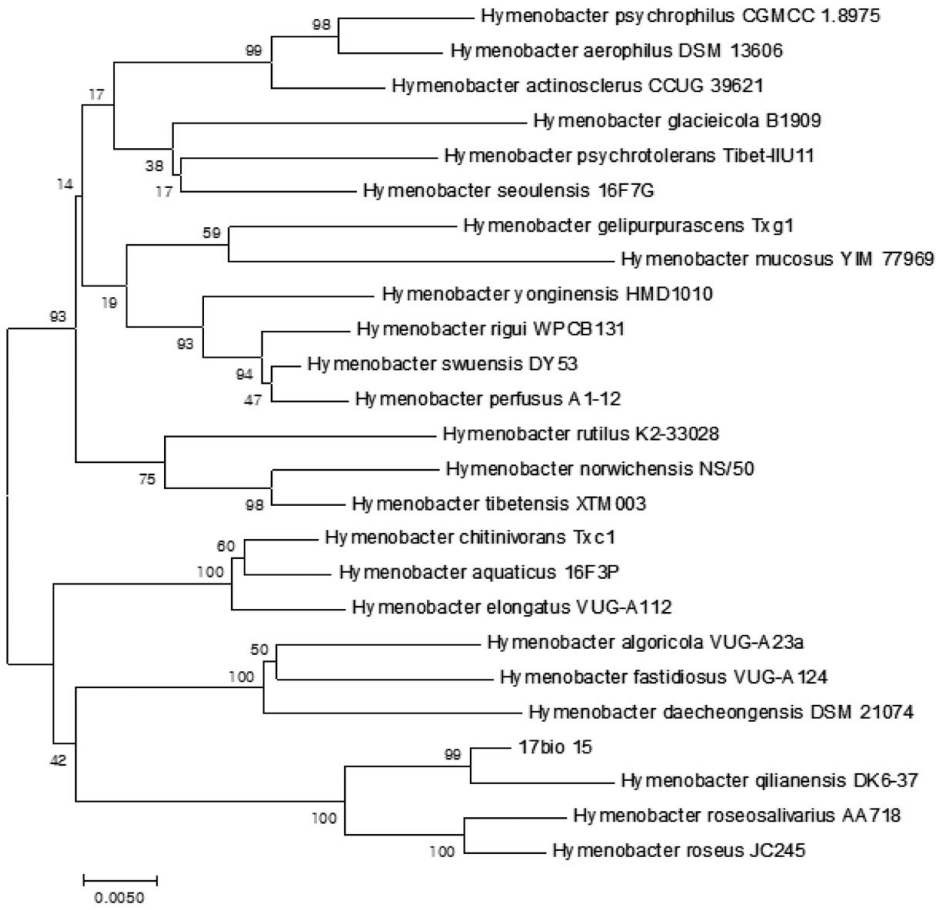

Fig. 7. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Hymenobacter*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

D-glucuronic acid, glucuronamide, mucic acid, quinic acid, D-saccharic acid, pheylacetic acid, D-lactic acid, citric acid, α-glutaric acid, D-malic acid, tween 40, and formic acid are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of pH 6, 1% NaCl, 4% NaCl, sodium lactate, rifamycin SV, nalidixic acid, potassium tellurite, aztreonam, and sodium butyrate but not pH 5, fusidic acid, 8% NaCl, D-serine, troleandomycin, minocycline, lincomycin, guanidine HCl, niaproof 4, vancomycin, tetrazolium violet, tetrazolium blue, lithium chloride, and sodium bromate.

Indole production is negative (API 20NE). In the API 20NE and ID 32GN systems, positive for reduction of nitrates (NO_3) to nitrite (NO_2^-), arginine dihydrolase, urease, esculin hydrolysis, β-galactosidase, L-rhamnose, *N*-acetyl-glucosamine, D-ribose, D-saccharose (sucrose), suberic acid, lactic acid, D-manitol, salicin, D-melibiose, propionic acid, valeric acid, L-histidine, potassium 2-ketogluconate, 3-hydroxybutyric acid, and 4-hydroxybenzoic acid. Negative for glucose fermentation, gelatin hydrolysis, capric acid, phenylacetic acid, inositol, D-maltose, itaconic acid, sodium malonate, sodium acetate, L-alanine, potassium 5-ketogluconate, glycogen, 3-hydroxybenzoic acid, L-serine, D-glucose, D-fucose, D-sorbitol, L-arabinose, trisodium citrate, and L-proline.

Strain 17G22-9 (=NIBRBAC000500503) was isolated from a soil sample, Gyeonggi-do, Pocheon-si, Soheul-eup, Jikdong-ri, Korea.

Description of *Pseudarthrobacter siccitolerans* 17G9-4

Cells are Gram-stain-positive and short rod-shaped. Colonies are yellow-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, D-maltose, D-trehalose, D-cellobiolose, gentiobiose, sucrose, D-turanose, stachyose, D-raffinose, D-melibiose, β-D-glucoside, D-salicin, neuraminic acid, α-D-glucose, D-fructose, D-mannitol, glycerol, L-histidine, D-gluconic acid, and L-malic acid are utilized as sole carbon source. But dextrin, α-D-lactose, *N*-glucosamine, β-mannosamin,

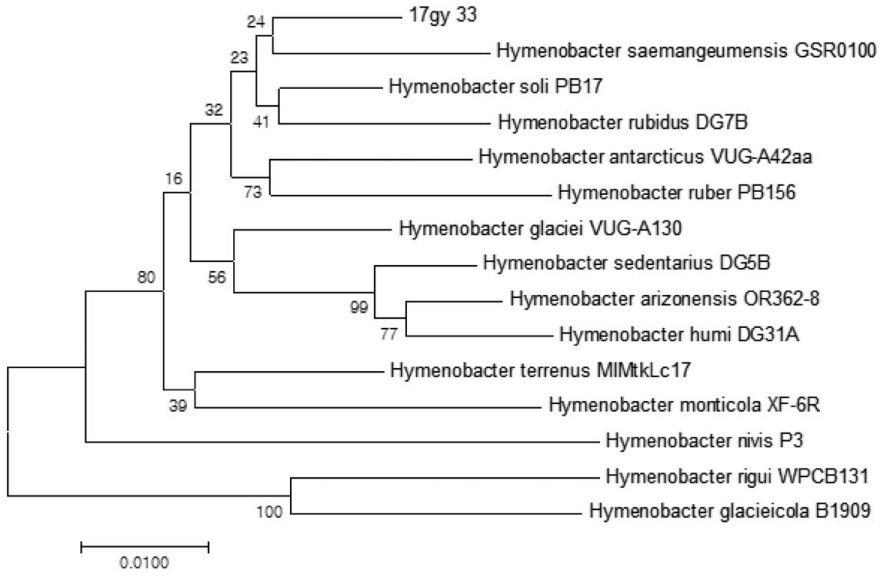

Fig. 8. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Hymenobacter*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

