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Unrecorded bacterial species from Korea in 2024: Taxonomic overview of 90 strains belonging to *Actinomycetota*, *Bacillota*, *Bacteroidota*, and *Verrucomicrobiota*

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This study summarizes the results of a nationwide survey aimed at documenting indigenous prokaryotic diversity in the Republic of Korea. A total of 90 previously unrecorded bacterial species were isolated through cultivation-based approaches from breast milk, seawater, sea sediments, freshwater sediments, soils, tidal flats, and wetlands. These environments represent diverse ecological niches shaped by salinity gradients, nutrient conditions, environmental stress, and anthropogenic influence, all of which contribute to the formation of complex and underexplored microbial communities. Taxonomic characterization of the isolates expands current knowledge of Korea's indigenous microbiota and provides essential baseline information for future taxonomic, ecological, and environmental microbiology studies. High 16S rRNA gene sequence similarity (>98.7%) and robust phylogenetic clustering with nearest relatives confirmed assignment of each strain to a predefined bacterial species. The 90 species were distributed across 4 phyla, 7 classes, 19 orders, 28 families, and 45 genera, including representatives of the phyla *Bacteroidota*, *Actinomycetota*, *Bacillota*, and *Verrucomicrobiota*. These taxa encompass diverse metabolic and ecological traits, reflecting the environmental heterogeneity of the sampling sites. Gram-staining characteristics, colony and cell morphologies, basic biochemical features, isolation sources, and strain identifiers are summarized in the species description section.

Keywords: 16S rRNA gene, bacterial diversity, indigenous prokaryotic species of Korea, unrecorded bacterial species

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Introduction

The phylum *Actinomycetota* represents a broadly distributed bacterial lineage frequently detected in soil, freshwater, marine habitats, and various host-associated environments (Goodfellow *et al*., 2012; Kim *et al*., 2021). Members of this group are typically Gram-stain-positive and exhibit rod-shaped or filamentous cell morphologies. *Actinomycetota* are well known for producing diverse secondary metabolites, and many clinically used antibiotics

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originate from this phylum (Naikpatil and Rathod, 2011). The genus *Streptomyces* is especially prominent due to its ecological abundance and metabolic versatility, whereas non-*Streptomyces* taxa are often categorized as "rare *Actinomycetota*" (Amin *et al*., 2020).

The phylum *Bacillota* includes Gram-stain-positive bacteria with generally low G+C contents and simple cellular structures (Gibbons and Murray, 1978; Qin *et al*., 2010). Species of this lineage occur in a wide range of environments such as soil, water, and animal gastrointestinal tracts. Many members play roles in fermentation, nutrient turnover, and other metabolic activities, and some can form endospores or display motility via flagella (Gibbons and Murray, 1978). This phylum contains taxa of industrial and medical relevance, including lactic acid-producing bacteria and pathogenic clostridia (Dworkin *et al*., 2006).

The phylum *Bacteroidota* was established to include phenotypically diverse Gram-stain-negative bacteria lacking endospore formation (Krieg *et al*., 2012). Members of this phylum comprise aerobic and anaerobic heterotrophs, chemolithotrophs, and methylotrophs, and some species are capable of nitrogen fixation. They inhabit a wide variety of terrestrial and aquatic environments, as well as extreme habitats and host-associated niches. In Korea, several unrecorded species within this phylum have been reported, with genera such as *Chryseobacterium*, *Flavobacterium*, *Mucilaginibacter*, and *Pedobacter* frequently observed (Cho *et al*., 2018; Lee *et al*., 2018; Maeng *et al*., 2018).

The phylum *Verrucomicrobiota* comprises bacterial groups detected primarily in soil and freshwater ecosystems (Hedlund, 2010). Although many of its members remain poorly characterized, environmental studies consistently report their presence, suggesting ecological relevance within natural microbial communities.

In 2024, as part of the National Institute of Biological Resources (NIBR) project for the survey and discovery of indigenous prokaryotic resources, extensive cultivation-based investigations were conducted across diverse environments in Korea. During this program, numerous previously unrecorded bacterial strains belonging to four phyla—*Actinomycetota*, *Bacillota*, *Bacteroidota*, and *Verrucomicrobiota*—were isolated and subjected to taxonomic characterization. Through these efforts, a total of 90 unrecorded species were identified, and their taxonomic features are presented in this study.

Materials and Methods

A total of 90 bacterial strains belonging to the classes *Actinomycetia*, *Bacilli*, *Chitinophagia*, *Cytophagia*, *Flavobacteriia*, *Sphingobacteriia* and *Verrucomicrobiae* were isolated from breast milk, sea sediment, seawater, sediment, soil, tidal flat and wetland samples. Mud, seawater, sediment and soil samples were processed independently and spread onto a diverse set of media, including R2A, ISP2, MA 2216, GYE, BHI, MRS, SCA, PTYG, TSB and NA, and all inoculated plates were incubated at 25 and 30°C for 5–10 days. The specific culture medium used for each strain—based on the individual medium list provided (e.g., ISP2, R2A, MA 2216, GYE, TSB, BHI, SCA, PTYG, MRS and NA)—together with the strain IDs, environmental sources and cultivation conditions is summarized in Table 1. All strains were purified as single colonies and preserved as 20–25% (w/v) glycerol suspensions at −80°C as well as in lyophilized ampoules.

Cellular morphology was assessed after incubating the cultures on agar plates for 2–5 days at their optimal growth temperature. The overall cell shape and dimensions were visualized using both scanning and transmission electron microscopy. Gram reactions were determined with a commercial Gram-staining kit, following the manufacturer's protocol. Physiological and biochemical traits were analysed with the API 20NE system (bioMérieux) in accordance with the instructions provided.

Genomic DNA from each bacterial strain was isolated and used as a template for PCR amplification of the 16S rRNA gene following the procedures described by Lane (1991). The resulting sequences from the 90 isolates were compared with those in the GenBank database using BLASTN, and additional taxonomic identification was performed through the EzBioCloud platform (Yoon *et al*., 2017). Sequence alignments were generated with Clustal_X (Thompson *et al*., 1997), and ambiguous regions or gaps were refined manually in BioEdit (Hall, 1999). Evolutionary distances were estimated according to the Kimura two-parameter substitution model (Kimura, 1983). Phylogenetic trees were reconstructed using the neighbor-joining algorithm (Saitou, 1987) implemented in MEGA X (Kumar *et al*., 2018), and the reliability of the branching patterns was assessed by bootstrap analysis with 1,000 replicates (Felsenstein, 1985).

Results and Discussion

The 90 strains were distributed in 7 classes of the *Actinomycetia*, *Bacilli*, *Chitinophagia*, *Cytophagia*, *Flavobacteriia*, *Sphingobacteriia*, and *Verrucomicrobiae*; 64 strains for the class *Actinomycetia*, 12 strains for the *Bacilli*, 1 strain for the *Chitinophagia*, 1 strain for the *Cytophagia*, 5 strains for the *Flavobacteriia*, 5 strains for the *Sphingobacteriia*, and 2 strains for the *Verrucomicrobiae* (Table 1). These strains were Gram-staining-negative or positive, chemoheterotrophic, rod, short-rod, or coccoid shaped showing in Fig. 1.

The strains belonging to the phylum *Actinomycetota* (Figs. 2 and 3) were assigned to a single class (*Actinomy-*

Table 1. The taxonomic affiliations of isolated strains belonging to the classes *Actinomycetia*, *Bacilli*, *Chitinophagia*, *Cytophagia*, *Flavobacteriia*, *Sphingobacteriia*, and *Verrucomicrobiae*.

Class	Order	Family	Strain ID	NIBR ID	Most closely related species	Similarity	Isolation source	Isolation site	Medium	Incubation conditions (°C, days)
Actinomycetia	*Catenulisporales*	*Catenulisporaceae*	MMS24-W30	NIBRBAC000512951	*Catenulispora yoronensis*	98.96	Soil	Jeju-si	ISP2	30°C, 7 days
Actinomycetia	*Cellulomonadales*	*Cellulomonadaceae*	B3	NIBRBAC000512882	*Cellulomonas uda*	99.65	Soil	Seoul	R2A	30°C, 3 days
Actinomycetia	*Cellulomonadales*	*Jonesiaceae*	CAU 1763	NIBRBAC000512768	*Flavimobilis marinus*	99.52	Sea sediment	Gangneung-si	MA	30°C, 3 days
Actinomycetia	*Cellulomonadales*	*Promicromonosporaceae*	CAU 1767	NIBRBAC000512771	*Cellulosimicrobium marinum*	99.31	Sea sediment	Gangneung-si	GYE	30°C, 3 days
Actinomycetia	*Cellulomonadales*	*Promicromonosporaceae*	JJUV-9	NIBRBAC000513023	*Krasilnikoviella muralis*	99.54	Soil	Jeju-si	R2A	25°C, 3 days
Actinomycetia	*Demequinales*	*Demequinaceae*	MBLB4913	NIBRBAC000512843	*Demequina soli*	98.98	Soil	Yeonggwang-gun	MA	30°C, 3 days
Actinomycetia	*Dermatophilales*	*Intrasporangiaceae*	NJ-19	NIBRBAC000513021	*Intrasporangium mesophilum*	99.58	Soil	Naju-si	R2A	25°C, 3 days
Actinomycetia	*Dermatophilales*	*Intrasporangiaceae*	HC149	NIBRBAC000512712	*Phycicoccus avicenniae*	98.96	Soil	Hongcheon-gun	R2A	28°C, 5 days
Actinomycetia	*Geodermatophilales*	*Geodermatophilaceae*	CW007	NIBRBAC000512695	*Blastococcus aurantiacus*	100.00	Soil	Cheorwon-gun	R2A	28°C, 3 days
Actinomycetia	*Geodermatophilales*	*Geodermatophilaceae*	CW061	NIBRBAC000512699	*Blastococcus fimeti*	99.58	Soil	Cheorwon-gun	R2A	28°C, 5 days
Actinomycetia	*Geodermatophilales*	*Geodermatophilaceae*	HW067	NIBRBAC000512718	*Blastococcus haudaquaticus*	99.36	Soil	Hongcheon-gun	R2A	28°C, 3 days
Actinomycetia	*Geodermatophilales*	*Geodermatophilaceae*	CW069	NIBRBAC000512700	*Geodermatophilus obscurus*	98.82	Soil	Cheorwon-gun	R2A	28°C, 3 days
Actinomycetia	*Geodermatophilales*	*Geodermatophilaceae*	HW128	NIBRBAC000512721	*Geodermatophilus pulveris*	98.82	Soil	Hongcheon-gun	R2A	28°C, 3 days
Actinomycetia	*Microbacteriales*	*Microbacteriaceae*	SBCC-2363	NIBRBAC000512871	*Curtobacterium caseinilyticum*	100.00	Tidal flat	Hongseong-gun	R2A	25°C, 3–5 days
Actinomycetia	*Microbacteriales*	*Microbacteriaceae*	CAU 1762	NIBRBAC000512767	*Leucobacter chromiiresistens*	99.52	Sea sediment	Gangneung-si	GYE	30°C, 3 days
Actinomycetia	*Micrococcales*	*Micrococcaceae*	MMS24-T94	NIBRBAC000512961	*Arthrobacter deserti*	98.87	Soil	Jeju-si	R2A	30°C, 7 days
Actinomycetia	*Micrococcales*	*Micrococcaceae*	MBLB4423	NIBRBAC000512827	*Arthrobacter oryzae*	99.19	Soil	Inje-gun	TSB	30°C, 3 days
Actinomycetia	*Micrococcales*	*Micrococcaceae*	SBCC-2548	NIBRBAC000512866	*Pseudarthrobacter albicanus*	99.43	Soil	Yeoncheon-gun	R2A	25°C, 5-7 days
Actinomycetia	*Micromonosporales*	*Micromonosporaceae*	HN2UV-2	NIBRBAC000513045	*Actinoplanes consettensis*	99.93	Soil	Hanam-si	R2A	25°C, 3 days
Actinomycetia	*Micromonosporales*	*Micromonosporaceae*	MMS24-N24	NIBRBAC000512956	*Actinoplanes couchii*	99.56	Soil	Chuncheon-si	R2A	30°C, 7 days
Actinomycetia	*Micromonosporales*	*Micromonosporaceae*	MMS24-N6	NIBRBAC000512957	*Actinoplanes rectilineatus*	100.00	Soil	Chuncheon-si	R2A	30°C, 6 days
Actinomycetia	*Micromonosporales*	*Micromonosporaceae*	HW046	NIBRBAC000512717	*Catellatospora bangladeshensis*	99.03	Soil	Hongcheon-gun	R2A	28°C, 3 days
Actinomycetia	*Micromonosporales*	*Micromonosporaceae*	1-1-1	NIBRBAC000513016	*Catellatospora sichuanensis*	98.89	Soil	Incheon	R2A	25°C, 3 days
Actinomycetia	*Micromonosporales*	*Micromonosporaceae*	AN1209	NIBRBAC000513028	*Couchioplanes caeruleus* subsp. *caeruleus*	99.38	Soil	Anseong-si	R2A	25°C, 3 days
Actinomycetia	*Mycobacteriales*	*Corynebacteriaceae*	16H2M10	NIBRBAC000512641	*Corynebacterium gallinarum*	99.65	Sediment	Guri-si	R2A	30°C, 3 days
Actinomycetia	*Mycobacteriales*	*Corynebacteriaceae*	1-1-8	NIBRBAC000513018	*Corynebacterium propinquum*	99.86	Soil	Incheon	R2A	25°C, 3 days
Actinomycetia	*Mycobacteriales*	*Gordoniaceae*	B18	NIBRBAC000512883	*Gordonia paraffinivorans*	99.86	Soil	Seoul	R2A	30°C, 3 days
Actinomycetia	*Mycobacteriales*	*Mycobacteriaceae*	CW224	NIBRBAC000512704	*Mycobacterium doricum*	98.75	Soil	Cheorwon-gun	R2A	28°C, 3 days
Actinomycetia	*Mycobacteriales*	*Mycobacteriaceae*	CW016	NIBRBAC000512696	*Mycobacterium gadium*	98.81	Soil	Cheorwon-gun	R2A	28°C, 2 days
Actinomycetia	*Mycobacteriales*	*Mycobacteriaceae*	CW227	NIBRBAC000512705	*Mycobacterium neglectum*	99.29	Soil	Cheorwon-gun	R2A	28°C, 3 days
Actinomycetia	*Mycobacteriales*	*Mycobacteriaceae*	HC045	NIBRBAC000512711	*Mycobacterium rhodesiae*	98.88	Soil	Hongcheon-gun	R2A	28°C, 2 days
Actinomycetia	*Mycobacteriales*	*Nocardiaceae*	G1-7	NIBRBAC000512891	*Nocardia asteroides*	99.93	Soil	Gimpo-si	R2A	30°C, 3 days
Actinomycetia	*Mycobacteriales*	*Nocardiaceae*	HC162	NIBRBAC000512713	*Nocardia exalbida*	98.89	Soil	Hongcheon-gun	R2A	28°C, 2 days
Actinomycetia	*Mycobacteriales*	*Nocardiaceae*	BS-22-B	NIBRBAC000513026	*Nocardia ignorata*	99.06	Wetland	Busan	R2A	25°C, 3 days
Actinomycetia	*Mycobacteriales*	*Nocardiaceae*	HC032	NIBRBAC000512709	*Nocardia noduli*	99.79	Soil	Hongcheon-gun	R2A	28°C, 2 days
Actinomycetia	*Mycobacteriales*	*Nocardiaceae*	MBLB4522	NIBRBAC000512828	*Rhodococcus oryzae*	99.33	Soil	Inje-gun	R2A	15°C, 5 days
Actinomycetia	*Propionibacteriales*	*Nocardioidaceae*	MMS24-I5-19	NIBRBAC000512955	*Mumia quercus*	99.37	Soil	Seogwipo-si	BHI	30°C, 7 days

Table 1. Continued.