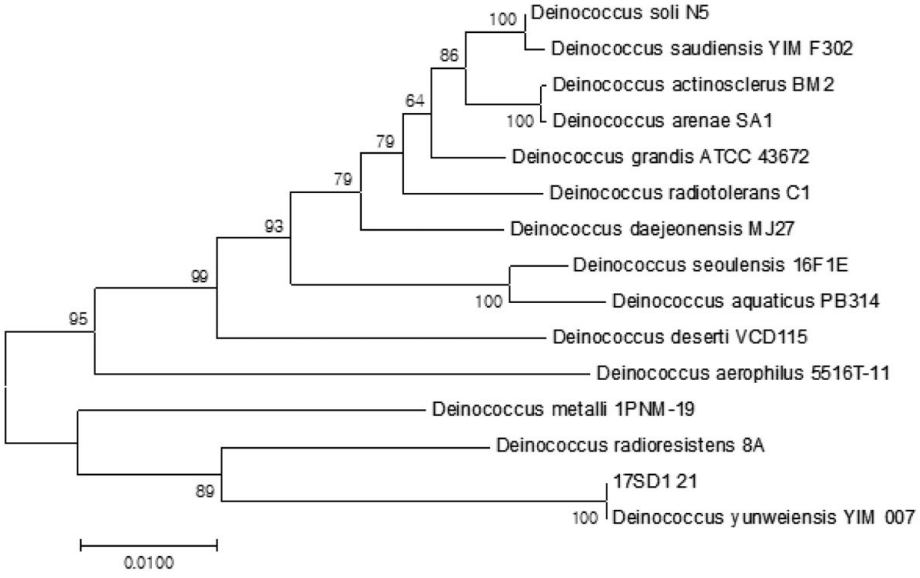

Fig. 9. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Deinococcus*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

N-galactosamin, D-mannose, D-galactose, 6-methyl-glucose, D-fucose, L-fucose, L-rhamnose, inosine, D-sorbitol, D-arabitol, myo-inositol, D-glucose, D-fructose, D-aspartic acid, D-serine, gelatin, glyctl-L-proline, L-alanine, L-arginine, L-aspartic acid, L-glutamic acid, pyroglutamic acid, L-serine, pectin, galacturonic acid, L-galactonic lactone, D-glucuronic acid, glucuronamide, mucic acid, quinic acid, D-saccharic acid, pheylacetic acid, methyl pyruvate, D-lactic acid, L-lactic acid, citric acid, α-glutaric acid, D-malic acid, succinic acid, tween 40, γ-butryric acid, α-butryric acid, β-butryric acid, acetoacetic acid, propionic acid, acetic acid, and formic acid are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of pH 6, 1% NaCl,

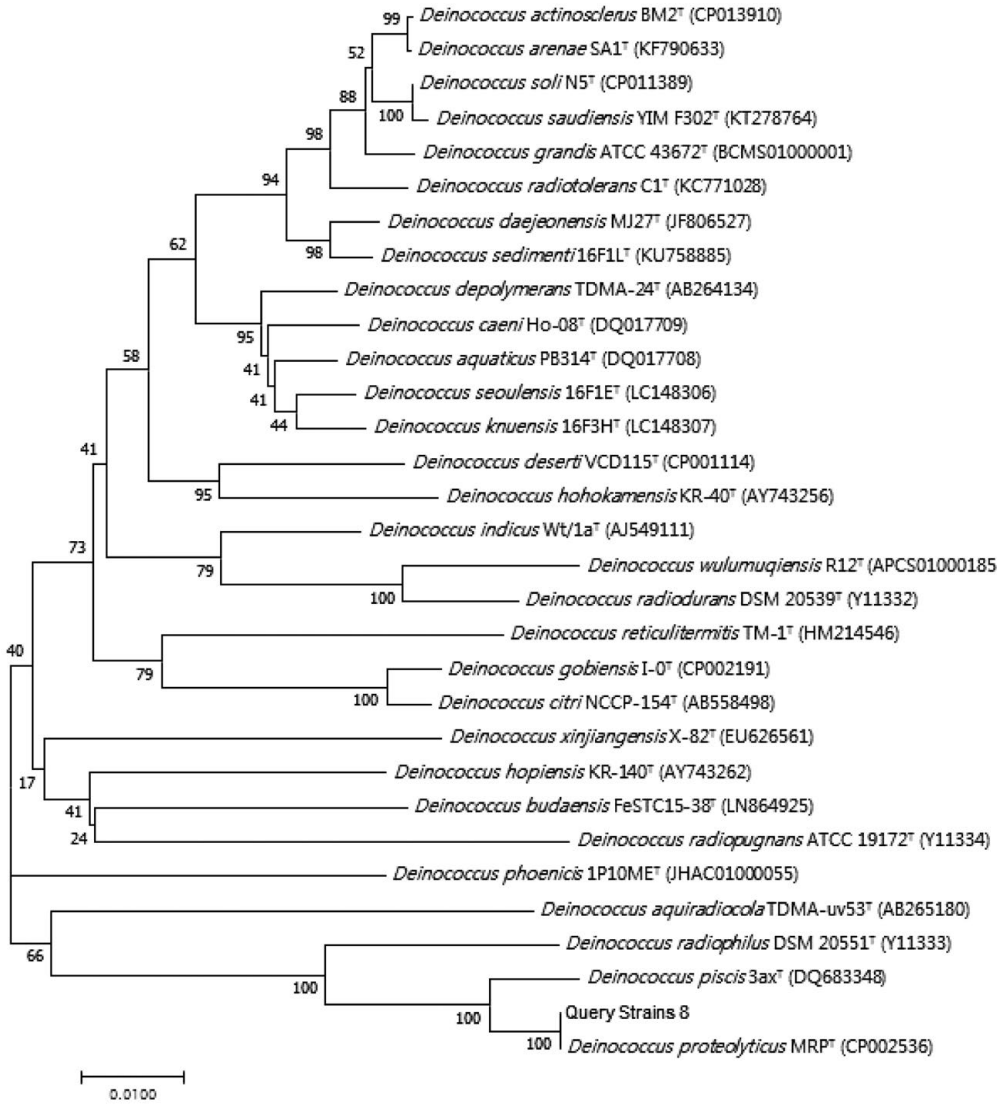

Fig. 10. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Deinococcus*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

4% NaCl, sodium lactate, D-serine, tetrazolium violet, nalidixic acid, lithium chloride, potassium tellurite, aztreonam, and sodium butyrate but not pH 5, 8% NaCl, fusidic acid, troleandomycin, rifamycin SV, minocycline, lincomycin, guanidine HCl, niaproof 4, vancomycin, tetrazolium blue and sodium bromate.