Class	Order	Family	Strain ID	NIBR ID	Most closely related species	Similarity	Isolation source	Isolation site	Medium	Incubation conditions (°C, days)
Actinomycetia	*Propionibacteriales*	*Nocardioidaceae*	SBCC-2329	NIBRBAC000512869	*Nocardioides fonticola*	98.99	Tidal flat	Yeosu-si	MA	25°C, 7 days
Actinomycetia	*Propionibacteriales*	*Nocardioidaceae*	HW118	NIBRBAC000512719	*Nocardioides stalactiti*	98.75	Soil	Hongcheon-gun	R2A	28°C, 3 days
Actinomycetia	*Propionibacteriales*	*Propionibacteriaceae*	CAU 1780	NIBRBAC000512785	*Enemella evansiae*	100.00	Soil	Gangneung-si	MA	30°C, 3 days
Actinomycetia	*Propionibacteriales*	*Propionibacteriaceae*	HW201	NIBRBAC000512726	*Microlunatus okinawensis*	99.51	Soil	Hongcheon-gun	R2A	28°C, 3 days
Actinomycetia	*Propionibacteriales*	*Propionibacteriaceae*	CW071	NIBRBAC000512701	*Microlunatus phosphovorus*	98.75	Soil	Cheorwon-gun	R2A	28°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	MMS24-JH4	NIBRBAC000512950	*Streptomyces luomodiensis*	99.10	Soil	Seogwipo-si	SCA	30°C, 7 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	SBCC-2597	NIBRBAC000512873	*Kitasatospora gansuensis*	98.80	Soil	Yeoncheon-gun	R2A	25°C, 7–10 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	KH11-5	NIBRBAC000513022	*Kitasatospora phosalacinea*	99.72	Soil	Incheon	R2A	25°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	MMS24-B12	NIBRBAC000512966	*Kitasatospora putterlickiae*	99.38	Soil	Seogwipo-si	R2A	30°C, 6 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	YH2UV-6	NIBRBAC000513044	*Sphaerisporangium aureirubrum*	98.73	Soil	Daegu	R2A	25°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	CAU 1773	NIBRBAC000512775	*Streptomyces antimycoticus*	99.93	Soil	Pocheon-si	GYE	30°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	KH11-2	NIBRBAC000513037	*Streptomyces abietis*	99.93	Soil	Incheon	R2A	25°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	SE5004	NIBRBAC000512994	*Streptomyces barringtoniae*	98.90	Soil	Wonju-si	PTYG	28°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	MMS24-I2-45	NIBRBAC000512954	*Streptomyces bauhiniae*	99.79	Soil	Jeju-si	SCA	30°C, 7 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	BS-63-A	NIBRBAC000513038	*Streptomyces fildesensis*	99.17	Soil	Busan	R2A	25°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	MW16	NIBRBAC000512884	*Streptomyces kebangsaanensis*	99.65	Seawater	Incheon	TSB	30°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	KH11-9	NIBRBAC000513039	*Streptomyces kunmingensis*	98.95	Soil	Incheon	R2A	25°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	SBCC-2419	NIBRBAC000512874	*Streptomyces longhuiensis*	100.00	Tidal flat	Boryeong-si	R2A	25°C, 7 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	Y1	NIBRBAC000512893	*Streptomyces murinus*	99.93	Soil	Goyang-si	ISP2	30°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	MMS24-W25	NIBRBAC000512962	*Streptomyces palmae*	99.93	Soil	Jeju-si	R2A	30°C, 7 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	CW082	NIBRBAC000512702	*Streptomyces polychromogenes*	99.79	Soil	Cheorwon-gun	R2A	28°C, 2 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	SBCC-2340	NIBRBAC000512861	*Streptomyces sanyensis*	100.00	Tidal flat	Buan-gun	MA	25°C, 5-7 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	MMS24-B14	NIBRBAC000512949	*Streptomyces shaanxiensis*	99.30	Soil	Seogwipo-si	SCA	30°C, 7 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	HC010	NIBRBAC000512708	*Streptomyces sporoverrucosus*	99.86	Soil	Hongcheon-gun	R2A	28°C, 3 days
Actinomycetia	*Streptomycetales*	*Streptomycetaceae*	HC264	NIBRBAC000512716	*Streptomyces vinaceus*	99.86	Soil	Hongcheon-gun	R2A	28°C, 3 days
Actinomycetia	*Streptosporangiales*	*Streptosporangiaceae*	MMS24-I3-26	NIBRBAC000512948	*Nonomuraea sediminis*	99.37	Soil	Jeju-si	SCA	30°C, 7 days
Actinomycetia	*Streptosporangiales*	*Streptosporangiaceae*	MMS24-T82	NIBRBAC000512963	*Nonomuraea wenchangensis*	99.79	Soil	Jeju-si	R2A	30°C, 6 days
Bacilli	*Bacillales*	*Bacillaceae*	GR1UV-10	NIBRBAC000513041	*Bacillus cereus*	100.00	Soil	Gangneung-si	R2A	25°C, 3 days
Bacilli	*Bacillales*	*Bacillaceae*	16S4S4	NIBRBAC000512637	*Bacillus stercoris*	99.8	Sediment	Yangpyeong-gun	R2A	30°C, 3 days
Bacilli	*Bacillales*	*Bacillaceae*	SBCC-2510	NIBRBAC000512864	*Pseudalkalibacillus salsuginis*	99.25	Tidal flat	Taean-gun	MA	25°C, 7 days
Bacilli	*Bacillales*	*Bacillaceae*	SBCC-2540	NIBRBAC000512865	*Rossellomorea arthrocnemi*	99.25	Tidal flat	Taean-gun	MA	25°C, 5 days
Bacilli	*Bacillales*	*Paenibacillaceae*	CAU 1781	NIBRBAC000512786	*Gorillibacterium massiliense*	99.29	Soil	Incheon	NA	30°C, 3 days
Bacilli	*Bacillales*	*Paenibacillaceae*	SBCC-2362	NIBRBAC000512870	*Paenibacillus allorhizoplanae*	99.24	Tidal flat	Taean-gun	R2A	25°C, 7 days
Bacilli	*Bacillales*	*Paenibacillaceae*	HH149	NIBRBAC000512996	*Paenibacillus kobensis*	98.91	Soil	Hongcheon-gun	R2A	28°C, 4 days
Bacilli	*Bacillales*	*Paenibacillaceae*	MBLB4623	NIBRBAC000512829	*Paenibacillus luteus*	99.22	Soil	Inje-gun	R2A	15°C, 5 days
Bacilli	*Bacillales*	*Paenibacillaceae*	MBLB4462	NIBRBAC000512830	*Paenibacillus marchantiophytorum*	98.94	Soil	Inje-gun	R2A	30°C, 3 days
Bacilli	*Bacillales*	*Paenibacillaceae*	BSUV-10	NIBRBAC000513029	*Paenibacillus pseudetheri*	99.78	Soil	Busan	R2A	25°C, 3 days

Table 1. Continued.

Class	Order	Family	Strain ID	NIBR ID	Most closely related species	Similarity	Isolation source	Isolation site	Medium	Incubation conditions (°C, days)
Bacilli	*Bacillales*	*Paenibacillaceae*	CAU 1772	NIBRBAC000512774	*Paenibacillus algicola*	99.10	Seawater	Jeju-si	MA	30°C, 4 days
Bacilli	*Lactobacillales*	*Lactobacillaceae*	SBCC-2590	NIBRBAC000512876	*Lactobacillus gasseri*	100.00	Breast Milk	Suwon-si	MRS	30°C, 2-3 days
Chitinophagia	*Chitinophagales*	*Chitinophagaceae*	MMS24-M95	NIBRBAC000512960	*Chitinophaga jiangningensis*	99.44	Soil	Boryeong-si	R2A	30°C, 7 days
Cytophagia	*Cytophagales*	*Cyclobacteriaceae*	SBCC-2388	NIBRBAC000512867	*Belliella aquatica*	99.93	Tidal flat	Yeosu-si	MA	25°C, 7 days
Flavobacteriia	*Flavobacteriales*	*Flavobacteriaceae*	HW162	NIBRBAC000512722	*Flavobacterium geliluteum*	98.92	Soil	Hongcheon-gun	R2A	28°C, 3 days
Flavobacteriia	*Flavobacteriales*	*Flavobacteriaceae*	CAU 1765	NIBRBAC000512770	*Salinimicrobium oceani*	99.72	Sea sediment	Gangneung-si	MA	30°C, 3 days
Flavobacteriia	*Flavobacteriales*	*Weeksellaceae*	MMS24-S12	NIBRBAC000512965	*Chryseobacterium indoltheticum*	98.85	Soil	Seogwipo-si	R2A	30°C, 6 days
Flavobacteriia	*Flavobacteriales*	*Weeksellaceae*	GYM17	NIBRBAC000512635	*Chryseobacterium lacus*	99.93	Soil	Anseong-si	R2A	30°C, 3 days
Flavobacteriia	*Flavobacteriales*	*Weeksellaceae*	16H3F4	NIBRBAC000512643	*Chryseobacterium potabilaquae*	100.00	Sediment	Seoul	R2A	30°C, 3 days
Sphingobacteriia	*Sphingobacteriales*	*Sphingobacteriaceae*	MMS24-M19	NIBRBAC000512959	*Mucilaginibacter yixingensis*	99.85	Soil	Boryeong-si	R2A	30°C, 7 days
Sphingobacteriia	*Sphingobacteriales*	*Sphingobacteriaceae*	MMS24-I3-10	NIBRBAC000512952	*Pedobacter heparinus*	99.37	Soil	Jeju-si	SCA	30°C, 7 days
Sphingobacteriia	*Sphingobacteriales*	*Sphingobacteriaceae*	BS-59	NIBRBAC000513032	*Pedobacter nutrimenti*	99.16	Soil	Busan	R2A	25°C, 3 days
Sphingobacteriia	*Sphingobacteriales*	*Sphingobacteriaceae*	HC123	NIBRBAC000512995	*Pedobacter yulinensis*	99.52	Soil	Hongcheon-gun	R2A	28°C, 4 days
Sphingobacteriia	*Sphingobacteriales*	*Sphingobacteriaceae*	MMS24-Q19	NIBRBAC000512953	*Sphingobacterium pakistanense*	98.82	Soil	Daejeon	R2A	30°C, 7 days
Verrucomicrobiae	*Verrucomicrobiales*	*Luteolibacter_f*	MMS24-K3	NIBRBAC000512946	*Luteolibacter arcticus*	99.36	Soil	Seogwipo-si	R2A	30°C, 7 days
Verrucomicrobiae	*Verrucomicrobiales*	*Luteolibacter_f*	HC177	NIBRBAC000512714	*Luteolibacter rhizosphaerae*	98.88	Soil	Hongcheon-gun	R2A	28°C, 2 days

cetia) and distributed across 30 distinct genera: *Catenulispora* (1 species), *Cellulomonas* (1 species), *Flavimobilis* (1 species), *Cellulosimicrobium* (1 species), *Krasilnikoviella* (1 species), *Demequina* (1 species), *Intrasporangium* (1 species), *Phycicoccus* (1 species), *Blastococcus* (3 species), *Geodermatophilus* (2 species), *Curtobacterium* (1 species), *Leucobacter* (1 species), *Arthrobacter* (2 species), *Pseudarthrobacter* (1 species), *Actinoplanes* (3 species), *Catellatospora* (2 species), *Couchioplanes* (1 species), *Corynebacterium* (2 species), *Gordonia* (1 species), *Mycobacterium* (4 species), *Nocardia* (4 species), *Rhodococcus* (1 species), *Mumia* (1 species), *Nocardioides* (2 species), *Enemella* (1 species), *Microlunatus* (2 species), *Streptomyces* (16 species), *Kitasatospora* (3 species), *Sphaerisporangium* (1 species), and *Nonomuraea* (2 species).

The strains belonging to the phylum *Bacillota* (Fig. 4) were assigned to a single class (*Bacilli*) and distributed across six distinct genera: *Bacillus* (2 species), *Pseudalkalibacillus* (1 species), *Rossellomorea* (1 species), *Gorillibacterium* (1 species), *Paenibacillus* (6 species), and *Lactobacillus* (1 species).

The remaining strains affiliated with the phyla *Bacteroidota* and *Verrucomicrobiota* (Fig. 5) were distributed across five orders (*Chitinophagales*, *Cytophagales*, *Flavobacteriales*, *Sphingobacteriales*, and *Verrucomicrobiales*) and nine distinct genera: *Chitinophaga* (1 species), *Belliella* (1 species), *Flavobacterium* (1 species), *Salinimicrobium* (1 species), *Chryseobacterium* (3 species), *Mucilaginibacter* (1 species), *Pedobacter* (3 species), *Sphingobacterium* (1 species), and *Luteolibacter* (2 species).

Here we report 90 unrecorded bacterial species in Korea belonging to 7 classes of 4 phyla.

Description of *Catenulispora yoronensis* MMS24-W30

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular, wrinkled, hard and yellow-colored after 7 days incubation on ISP2 at 30°C. In the API 20NE system, positive for esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-mannitol and D-maltose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of L-arabinose, D-mannose, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MMS24-W30 (=NIBRBAC 000512951) was isolated from soil in Hallim-eup, Jeju-si, Jeju-do, Republic of Korea (33°21′20.7″N, 126°18′21.2″E).

Description of *Cellulomonas uda* B3

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular, low convex and ivory-colored after 3 days incubation on R2A at 30°C. In the

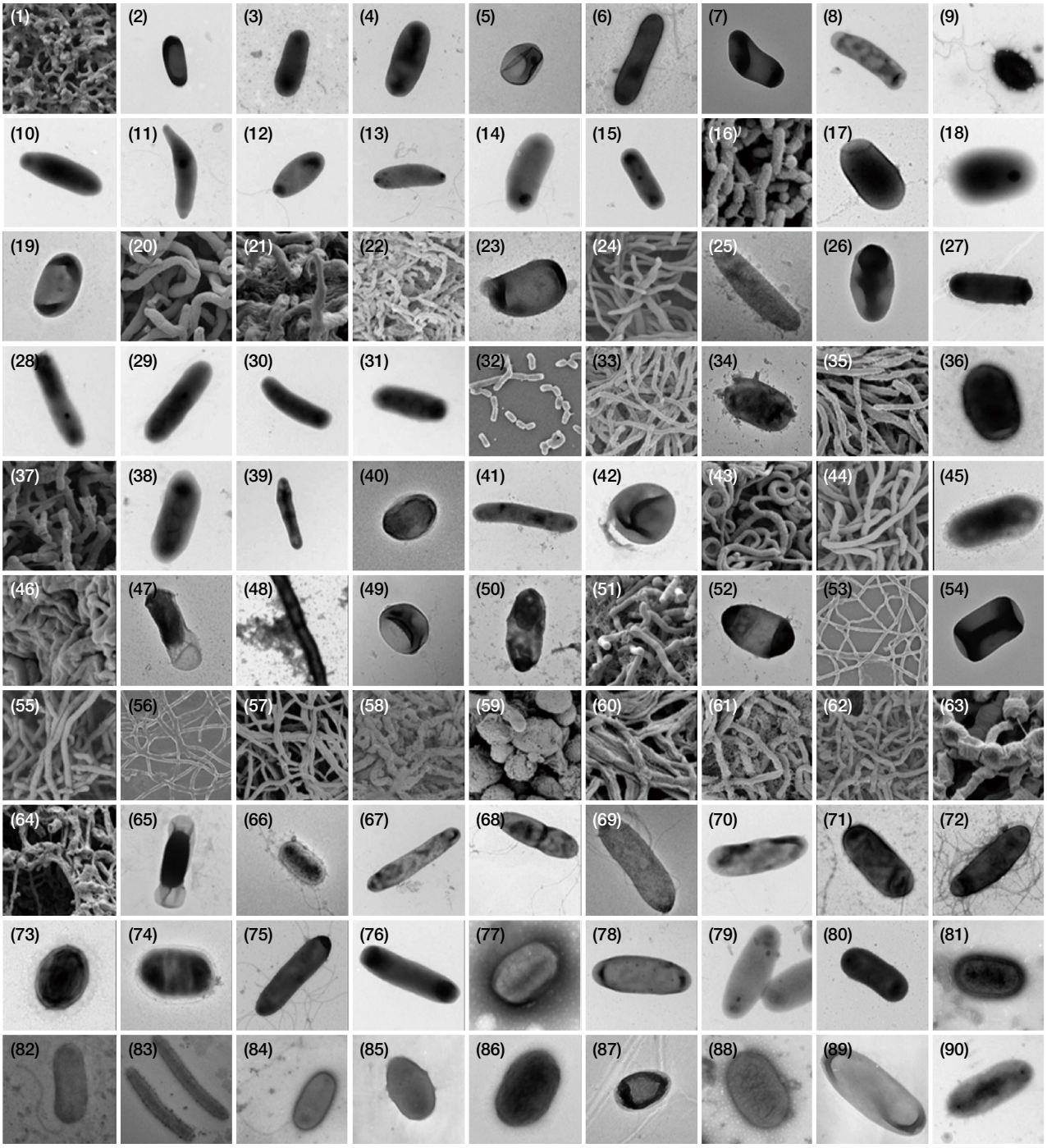

Fig. 1. Scanning electron micrographs and transmission electron micrographs of cells of the strains isolated in this study. Strains: 1, MMS24-W30; 2, B3; 3, CAU 1763; 4, CAU 1767; 5, JJUV-9; 6, MBLB4913; 7, NJ-19; 8, HC149; 9, CW007; 10, CW061; 11, HW067; 12, CW069; 13, HW128; 14, SBCC-2363; 15, CAU 1762; 16, MMS24-T94; 17, MBLB4423; 18, SBCC-2548; 19, HN2UV-2; 20, MMS24-N24; 21, MMS24-N6; 22, HW046; 23, 1-1-1; 24, AN1209; 25, 16H2M10; 26, 1-1-8; 27, B18; 28, CW224; 29, CW016; 30, CW227; 31, HC045; 32, G1-7; 33, HC162; 34, BS-22-B; 35, HC032; 36, MBLB4522; 37, MMS24-I5-19; 38, SBCC-2329; 39, HW118; 40, CAU 1780; 41, HW201; 42, CW071; 43, MMS24-JH4; 44, SBCC-2597; 45, KH11-5; 46, MMS24-B12; 47, YH2UV-6; 48, CAU 1773; 49, KH11-2; 50, SE5004; 51, MMS24-I2-45; 52, BS-63-A; 53, MW16; 54, KH11-9; 55, SBCC-2419; 56, Y1; 57, MMS24-W25; 58, CW082; 59, SBCC-2340; 60, MMS24-B14; 61, HC010; 62, HC264; 63, MMS24-I3-26; 64, MMS24-T82; 65, GR1UV-10; 66, 16S4S4; 67, SBCC-2510; 68, SBCC-2540; 69, CAU 1781; 70, SBCC-2362; 71, HH149; 72, MBLB4623; 73, MBLB4462; 74, BSUV-10; 75, CAU 1772; 76, SBCC-2590; 77, MMS24-M95; 78, SBCC-2388; 79, HW162; 80, CAU 1765; 81, MMS24-S12; 82, GYM17; 83, 16H3F4; 84, MMS24-M19; 85, MMS24-I3-10; 86, BS-59; 87, HC123; 88, MMS24-Q19; 89, MMS24-K3; 90, HC177.