Nitrate reduction and indole production are negative (API 20NE). In the API 20NE and ID 32GN systems, positive for arginine dihydrolase, urease, esculin hydrolysis, β-galactosidase, L-rhamnose, *N*-acetyl-glucosamine, D-ribose, nositol, D-saccharose (sucrose), D-maltose, sodium acetate, lactic acid, L-alanine, 3-hydroxybenzoic acid, L-serine, D-glucose, salicin, D-fucose, D-sorbitol, L-histidine, 3-hydroxybutyric acid, and 4-hydroxybenzoic acid. Negative for glucose fermentation, gelatin hydrolysis, capric acid, adipic acid, trisodium citrate, itaconic acid, suberic acid, sodium malonate, potassium 5-ketogluconate, glycoGen, D-mannitol, D-melibiose, L-arabinose, propionic acid, valeric acid, trisodium citrate, potassium 2-ketogluconate, and L-proline.

Strain 17G9_4 (=NIBRBAC000500499) was isolated from a soil sample, Gyeonggi-do, Pocheon-si, Soheul-eup, Jikdong-ri, Korea.

Description of *Hymenobacter qilianensis* 17Bio_15

Cells are Gram-stain-negative, non-flagellated, and long rod-shaped. Colonies are pink-colored after 3 days

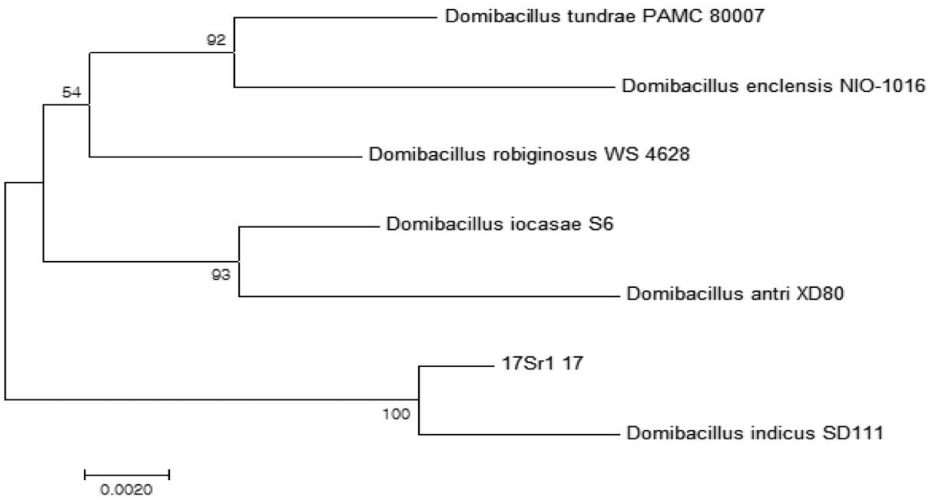

Fig. 11. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Domibacillus*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

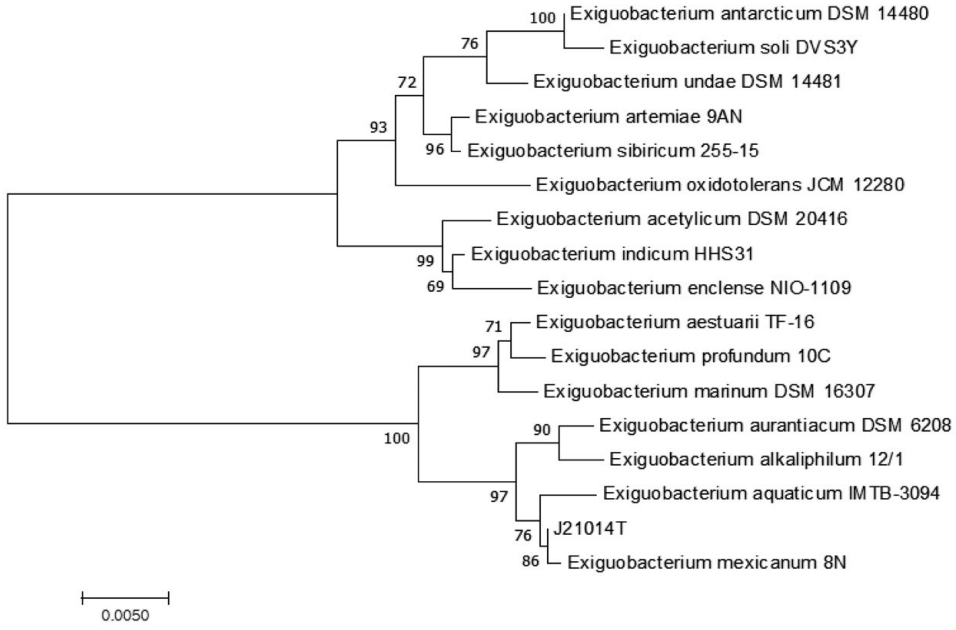

Fig. 12. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Exiguobacterium*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

of incubation on R2A at 25°C. In the BIOLOG GEN III, α-D-glucose, D-arabitol, L-arginine, L-aspartic acid, D-gluconic acid, and citric acid are utilized as sole carbon source. But acetoacetic acid, *N*-acetyl-D-mannosamine, L-alanine, D-cellobiose, dextrin, D-fructose, D-fructose 6-PO_4, L-galactonic acid lactone, D-galactose, D-galacturonic acid, gelatin, gentiobiose, glucuronamide, D-glucuronic acid, L-glutamic acid, inosine, α-keto-glutaric acid, L-malic acid, D-maltose, D-mannitol, D-mannose, D-melibiose, β-methyl-D-glucoside, 3-methyl glucose, myo-inositol, pectin, propionic acid, glycyl-L-proline, L-pyroglutamic acid, quinic acid, D-raffinose, L-rhamnose, L-serine, stachyose, sucrose, D-trehalose, D-turanose, acetic acid, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, *N*-acetyl-D-glucosamine, γ-amino-butryric acid, D-aspartic acid, bromo-succinic acid, formic acid,

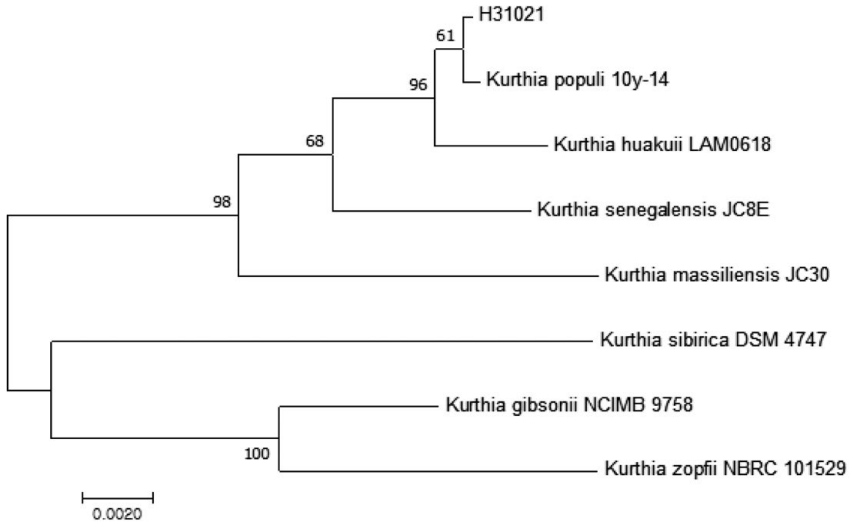

Fig. 13. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Kurthia*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

D-fucose, L-fucose, D-glucose-6-PO_4, glycerol, L-histidine, α-hydroxybutyric acid, β-hydroxy-D, L-butyric acid, *p*-hydroxy-phenylacetic acid, α-keto-butyric acid, L-lactic acid, D-lactic acid methyl ester, α-D-lactose, D-malic acid, methyl pyruvate, mucic acid, D-saccharic acid, D-salicin, D-serine, D-sorbitol, and tween 40 are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of rifamycin SV, minocycline, lincomycin, and tetrazolium but not 1% NaCl, 1% sodium lactate, 4% NaCl, 8% NaCl, guanidine HCl, lithium chloride, pH 6, potassium tellurite, D-serine, sodium butyrate, tetrazolium violet, aztreonam, fusidic acid, nalidixic acid, niaproof 4, pH 5, sodium bromate, troleandomycin, and vancomycin.

Indole production is negative (API 20NE). In the API 20NE and ID 32GN systems, positive for reduction of nitrates (NO_3) to nitrogen (N_2), arginine dihydrolase, urease, esculin hydrolysis, β-galactosidase, D-saccharose (sucrose), itaconic acid, glycogen, 3-hydroxybenzoic acid, propionic acid, valeric acid, trisodium citrate, and potassium 2-ketogluconate. Weak for gelatin hydrolysis. Negative for reduction of nitrates (NO_3) to nitrite (NO_2^-), Indole production on tryptophan, glucose fermentation, D-glucose, L-arabinose, D-mannose, D-mannitol, D-maltose, capric acid, adipic acid, malic acid, trisodium citrate, phenylacetic acid, L-rhamnose, *N*-acetyl-glucosamine, D-ribose, inositol, D-maltose, suberic acid, sodium malonate, sodium acetate, lactic acid, L-alanine, potassium 5-ketogluconate, L-serine, D-mannitol, D-glucose, salicin, D-melibiose, D-fucose, D-sorbitol, L-arabinose, L-histidine, 3-hydroxybutyric acid, 4-hydroxybrnzoic acid, and L-proline.

Strain 17Bio_15 (=NIBRBAC000500513) was isolated from a soil sample, Seoul, Nowon-gu Gongneung-dong, Korea.

Description of *Hymenobacter terrae* 17gy_33

Cells are Gram-stain-negative, non-flagellated, and short rod-shaped. Colonies are pink-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, stachyose, D-mannitol, D-arabitol, glycerol, D-serine, L-glutamic acid, and pectins are utilized as sole carbon source. But acetoacetic acid, *N*-acetyl-D-mannosamine, L-alanine, L-arginine, L-aspartic acid, D-cellobiose, dextrin, D-fructose, D-fructose 6-P,O4, L-galactonic acid lactone, D-galactose, D-galacturonic acid, gelatin, gentiobiose, D-gluconic acid, α-D-glucose, glucuronamide, D-glucuronic acid, inosine, α-keto-glutaric acid, L-malic acid, D-maltose, D-mannose, D-melibiose, β-methyl-D-glucoside, 3-methyl glucose, myo-inositol, propionic acid, glycyl-L-proline, L-pyroglutamic acid, quinic acid, D-raffinose, L-rhamnose, L-serine, sucrose, D-trehalose, D-turanose, acetic acid, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, *N*-acetyl-D-glucos amine, γ-amino-butryric acid, D-aspartic acid, bromo-succinic acid, citric acid, formic acid, D-fucose, L-fucose, D-glucose-6-PO_4, L-histidine, α-hydroxybutyric acid, β-hydroxy-D, L-butyric acid, *p*-hydroxy-phenyl-acetic acid, α-keto-butyric acid, L-lactic acid, D-lactic acid methyl ester, α-D-lactose, D-malic acid, methyl pyruvate, mucic acid, D-saccharic acid, D-salicin, D-sorbitol, and tween 40 are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of