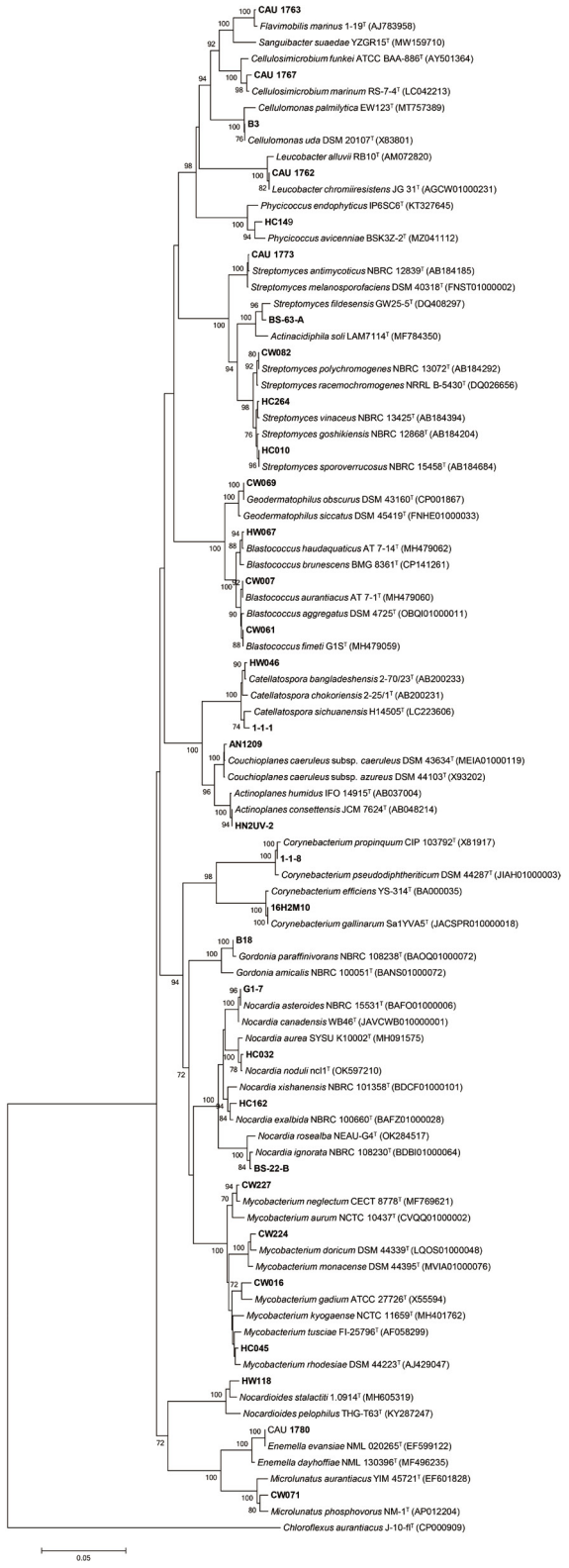

Fig. 2. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences, showing the relationship between the strains in the phylum *Actinomycetota*. Bootstrap values (>60%) based on 1,000 replications are shown on the branches. The tree was constructed using the neighbor-joining method. Bar, 0.02 substitutions per nucleotide position.

API 20NE system, positive for nitrate reduction, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose and D-maltose, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis utilization of D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain B3 (=NIBRBAC000512882) was isolated from soil in Yeongdeungpo-gu, Seoul, Republic of Korea (37°49′98.8″N, 126°90′52.4″E).

Description of *Flavimobilis marinus* CAU 1763

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular, smooth, entire, convex, transparent and yellow-colored after 3 days incubation on MA at 30°C. In the API 20NE system, positive for nitrate reduction and esculin hydrolysis, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CAU 1763 (=NIBRBAC000512768) was isolated from sea sediment in Gangneung-si, Gangwon-do, Republic of Korea (37°83′87.7″N, 128°87′66.4″E).

Description of *Cellulosimicrobium marinum* CAU 1767

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular, smooth, entire, convex, opaques and yellow-colored after 3 days incubation on GYE at 30°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-maltose and potassium gluconate, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of D-mannitol, *N*-acetyl-D-glucosamine, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CAU 1767 (=NIBRBAC000512771) was isolated from sea sediment in Gangneung-si, Gangwon-do, Republic of Korea (37°83′87.7″N, 128°87′66.4″E).

Description of *Krasilnikoviella muralis* JJUV-9

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are circular, slightly convex, entire and yellow-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for nitrate reduction, glucose acidification, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-mannose, *N*-acetyl-D-glucosamine, D-maltose and potassium gluconate, but negative for indole production, arginine dihydrolase, urease activity, utilization of L-arab-

inose, D-mannitol, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain JJUV-9 (=NIBRBAC000513023) was isolated from soil in Aewol-eup, Jeju-si, Jeju-do, Republic of Korea (33°25′58.2″N, 126°19′16.0″E).

Description of *Demequina soli* MBLB4913

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are round, entire, raised, smooth and yellow-colored after 3 days incubation on MA at 30°C. In the API 20NE system, positive for esculin hydrolysis and β-galactosidase activity, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MBLB4913 (=NIBRBAC000512843) was isolated from soil in Yeonggwang-gun, Jeollanam-do, Republic of Korea (35°16′59.6″N, 126°20′05.3″E).

Description of *Intrasporangium mesophilum* NJ-19

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular, slightly convex, entire, opaque and cream-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for esculin hydrolysis, gelatin hydrolysis and β-galactosidase activity, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain NJ-19 (=NIBRBAC 000513021) was isolated from soil in Naju-si, Jeollanam-do, Republic of Korea (34°57′51.4″N, 126°51′19.8″E).

Description of *Phycicoccus avicenniae* HC149

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are round, entire, flat and cream-colored after 5 days incubation on R2A at 28°C. In the API 20NE system, positive for utilization of L-arabinose and D-maltose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain HC149 (=NIBRBAC 000512712) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (37°43′30.1″N, 127°56′ 33.4″E).

Description of *Blastococcus aurantiacus* CW007

Cells are Gram-staining-positive, flagellated and oval-shaped. Colonies are round, entire, flat and pale orange-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for esculin hydrolysis and β-galactosidase activity, utilization of D-glucose, potassium gluconate and adipic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, capric acid, malic acid, trisodium citrate and phenylacetic acid. Strain CW007 (=NIBRBAC000 512695) was isolated from soil in Cheorwon-gun, Gangwon-do, Republic of Korea (38°08′46.9″N, 127°17′43.1″E).

Description of *Blastococcus fimeti* CW061

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are round, entire, flat and pale pink-colored after 5 days incubation on R2A at 28°C. In the API 20NE system, positive for β-galactosidase activity, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CW061 (=NIBRBAC000512699) was isolated from soil in Cheorwon-gun, Gangwon-do, Republic of Korea (38°08′46.9″N, 127°17′43.1″E).

Description of *Blastococcus haudaquaticus* HW067

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are round, entire, raised and pale orange-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for utilization of D-glucose, L-arabinose, potassium gluconate and malic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain HW067 (=NIBR BAC000512718) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (38°09′23.1″N, 127° 39′21.9″E).

Description of *Geodermatophilus obscurus* CW069

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are round, entire, flat and ivory-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for utilization of D-glucose, L-arabinose and D-mannitol, but negative for nitrate reduction, indole

production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-mannose, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CW069 (=NIBRBAC000512700) was isolated from soil in Cheorwon-gun, Gangwon-do, Republic of Korea (38°08′46.9″N, 127°17′43.1″E).

Description of *Geodermatophilus pulveris* HW128

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are round, entire, flat and cream-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain HW128 (=NIBRBAC000512721) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (38°09′23.1″N, 127°39′21.9″E).

Description of *Curtobacterium caseinilyticum* SBCC-2363

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are circular to slightly irregular, smooth and vivid yellow-colored after 3–5 days incubation on R2A at 25°C. In the API 20NE system, positive for esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose and potassium gluconate, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain SBCC-2363 (=NIBRBAC000512871) was isolated from tidal flat in Hongseong-gun, Chungcheongnam-do, Republic of Korea (36°32′30″N, 126°28′08″E).

Description of *Leucobacter chromiiresistens* CAU 1762

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular, smooth, entire, convex and yellow-colored after 3 days incubation on GYE at 30°C. In the API 20NE system, positive for glucose acidification, arginine dihydrolase, esculin hydrolysis, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid and trisodium citrate, but negative for nitrate reduction, indole production, urease activity, β-galactosidase activity, utilization of capric acid, malic acid and phenylacetic acid. Strain CAU 1762 (=NIBRBAC000512767) was isolated from sea sediment in Gangneung-si, Gangwon-do, Republic of Korea (37°84′94.3″N, 128°87′71.5″E).