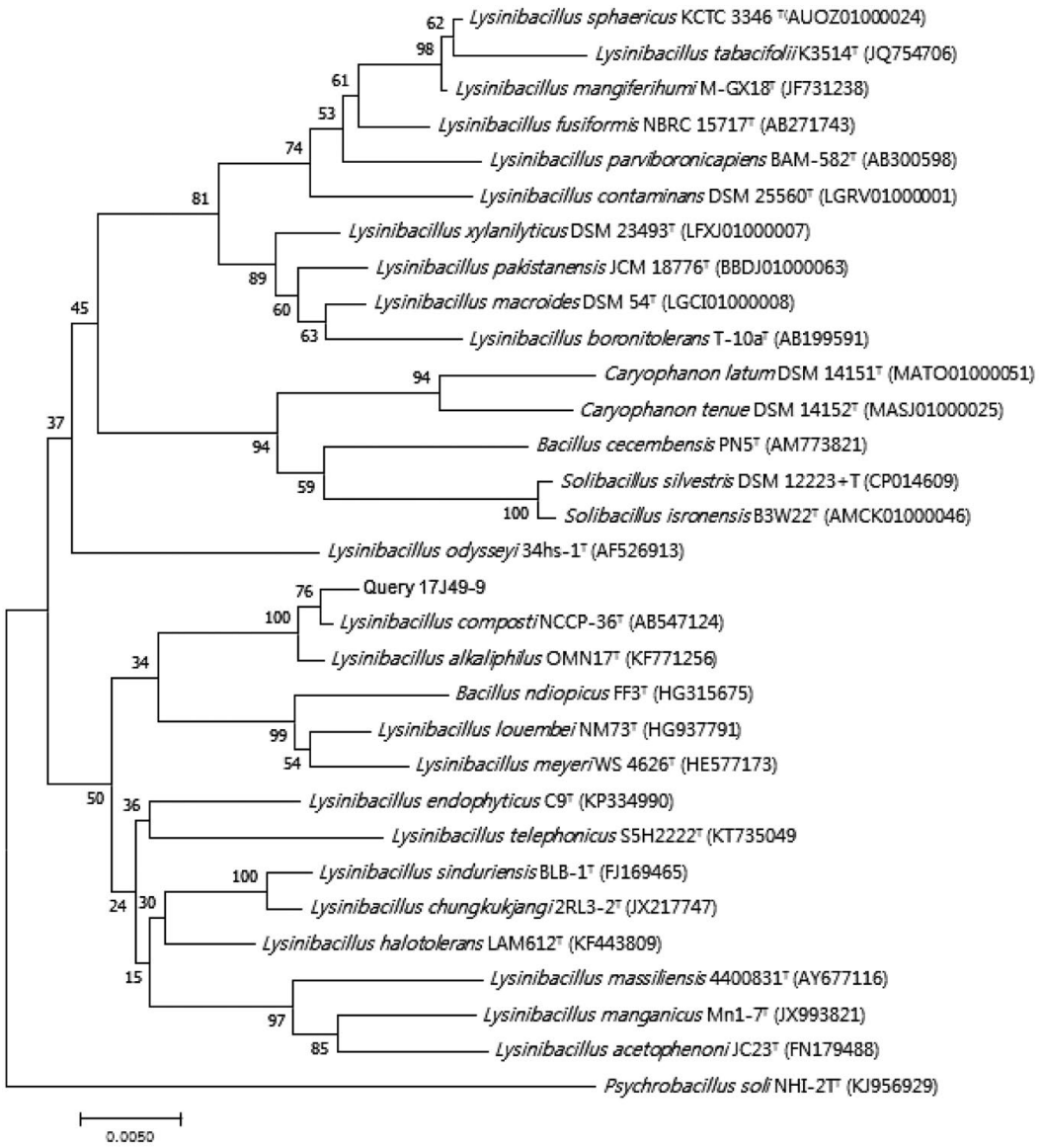

Fig. 14. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Lysinibacillus*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

rifamycin SV, minocycline, tetrazolium violet, nalidixic acid, and aztreonam but not 1% NaCl, 1% sodium lactate, 4% NaCl, 8% NaCl, guanidine HCl, lithium chloride, pH 6, potassium tellurite, D-serine, sodium butyrate, fusidic acid, lincomycin, niaproof 4, pH 5, sodium bromate, tetrazolium blue, troleandomycin, and vancomycin.

Indole production is negative (API 20NE). In the API 20NE and ID 32GN systems, positive for reduction of nitrates (NO_3) to nitrogen (N_2), arginine dihydrolase, urease, esculin hydrolysis, β-galactosidase, D-maltose, L-alanine, salicin, D-sorbitol, L-arabinose, trisodium citrate. Negative for indole production on tryptophan, glucose fermentation, gelatin hydrolysis, D-glucose, L-arabinose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate, phenylacetic acid, L-rhamnose, *N*-acetyl-glucosamine, D-ribose, inositol, D-saccharose (sucrose), itaconic acid, suberic acid, sodium malonate, sodium acetate, lactic acid, potassium 5-ketogluconate, glycogen, 3-hydroxybenzoic acid, L-serine, D-mannitol, D-glucose, D-melibiose, D-fucose, propionic acid, valeric acid, L-histidine, potassium 2-ketogluconate, 3-hydroxybutyric acid, 4-hydroxybenzoic acid, and L-proline.

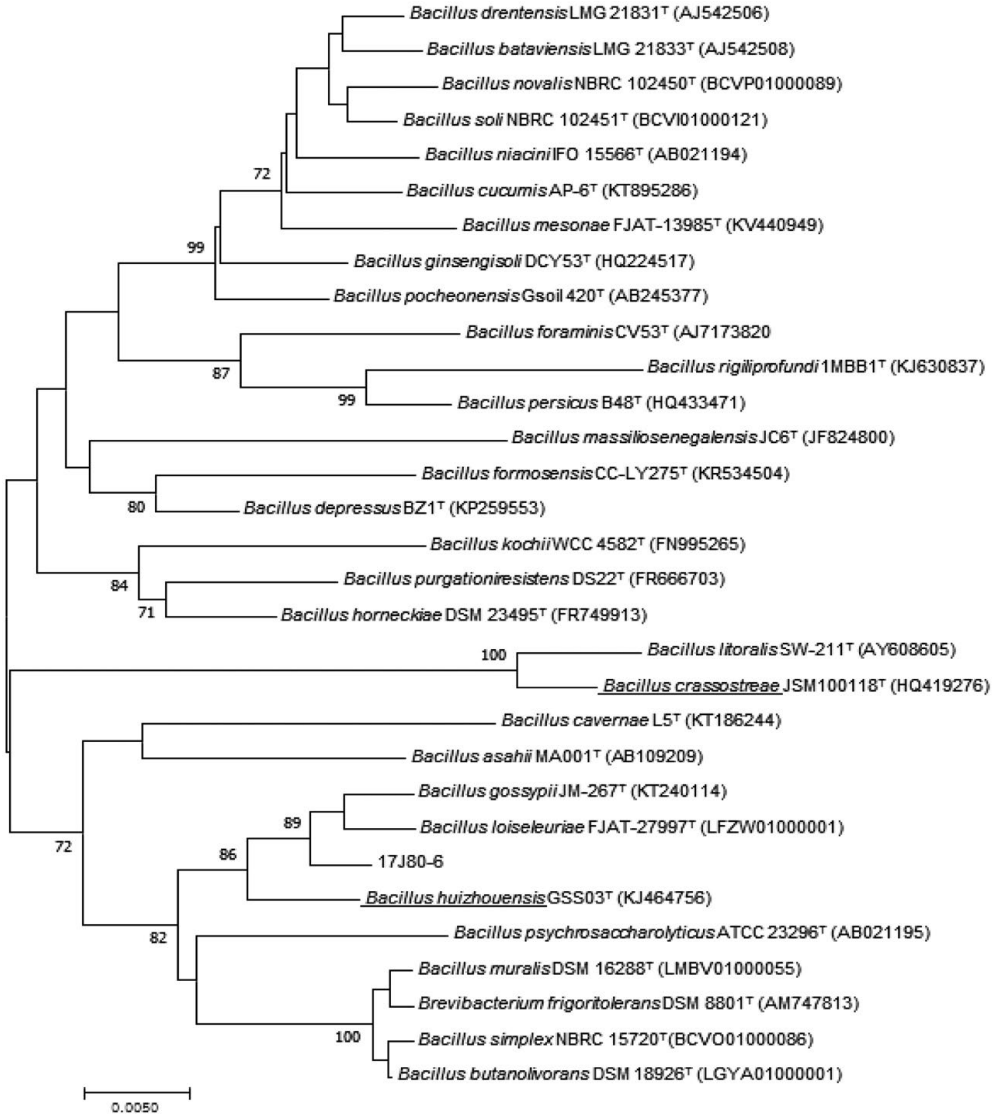

Fig. 15. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences shows the relationship between the strains isolated in this study and their relatives of the genus *Bacillus*. Bootstrap values (>70%) are shown above nodes for the neighbor-joining methods. Bar: 0.0050 substitutions per nucleotide position, respectively.

Strain 17gy_33 (=NIBRBAC000500514) was isolated from a soil sample, Seoul, Nowon-gu Gongneung-dong, Korea.

Description of *Deinococcus yunweiensis* 17SD1_21

Cells are Gram-stain-negative, non-flagellated, and short rod-shaped. Colonies are orange-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, D-mannitol, and acetoacetic acid are utilized as sole carbon source. But *N*-acetyl-D-mannosamine, L-alanine, L-arginine, L-aspartic acid, D-cellobiose, dextrin, D-fructose, D-fructose 6-PO_4, L-galactonic acid lactone, D-galactose, D-galacturonic acid, gelatin, gentiobiose, D-gluconic acid, α-D-glucose, glucuronamide, D-glucuronic acid, L-glutamic acid, inosine, α-ketoglutaric acid, L-malic acid, D-maltose, D-mannose, D-melibiose, β-methyl-D-glucoside, 3-methyl glucose, myo-inositol, pectin, propionic acid, glycyl-L-proline, L-pyroglutamic acid, quinic acid, D-raffinose, L-rhamnose, L-serine, stachyose, sucrose, D-trehalose, D-turanose, acetic acid, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, *N*-acetyl-D-glucosamine, γ-aminobutryric acid, D-arabitol, D-aspartic acid, bromo-succinic acid, citric acid, formic acid, D-fucose, L-fucose, D-glucose-6-PO_4, glycerol, L-histidine, α-hydroxybutyric

acid, β-hydroxy-D,L-butyric acid, *p*-hydroxy-phenylacetic acid, α-keto-butyric acid, L-lactic acid, D-lactic acid methyl ester, α-D-lactose, D-malic acid, methyl pyruvate, mucic acid, D-saccharic acid, D-salicin, D-serine, D-sorbitol, and tween 40 are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of 1% NaCl, 1% sodium lactate, 4% NaCl, 8% NaCl, guanidine HCl, lithium chloride, pH 6, potassium tellurite, D-serine, sodium butyrate, tetrazolium violet, aztreonam, fusidic acid, lincomycin, minocycline, nalidixic acid, niaproof 4, pH 5, rifamycin SV, sodium bromate, tetrazolium blue, troleandomycin, and vancomycin.

Indole production is negative (API 20NE). In the API 20NE and ID 32GN systems, positive for reduction of nitrates (NO_3) to nitrogen (N_2), arginine dihydrolase, urease, esculin hydrolysis, β-galactosidase, D-saccharose (sucrose), D-maltose, and D-sorbitol. Weak reaction observed with gelatin hydrolysis. Negative for reduction of nitrates (NO_3) to nitrite (NO_2^-), indole production on tryptophan, glucose fermentation, L-rhamnose, *N*-acetyl-glucosamine, D-ribose, inositol, itaconic acid, suberic acid, sodium malonate, sodium acetate, lactic acid, L-alanine, potassium 5-ketogluconate, glycogen, 3-hydroxybenzoic acid, L-serine, D-mannitol, D-glucose, salicin, D-melibiose, D-fucose, L-arabinose, propionic acid, capric acid, valeric acid, trisodium citrate, L-histidine, potassium 2-ketogluconate, 3-hydroxybutyric acid, 4-hydroxybenzoic acid, and L-proline.

Strain 17SD1_21 (=NIBRBAC000500511) was isolated from a soil sample, Seoul, Nowon-gu Gongneung-dong, Korea.

Description of *Deinococcus proteolyticus* Strain8

Cells are Gram-stain-positive and cocci-shaped. Colonies are orange-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, sucrose, inosine, D-fructose, α-D-glucose, D-mannitol, L-histidine, and tween 40 are utilized as sole carbon source. But D-trehalose, D-cellobiose, gentiobiose, stachyose, D-raffinose, D-galactose, D-sorbitol, glycerol, D-serine, L-alanine, L-arginine, L-aspartic acid, L-serine, D-gluconic acid, D-glucuronic acid, glucuronamide, propionic acidaceto-acetic acid, *N*-acetyl-D-mannosamine, dextrin, D-fructose 6-PO_4, L-galactonic acid lactone, D-galacturonic acid, gelatin, L-glutamic acid, α-keto-glutaric acid, L-malic acid, D-maltose, D-mannose, D-melibiose, β-methyl-D-glucoside, 3-methyl glucose, myo-inositol, pectin, glycyl-L-proline, L-pyroglutamic acid, quinic acid, L-rhamnose, D-turanose acetic acid, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, *N*-acetyl-D-glucosamine, γ-amino-butryric acid, D-arabitol, D-aspartic acid, bromo-succinic acid, citric acid, formic acid, D-fucose, L-fucose, D-glucose-6-PO_4, α-hydroxybutyric acid, β-hydroxy-D,L-butyric acid, *p*-hydroxy-phenylacetic acid, α-keto-butyric acid, L-lactic acid, D-lactic acid methyl ester, α-D-lactose, D-malic acid, methyl pyruvate, mucic acid, D-saccharic acid, and D-salicin are not utilized. In sensitivity tests, the tetrazolium redox dye was reduced in the presence of 1% NaCl, 1% sodium lactate, lithium chloride, pH 6, nalidixic acid, and rifamycin SV but not potassium tellurite, aztreonam, 4% NaCl, 8% NaCl, guanidine HCl, D-serine, sodium butyrate, tetrazolium violet fusidic acid, lincomycin, minocycline, niaproof 4, pH 5, sodium bromate, tetrazolium blue, troleandomycin, and vancomycin.

In the API 20NE, positive for reduction of nitrates (NO_3) to nitrite (NO_2^-), arginine dihydrolase, D-glucose, and esculin hydrolysis. Negative for indole production on tryptophan, glucose fermentation, gelatin hydrolysis, β-galactosidase, D-mannitol, *N*-acetyl-D-glucosamine, urease, D-mannose, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate, and phenylacetic acid, and L-arabinose.

Strain8 (=NIBRBAC000500528) was isolated from a soil sample, Jeju-do, Korea.

Description of *Domibacillus indicus* 17Sr1_17

Cells are Gram-stain-negative, non-flagellated, and long rod-shaped. Colonies are yellow-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, dextrin, D-maltose, D-trehalose, D-cellobiose, gentiobiose, sucrose, D-turanose, stachyose, D-raffinose, D-melibiose, β-methyl-D-glucoside, D-salicin, *N*-acetyl-D-glucosamine, α-D-glucose, D-mannose, D-fructose, D-galactose, L-rhamnose, inosine, D-sorbitol, D-mannitol, D-arabitol, myo-inositol, glycerol, L-alanine, L-arginine, L-aspartic acid, L-glutamic acid, L-pyroglutamic acid, pectin, D-galacturonic acid, L-galactonic acid lactone, D-gluconic acid, D-glucuronic acid, glucuronamide, mucic acid, quinic acid, D-saccharic acid, L-lactic acid, citric acid, L-malic acid, acetic acid, and formic acid were utilized as sole carbon source. But acetoacetic acid, *N*-acetyl-D-mannosamine, D-fructose 6-PO_4, D-galactose, gelatin, α-keto-glutaric acid, 3-methyl glucose, propionic acid, glycyl-L-proline, L-serine, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, γ-amino-butryric acid, D-aspartic acid, bromo-succinic acid, D-fucose, L-fucose, D-glucose-6-PO_4, L-histidine, α-hydroxybutyric acid, β-hydroxy-D,L-butyric acid, *p*-hydroxy-phenylacetic acid, α-keto-butyric acid, D-lactic acid methyl ester, α-D-lactose, D-malic acid, methyl pyruvate, D-serine, and tween 40 are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of pH 6, 1% NaCl, 4% NaCl, 1% sodium lactate, potassium tellurite, and sodium butyrate but not 8% NaCl, guanidine HCl,

lithium chloride, D-serine, tetrazolium violet, aztreonam, fusidic acid, lincomycin, minocycline, nalidixic acid, niaproof 4, pH 5, rifamycin SV, sodium bromate, tetrazolium blue, troleandomycin, and vancomycin.