Description of *Arthrobacter deserti* MMS24-T94

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular and yellow-colored after 7 days incubation on R2A at 30°C. In the API 20NE system, positive for nitrate reduction, urease activity, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid, but negative for indole production, glucose acidification, arginine dihydrolase, esculin hydrolysis and utilization of *N*-acetyl-D-glucosamine. Strain MMS24-T94 (=NIBRBAC000512961) was isolated from soil in Hallim-eup, Jeju-si, Jeju-do, Republic of Korea (33°21′20.7″N, 126°18′21.2″E).

Description of *Arthrobacter oryzae* MBLB4423

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are round, entire, convex, smooth and cream-colored after 3 days incubation on TSB at 30°C. In the API 20NE system, positive for utilization of D-glucose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid and trisodium citrate, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, capric acid, malic acid and phenylacetic acid. Strain MBLB4423 (=NIBRBAC000512827) was isolated from soil in Inje-gun, Gangwon-do, Republic of Korea (37°25′54.7″N, 126°24′59.7″E).

Description of *Pseudarthrobacter albicanus* SBCC-2548

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are circular, slightly convex, smooth and milky white-colored after 5–7 days incubation on R2A at 25°C. In the API 20NE system, positive for nitrate reduction, urease activity, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, malic acid, trisodium citrate and phenylacetic acid, but negative for indole production, glucose acidification, arginine dihydrolase, esculin hydrolysis, gelatin hydrolysis, utilization of D-mannose, D-maltose, capric acid and adipic acid. Strain SBCC-2548 (=NIBRBAC000512866) was isolated from soil in Yeoncheon-gun, Gyeonggi-do, Republic of Korea (38°07′19″N, 127°15′54″E).

Description of *Actinoplanes consettensis* HN2UV-2

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are circular, flat, entire and brown-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for gelatin hydrolysis, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain HN2UV-2 (=NIBRBAC000513045) was isolated from soil in Hanam-si, Gyeonggi-do, Republic of Korea (37°31′17.0″N, 127°11′17.5″E).

Description of *Actinoplanes couchii* MMS24-N24

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are irregular edges, dry and brown orange-colored after 7 days incubation on R2A at 30°C. In the API 20NE system, positive for urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid and malic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, utilization of capric acid, trisodium citrate and phenylacetic acid. Strain MMS24-N24 (=NIBRBAC000512956) was isolated from soil in Chuncheon-si, Gangwon-do, Republic of Korea (37°47′31″N, 127°31′31″E).

Description of *Actinoplanes rectilineatus* MMS24-N6

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are irregular edges, dry and brown orange-colored after 6 days incubation on R2A at 30°C. In the API 20NE system, positive for urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid and trisodium citrate, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, utilization of capric acid and phenylacetic acid. Strain MMS24-N6 (=NIBRBAC000512957) was isolated from soil in Chuncheon-si, Gangwon-do, Republic of Korea (37°47′31″N, 127°31′31″E).

Description of *Catellatospora bangladeshensis* HW046

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are filamentous, umbonate and yellow to brown-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid and trisodium citrate, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-mannitol, capric acid and phenylacetic acid. Strain HW 046 (=NIBRBAC000512717) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (38°09′23.1″N, 127°39′21.9″E).

Description of *Catellatospora sichuanensis* 1-1-1

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are filamentous, convex, undulate and yellow-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for nitrate reduction, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 1-1-1 (=NIBRBAC000513016) was isolated from soil in Ganghwa-gun, Incheon, Republic of Korea (37°35′32.5″N, 126°27′27.2″E).

Description of *Couchioplanes caeruleus* subsp. *caeruleus* AN1209

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are Irregular, slightly convex, undulate and creamy white-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose and malic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of potassium gluconate, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain AN1209 (=NIBRBAC000513028) was isolated from soil in Anseong-si, Gyeonggi-do, Republic of Korea (37°01′02.6″N, 127°15′48.9″E).

Description of *Corynebacterium gallinarum* 16H2M10

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are Smooth, convex and yellow-colored after 3 days incubation on R2A at 30°C. In the API 20NE system, positive for nitrate reduction, glucose acidification, esculin hydrolysis, utilization of D-glucose, D-maltose, adipic acid, trisodium citrate and phenylacetic acid, but negative for indole production, arginine dihydrolase, urease activity, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannose, D-manni-

tol, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid and malic acid. Strain 16H2M10 (=NIBRBAC000 512641) was isolated from sediment in Guri-si, Gyeonggi-do, Republic of Korea (37°34′31.8″N, 127°09′38.2″E).

Description of *Corynebacterium propinquum* 1-1-8

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are punctiform, raised, entire and creamy white-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for nitrate reduction, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 1-1-8 (=NIBRBAC000513018) was isolated from soil in Ganghwa-gun, Incheon, Republic of Korea (37°35′32.5″N, 126°27′27.2″E).

Description of *Gordonia paraffinivorans* B18

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular, round and orange-colored after 3 days incubation on R2A at 30°C. In the API 20NE system, positive for nitrate reduction, urease activity, esculin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid, trisodium citrate and phenylacetic acid, but negative for indole production, glucose acidification, arginine dihydrolase, gelatin hydrolysis, β-galactosidase activity and utilization of capric acid. Strain B18 (=NIBRBAC000512 883) was isolated from soil in Yeongdeungpo-gu, Seoul, Republic of Korea (37°49′98.8″N, 126°90′52.4″E).

Description of *Mycobacterium doricum* CW224

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are round, entire, flat and pale yellow-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CW 224 (=NIBRBAC000512704) was isolated from soil in Cheorwon-gun, Gangwon-do, Republic of Korea (38°08′ 46.9″N, 127°17′43.1″E).

Description of *Mycobacterium gadium* CW016

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are round, entire, raised and pale yellow-colored after 2 days incubation on R2A at 28°C. In the API 20NE system, positive for utilization of D-mannitol, potassium gluconate and malic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-D-glucosamine, D-maltose, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain CW016 (=NIBRBAC000 512696) was isolated from soil in Cheorwon-gun, Gangwon-do, Republic of Korea (38°08′46.9″N, 127°17′43.1″E).

Description of *Mycobacterium neglectum* CW227

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are round, entire, raised and white-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for utilization of D-glucose, D-mannitol, potassium gluconate and malic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannose, *N*-acetyl-D-glucosamine, D-maltose, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain CW227 (=NIBRBAC000512 705) was isolated from soil in Cheorwon-gun, Gangwon-do, Republic of Korea (38°08′46.9″N, 127°17′43.1″E).

Description of *Mycobacterium rhodesiae* HC045

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are round, entire, raised and white-colored after 2 days incubation on R2A at 28°C. In the API 20NE system, positive for nitrate reduction, utilization of D-glucose, D-mannitol, potassium gluconate, adipic acid and malic acid, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannose, *N*-acetyl-D-glucosamine, D-maltose, capric acid, trisodium citrate and phenylacetic acid. Strain HC045 (=NIBRBAC000512711) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (37°43′30.1″N, 127°56′33.4″E).

Description of *Nocardia asteroides* G1-7

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are filamentous, adherent, chalky and creamy white-colored after 3 days incubation on R2A at 30°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, *N*-acetyl-D-glucosamine and adipic acid, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of L-arabinose, D-mannose, D-mannitol, D-

maltose, potassium gluconate, capric acid, malic acid, trisodium citrate, phenylacetic acid. Strain G1-7 (=NIBRBAC 000512891) was isolated from soil in Gimpo-si, Gyeonggi-do, Republic of Korea (37°36′34.6″N, 126°46′32.0″E).

Description of *Nocardia exalbida* HC162

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are filamentous, umbonate and yellow orange-colored after 2 days incubation on R2A at 28°C. In the API 20NE system, positive for urease activity, utilization of D-glucose and trisodium citrate, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid and phenylacetic acid. Strain HC162 (=NIBR BAC000512713) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (37°43′30.1″N, 127° 56′33.4″E).

Description of *Nocardia ignorata* BS-22-B

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are circular, slightly convex, entire and creamy white-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine and potassium gluconate, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-maltose, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain BS-22-B (=NIBR BAC000513026) was isolated from wetland in Haeundae-gu, Busan, Republic of Korea (35°10′44.6″N, 129°8′ 13.6″E).

Description of *Nocardia noduli* HC032

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are filamentous, umbonate and pale orange-colored after 2 days incubation on R2A at 28°C. In the API 20NE system, positive for utilization of D-glucose, potassium gluconate and adipic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, capric acid, malic acid, trisodium citrate and phenylacetic acid. Strain HC032 (=NIBRBAC000512709) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (37°43′30.1″ N, 127°56′33.4″E).

Description of *Rhodococcus oryzae* MBLB4522

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are round, entire, convex, smooth and cream-colored after 5 days incubation on R2A at 15°C. In the API 20NE system, positive for nitrate reduction, utilization of D-glucose, potassium gluconate and malic acid, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain MBLB4522 (=NIBR BAC000512828) was isolated from soil in Inje-gun, Gangwon-do, Republic of Korea (37°25′54.7″N, 126°24′59.7″E).