Indole production is negative (API 20NE). In the API 20NE and ID 32GN systems, positive for reduction of nitrates (NO_3) to nitrite (NO_2^-), arginine dihydrolase, urease, esculin hydrolysis, β-galactosidase, L-rhamnose, *N*-acetyl-glucosamine, inositol, D-maltose, sodium acetate, L-alanine, glycogen, D-mannitol, salicin, D-melibiose, D-sorbitol, L-arabinose, potassium 2-ketogluconate, 3-hydroxybutyric acid, and L-proline. Negative for reduction of nitrates (NO_3) to nitrogen (N_2), indole production on tryptophan, glucose fermentation, gelatin hydrolysis, capric acid, adipic acid, phenylacetic acid, D-ribose, D-saccharose (sucrose), itaconic acid, suberic acid, sodium malonate, lactic acid, potassium 5-ketogluconate, 3-hydroxybenzoic acid, L-serine, D-glucose, D-fucose, propionic acid, capric acid, valeric acid, trisodium citrate, L-histidine, and 4-hydroxybenzoic acid.

Strain 17Sr1_17 (=NIBRBAC000500512) was isolated from a soil sample, Seoul, Nowon-gu Gongneung-dong, Korea.

Description of *Exiguobacterium mexicanum* J21014T

Cells are Gram-stain-positive, and cocci-shaped. Colonies are yellow-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, D-trehalose, D-cellobiose, gentiobiose, sucrose, stachyose, D-raffinose, D-galactose, inosine, D-sorbitol, glycerol, D-serine, L-alanine, L-arginine, L-aspartic acid, L-serine, D-gluconic acid, D-glucuronic acid, glucuronamide, and propionic acid are utilized as sole carbon source. But acetoacetic acid, *N*-acetyl-D-mannosamine, dextrin, D-fructose, D-fructose 6-PO_4, L-galactonic acid lactone, D-galacturonic acid, gelatin, α-D-glucose, L-glutamic acid, α-keto-glutaric acid, L-malic acid, D-maltose, D-mannitol, D-mannose, D-melibiose, β-methyl-D-glucoside, 3-methyl glucose, myo-inositol, pectin, glycyl-L-proline, L-pyroglutamic acid, quinic acid, L-rhamnose, D-turanose acetic acid, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, *N*-acetyl-D-glucosamine, γ-amino-butryric acid, D-arabitol, D-aspartic acid, bromo-succinic acid, citric acid, formic acid, D-fucose, L-fucose, D-glucose-6-PO_4, L-histidine, α-hydroxybutyric acid, β-hydroxy-D,L-butyric acid, *p*-hydroxy-phenylacetic acid, α-keto-butyric acid, L-lactic acid, D-lactic acid methyl ester, α-D-lactose, D-malic acid, methyl pyruvate, mucic acid, D-saccharic acid, D-salicin, and tween 40 are not utilized.

In sensitivity tests, the tetrazolium redox dye is reduced in the presence of potassium tellurite and aztreonam but not 1% NaCl, 1% sodium lactate, 4% NaCl, 8% NaCl, guanidine HCl, lithium chloride, pH 6, D-serine, sodium butyrate, tetrazolium violet fusidic acid, lincomycin, minocycline, nalidixic acid, niaproof 4, pH 5, rifamycin SV, sodium bromate, tetrazolium blue, troleandomycin, and vancomycin.

Indole production is negative (API 20NE). In the API 20NE and ID 32GN systems, positive for reduction of nitrates (NO_3) to nitrite (NO_2^-), arginine dihydrolase, urease, esculin hydrolysis, gelatin hydrolysis, D-ribose, inositol, D-saccharose (sucrose), D-maltose, suberic acid, sodium acetate, lactic acid, L-alanine, glycogen, L-serine, D-glucose, propionic acid, capric acid, valeric acid, trisodium citrate, L-histidine, 3-hydroxybutyric acid, and L-proline. Negative for reduction of nitrates (NO_3) to nitrogen (N_2), indole production on tryptophan, glucose fermentation, β-galactosidase, capric acid, adipic acid, trisodium citrate, L-rhamnose, *N*-acetyl-glucosamine, itaconic acid, sodium malonate, potassium 5-ketogluconate, 3-hydroxybenzoic acid, D-mannitol, salicin, D-melibiose, D-fucose, D-sorbitol, L-arabinose, potassium 2-ketogluconate, and 4-hydroxybenzoic acid.

Strain J21014T (=NIBRBAC000500525) was isolated from a soil sample, Seoul, Nowon-gu Gongneung-dong, Korea.

Description of *Kurthia senegalensis* H31021

Cells are Gram-stain-positive, and short rod-shaped. Colonies are yellow-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, gentiobiose, sucrose, stachyose, D-raffinose, D-galactose, inosine, D-sorbitol, glycerol, D-serine, L-alanine, L-arginine, L-aspartic acid, L-serine, D-gluconic acid, D-glucuronic acid, glucuronamide, and propionic acid are utilized as sole carbon source. But D-trehalose, D-cellobiose, acetoacetic acid, *N*-acetyl-D-mannosamine, dextrin, D-fructose, D-fructose 6-PO_4, L-galactonic acid lactone, D-galacturonic acid, gelatin, α-D-glucose, L-glutamic acid, α-keto-glutaric acid, L-malic acid, D-maltose, D-mannitol, D-mannose, D-melibiose, β-methyl-D-glucoside, 3-methyl glucose, myo-inositol, pectin, glycyl-L-proline, L-pyroglutamic acid, quinic acid, L-rhamnose, D-turanose acetic acid, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, *N*-acetyl-D-glucosamine, γ-amino-butryric acid, D-arabitol, D-aspartic acid, bromo-succinic acid, citric acid, formic acid, D-fucose, L-fucose, D-glucose-6-PO_4, L-histidine, α-hydroxybutyric acid, β-hydroxy-D, L-butyric acid, *p*-hydroxy-phenylacetic acid, α-keto-butyric acid, L-lactic acid, D-lactic acid methyl ester, α-D-lactose, D-malic acid, methyl pyruvate, mucic acid, D-saccharic acid, D-salicin, and tween 40 are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of potassium tellurite and aztreonam but not 1% NaCl, 1% sodium lactate, 4% NaCl, 8% NaCl, guanidine HCl, lithium chloride, pH

6, D-serine, sodium butyrate, tetrazolium violet fusidic acid, lincomycin, minocycline, nalidixic acid, niaproof 4, pH 5, rifamycin SV, sodium bromate, tetrazolium blue, troleandomycin, and vancomycin.