Description of *Mumia quercus* MMS24-I5-19

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are round, raised, smooth, sharpness and yellow-colored after 7 days incubation on BHI at 30°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, *N*-acetyl-D-glucosamine, D-maltose and potassium gluconate, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-mannose, D-mannitol, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MMS24-I5-19 (=NIBRBAC000512955) was isolated from soil in Daejeong-eup, Seogwipo-si, Jeju-do, Republic of Korea (33° 17′12.2″N, 126°16′13.1″E).

Description of *Nocardioides fonticola* SBCC-2329

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular, convex, smooth, glistening and yellow-colored after 7 days incubation on MA at 25°C. In the API 20NE system, positive for gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-maltose and malic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, utilization of L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain SBCC-2329 (=NIBRBAC000512869) was isolated from tidal flat in Yeosu-si, Jeollanam-do, Republic of Korea (34°41′05″N, 127°45′35″E).

Description of *Nocardioides stalactiti* HW118

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are round, entire, raised and white-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for arginine dihydrolase, gelatin

hydrolysis and utilization of *N*-acetyl-D-glucosamine, but negative for nitrate reduction, indole production, glucose acidification, urease activity, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain HW118 (=NIBRBAC000512719) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (38°09′23.1″N, 127°39′21.9″E).

Description of *Enemella evansiae* CAU 1780

Cells are Gram-staining-positive, non-flagellated and coccoid-shaped. Colonies are circular, smooth, entire, convex and pale yellow-colored after 3 days incubation on MA at 30°C. In the API 20NE system, positive for nitrate reduction, glucose acidification, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid and trisodium citrate, but negative for indole production, arginine dihydrolase, urease activity, utilization of capric acid and phenylacetic acid. Strain CAU 1780 (=NIBRBAC000512785) was isolated from soil in Gangneung-si, Gangwon-do, Republic of Korea (37°83′87.7″N, 128°87′66.4″E).

Description of *Microlunatus okinawensis* HW201

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are round, entire, flat and pale yellow-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine and D-maltose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain HW201 (=NIBRBAC000512726) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (38°09′23.1″N, 127°39′21.9″E).

Description of *Microlunatus phosphovorus* CW071

Cells are Gram-staining-positive, non-flagellated and coccoid-shaped. Colonies are round, entire, raised and white-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for esculin hydrolysis and β-galactosidase activity, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CW071 (=NIBRBAC000512701) was isolated from soil in Cheorwon-gun, Gangwon-do, Republic of Korea (38°08′46.9″N 127°17′43.1″E).

Description of *Streptomyces luomodiensis* MMS24-JH4

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are circular, hard, stuck and yellow-colored after 7 days incubation on SCA at 30°C. In the API 20NE system, positive for esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose and malic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of L-arabinose, D-mannose, potassium gluconate, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain MMS24-JH4 (=NIBRBAC000512950) was isolated from soil in Daejeong-eup, Seogwipo-si, Jeju-do, Republic of Korea (33°17′12.2″N, 126°16′13.1″E).

Description of *Kitasatospora gansuensis* SBCC-2597

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are irregular, aerial and substrate mycelia and greyish yellow-colored after 7−10 days incubation on R2A at 25°C. In the API 20NE system, positive for nitrate reduction, β-galactosidase activity, utilization of D-glucose, *N*-acetyl-D-glucosamine, potassium gluconate and malic acid, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, utilization of L-arabinose, D-mannose, D-mannitol, D-maltose, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain SBCC-2597 (=NIBRBAC000512873) was isolated from soil in Yeoncheon-gun, Gyeonggi-do, Republic of Korea (38°07′19″N, 127°15′54″E).

Description of *Kitasatospora phosalacinea* KH11-5

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are Irregular, slightly convex, undulate and creamy white-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for nitrate reduction, utilization of D-glucose and D-mannose, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain KH11-5 (=NIBRBAC000513022) was isolated from soil in Ganghwa-gun, Incheon, Republic of Korea (37°35′32.5″N, 126°27′27.2″E).

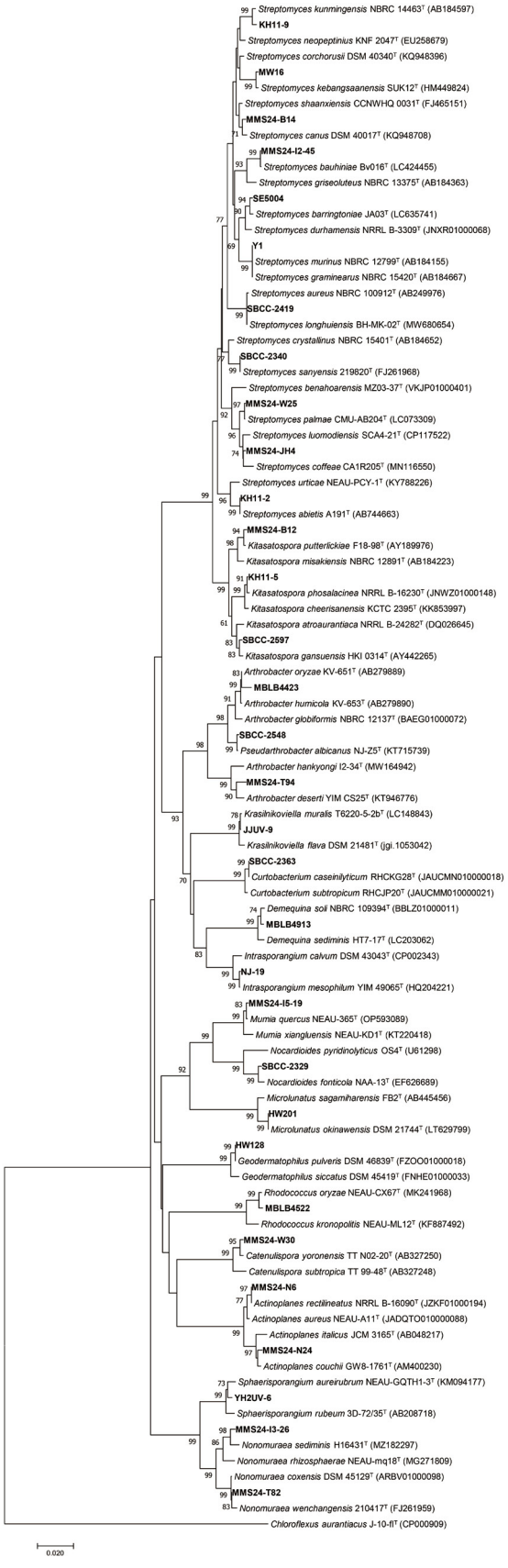

Fig. 3. Same as Fig. 2.

Description of *Kitasatospora putterlickiae* MMS24-B12

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are round, hard, smooth and brown beige-colored after 6 days incubation on R2A at 30°C. In the API 20NE system, positive for esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid and trisodium citrate, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of capric acid and phenylacetic acid. Strain MMS24-B12 (=NIBRBAC000512966) was isolated from soil in Daejeong-eup, Seogwipo-si, Jeju-do, Republic of Korea (33°17′12.2″N, 126°16′13.1″E).

Description of *Sphaerisporangium aureirubrum* YH2UV-6

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular, convex, glistening and red orange-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for β-galactosidase activity, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain YH2UV-6 (=NIBRBAC000513044) was isolated from soil in Dong-gu, Daegu, Republic of Korea (35°51′31.8″N, 128°41′57.2″E).

Description of *Streptomyces antimycoticus* CAU 1773

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are circular, rough, entire, convex, opaques and beige-colored after 3 days incubation on GYE at 30°C. In the API 20NE system, positive for esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid and malic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of capric acid, trisodium citrate and phenylacetic acid. Strain CAU 1773 (=NIBRBAC000512775) was isolated from soil in Pocheon-si, Gyeonggi-do, Republic of Korea (38°07′18.4″N, 127°12′31.9″E).

Description of *Streptomyces abietis* KH11-2

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are circular, raised, undulate and

cream-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for β-galactosidase activity, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain KH11-2 (=NIBRBAC000513037) was isolated from soil in Ganghwa-gun, Incheon, Republic of Korea (37°35′32.5″N, 126°27′27.2″E).

Description of *Streptomyces barringtoniae* SE5004

Cells are Gram-staining-positive, non-flagellated and coccoid-shaped. Colonies are circular, flat to umbonate, curled and light yellow-colored after 3 days incubation on PTYG at 28°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid and trisodium citrate, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of capric acid and phenylacetic acid. Strain SE5004 (=NIBRBAC000512994) was isolated from soil in Wonju-si, Gangwon-do, Republic of Korea (37°37′17″N, 127°92′53″E).

Description of *Streptomyces bauhiniae* MMS24-I2-45

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are irregular, filamentous, dull and brown-colored after 7 days incubation on SCA at 30°C. In the API 20NE system, positive for urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose and potassium gluconate, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, utilization of capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MMS24-I2-45 (=NIBRBAC000512954) was isolated from soil in Hallim-eup, Jeju-si, Jeju-do, Republic of Korea (33°21′20.7″N, 126°18′21.2″E).