Nitrate reduction and indole production are negative (API 20NE). In the API 20NE and ID 32GN systems, positive for *N*-acetyl-β-glucosaminidase, acid phosphatase, alkaline phosphatase, α-chymotrypsin, cystine arylamidase, α-galactosidase, β-galactosidase (PNPG), α-glucosidase (starch hydrolysis), β-glucosidase (esculin hydrolysis), leucine arylamidase, naphthol-AS-BI-phosphohydrolase, trypsin, and valine arylamidase. Negative for arginine dihydrolase, α-fucosidase, β-glucuronidase, acetate, *N*-acetyl-D-glucosamine, adipate, L-arabinose, caprate, citrate, gluconate, D-glucose, L-malate, D-maltose, D-mannitol, D-mannose, and phenyl acetate, lipase (C14), α-mannosidase, protease (gelatin hydrolysis), and urease.

Strain H31021 (=NIBRBAC000500526) was isolated from a soil sample, Seoul, Nowon-gu Gongneung-dong, Korea.

Description of *Lysinibacillus composti* 17J49-9

Cells are Gram-stain negative, and oval-shaped. Colonies are white-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, L-alanine, L-arginine, acetoacetic acid, L-glutamic acid, and tween 40 are utilized as sole carbon source. But D-trehalose, D-cellobiose, gentiobiose, sucrose, stachyose, D-raffinose, D-galactose, inosine, D-sorbitol, glycerol, D-serine, L-aspartic acid, L-serine, D-gluconic acid, D-glucuronic acid, glucuronamide, propionic acid, *N*-acetyl-D-mannosamine, dextrin, D-fructose, D-fructose 6-PO_4, L-galactonic acid lactone, D-galacturonic acid, gelatin, α-D-glucose, α-keto-glutaric acid, L-malic acid, D-maltose, D-mannitol, D-mannose, D-melibiose, β-methyl-D-glucoside, 3-methyl glucose, myo-inositol, pectin, glycyl-L-proline, L-pyroglutamic acid, quinic acid, L-rhamnose, D-turanose acetic acid, *N*-acetyl-D-galactosamine, *N*-acetyl-neuraminic acid, *N*-acetyl-D-glucosamine, γ-amino-butryric acid, D-arabitol, D-aspartic acid, bromosuccinic acid, citric acid, formic acid, D-fucose, L-fucose, D-glucose-6-PO_4, L-histidine, α-hydroxybutyric acid, β-hydroxy-D,L-butyric acid, *p*-hydroxy-phenylacetic acid, α-keto-butyric acid, L-lactic acid, D-lactic acid methyl ester, α-D-lactose, D-malic acid, methyl pyruvate, mucic acid, D-saccharic acid, and D-salicin are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of potassium tellurite, aztreonam, 1% NaCl, 1% sodium lactate, 4% NaCl, lithium chloride, pH 6, and nalidixic acid but not 8% NaCl, guanidine HCl, D-serine, sodium butyrate, tetrazolium violet fusidic acid, lincomycin, minocycline, niaproof 4, pH 5, rifamycin SV, sodium bromate, tetrazolium blue, troleandomycin, and vancomycin.

Nitrate reduction and indole production are negative (API 20NE). In the API 20NE systems, positive for arginine dihydrolase, urease D-glucose, D-mannose, D-maltose, potassium gluconate, malic acid, trisodium citrate, esculin hydrolysis, gelatin hydrolysis, β-galactosidase, L-arabinose, D-mannitol, and *N*-acetyl-D-glucosamine. Negative for capric acid, adipic acid, phenylacetic acid, glucose fermentation.

Strain 17J49-9 (=NIBRBAC000500529) was isolated from a soil sample, Seoul, Nowon-gu Gongneung-dong, Korea.

Description of *Bacillus loiseleuriae* 17J80-6

Cells are Gram-stain positive and oval-shaped. Colonies are white-colored after 3 days of incubation on R2A at 25°C. In the BIOLOG GEN III, dextrin, D-maltose, D-cellobiolose, gentiobiose, sucrose, D-turanose, stachyose, D-raffinose, α-D-lactose, D-melibiose, β-D-glucoside, D-salicin, *N*-glucosamine, β-mannosamin, neuraminic acid, α-D-glucose, D-fructose, D-galactose, D-mannitol, D-arabitol, D-serine, L-glutamic acid, pectin, D-glucuronic acid, and methyl pyruvate are utilized as sole carbon source. But D-trehalose, *N*-galactosamin, D-mannose, 6-methyl-glucose, D-fucose, L-fucose, L-rhamnose, inosine, D-sorbitol, myo-inositol, glycerol, D-fructose, D-aspartic acid, gelatin, glyctl-L-proline, L-alanine, L-aspartic acid, L-histidine, pyroglutamic acid, L-serine, galacturonic acid, L-galactonic lactone, D-gluconic acid, glucuronamide, mucic acid, quinic acid, D-saccharic acid, pheylacetic acid, D-lactic acid, L-lactic acid, citric acid, α-glutaric acid, D-malic acid, L-malic acid, succinic acid, tween 40, γ-butryric acid, α-butryric acid, β-butryric acid, acetoacetic acid, propionic acid, acetic acid, and formic acid are not utilized. In sensitivity tests, the tetrazolium redox dye is reduced in the presence of potassium tellurite, aztreonam, 1% NaCl, 1% sodium lactate, 4% NaCl, lithium chloride, pH 6, nalidixic acid, sodium butyrate, and sodium bromate but not in pH 5, 8% NaCl, fusidic acid, D-serine, troleandomycin, rifamycin SV, minocycline, lincomycin, guanidine HCl, niaproof 4, vancomycin, tetrazolium violet, tetrazolium blue, lithium chloride, aztreonam, and sodium bromate.

Nitrate reduction and indole production are negative (API 20NE). In the API 20NE and ID 32GN systems, positive for arginine dihydrolase, urease, esculin hydrolysis, gelatin hydrolysis, β-galactosidase, *N*-acetyl-glucosamine, D-ribose, D-saccharose (sucrose), D-maltose, L-alanine, glycogen, 3-hydroxybenzoic acid, D-mannitol, salicin, D-melibiose, valeric acid, L-histidine, 3-hydroxybutyric acid, and 4-hydroxybenzoic acid. Negative for glucose fermentation, L-arabinose, D-mannose,

N-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate, phenylacetic acid, L-rhamnose, inositol, itaconic acid, suberic acid, sodium malonate, sodium acetate, lactic acid, potassium 5-ketogluconate, L-serine, D-glucose, D-fucose, D-sorbitol, L-arabinose, propionic acid, potassium 2-ketogluconate, and L-proline.

Strain 17J80-6 (=NIBRBAC000500502) was isolated from a soil sample, Jeju-do, Korea.

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