Description of *Streptomyces fildesensis* BS-63-A

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are circular, slightly convex, entire and cream-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, *N*-acetyl-D-glucosamine, potassium gluconate and malic acid, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of D-mannose, D-mannitol, D-maltose, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain BS-63-A (=NIBRBAC000513038) was isolated from soil in Haeundae-gu, Busan, Republic of Korea (35°10′44.6″N, 129°8′13.6″E).

Description of *Streptomyces kebangsaanensis* MW16

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are adherent, raised and ivory-colored after 3 days incubation on TSB at 30°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid, trisodium citrate and phenylacetic acid, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis and utilization of capric acid. Strain MW16 (=NIBRBAC000512884) was isolated from seawater in Ganghwa-gun, Incheon, Republic of Korea (37°39′04.6″N, 126°19′58.3″E).

Description of *Streptomyces kunmingensis* KH11-9

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular, slightly convex, entire and cream-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate and malic acid, but negative for indole production, glucose acidification, arginine dihydrolase, utilization of D-maltose, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain KH11-9 (=NIBRBAC000513039) was isolated from soil in Ganghwa-gun, Incheon, Republic of Korea (37°35′32.5″N, 126°27′27.2″E).

Description of *Streptomyces longhuiensis* SBCC-2419

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are circular to slightly irregular and light yellow-colored after 7 days incubation on R2A at 25°C. In the API 20NE system, positive for esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid, trisodium citrate and phenylacetic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity and utilization of capric acid. Strain SBCC-2419 (=NIBRBAC000512874) was isolated from tidal flat in Boryeong-si, Chungcheongnam-do, Republic of Korea (36°20′15″N, 126°53′93″E).

Description of *Streptomyces murinus* Y1

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are filamentous, umbonate, adherent and milky white to yellow-colored after 3 days incubation on ISP2 at 30°C. In the API 20NE system, positive for esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, malic acid and phenylacetic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of L-arabinose, D-maltose, capric acid, adipic acid and trisodium citrate. Strain Y1 (=NIBRBAC000512893) was isolated from soil in Goyang-si, Gyeonggi-do, Republic of Korea (37°39′18.3″N, 126°46′07.2″E).

Description of *Streptomyces palmae* MMS24-W25

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are oval, spira and brown-colored after 7 days incubation on R2A at 30°C. In the API 20NE system, positive for urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, *N*-acetyl-D-glucosamine, D-maltose, malic acid and phenylacetic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, utilization of L-arabinose, D-mannose, D-mannitol, potassium gluconate, capric acid, adipic acid and trisodium citrate. Strain MMS24-W25 (=NIBRBAC000512962) was isolated from soil in Hallim-eup, Jeju-si, Jeju-do, Republic of Korea (33°21′20.7″N, 126°18′21.2″E).

Description of *Streptomyces polychromogenes* CW082

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are filamentous, umbonate and pale brown-colored after 2 days incubation on R2A at 28°C. In the API 20NE system, positive for nitrate reduction, arginine dihydrolase, urease activity, utilization of D-glucose, D-mannose, *N*-acetyl-D-glucosamine, D-maltose, adipic acid, malic acid and trisodium citrate, but negative for indole production, glucose acidification, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannitol, potassium gluconate, capric acid and phenylacetic acid. Strain CW082 (=NIBRBAC000512702) was isolated from soil in Cheorwon-gun, Gangwon-do, Republic of Korea (38°08′46.9″N, 127°17′43.1″E).

Description of *Streptomyces sanyensis* SBCC-2340

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are circular, slightly convex, smooth and greyish yellow-colored after 5–7 days incubation on MA at 25°C. In the API 20NE system, positive for esculin hydrolysis, utilization of D-glucose and D-maltose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain SBCC-2340 (=NIBRBAC000512861) was isolated from tidal flat in Buan-gun, Jeonbuk-do, Republic of Korea (35°40′45″N, 126°31′47″E).

Description of *Streptomyces shaanxiensis* MMS24-B14

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are circular and white-colored after 7 days incubation on SCA at 30°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, malic acid and trisodium citrate, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of D-maltose, capric acid, adipic acid and phenylacetic acid. Strain MMS24-B14 (=NIBRBAC000512949) was isolated from soil in Daejeong-eup, Seogwipo-si, Jeju-do, Republic of Korea (33°17′12.2″N, 126°16′13.1″E).

Description of *Streptomyces sporoverrucosus* HC010

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are filamentous, umbonate and brown-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for arginine dihydrolase, urease activity, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid and trisodium citrate, but negative for nitrate reduction, indole production, glucose acidification, gelatin hydrolysis, utilization of L-arabinose, D-mannose, D-mannitol, capric acid and phenylacetic acid. Strain HC010 (=NIBRBAC000512708) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (37°43′30.1″N, 127°56′33.4″E).

Description of *Streptomyces vinaceus* HC264

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are filamentous, umbonate and brown-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, utilization of D-glucose, D-mannose, *N*-acetyl-D-glucosamine, potassium gluconate and malic acid, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, β-galactosidase activity, utilization of L-arab-

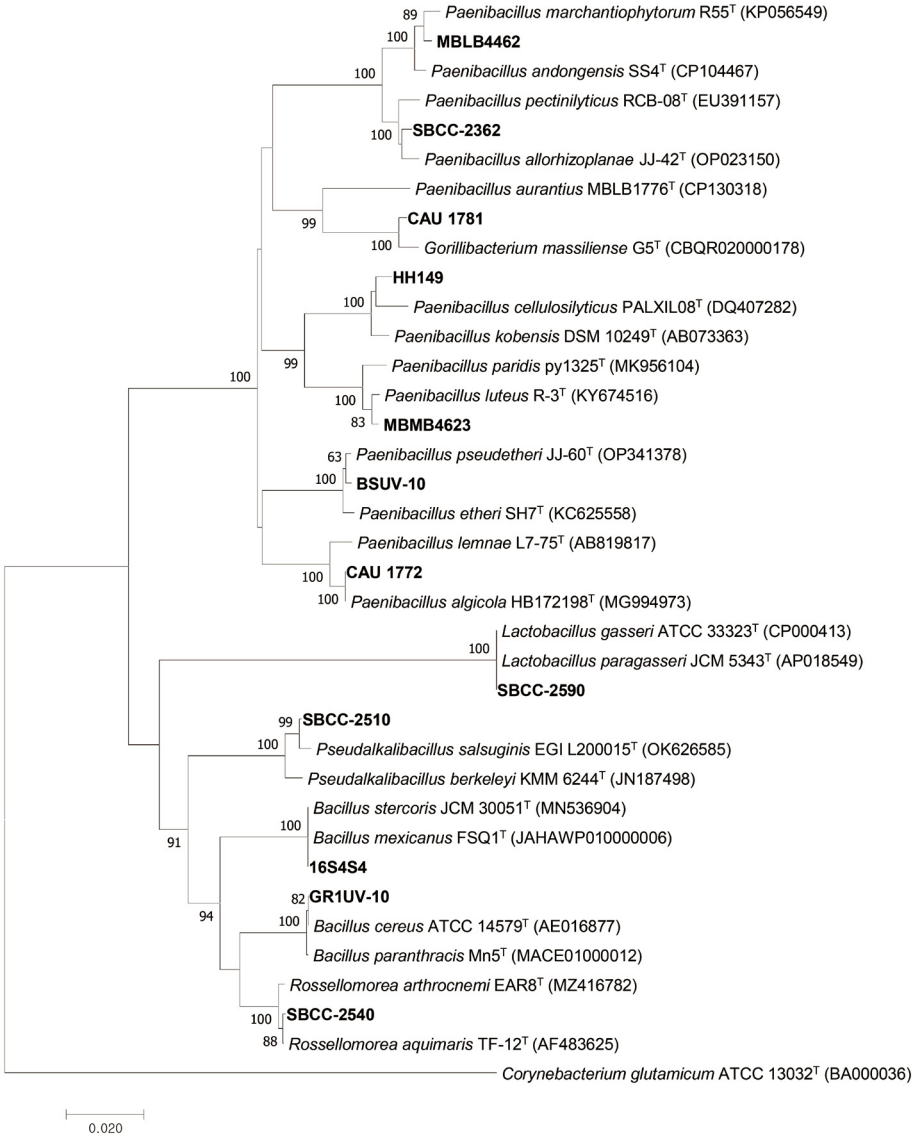

Fig. 4. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences, showing the relationship between the strains in the phylum *Bacillota*. Bootstrap values (>60%) based on 1,000 replications are shown on the branches. The tree was constructed using the neighbor-joining method. Bar, 0.02 substitutions per nucleotide position.

inose, D-mannitol, D-maltose, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain HC264 (=NIBRBAC000512716) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (37°43′30.1″N, 127°56′33.4″E).

Description of *Nonomuraea sediminis* MMS24-I3-26

Cells are Gram-staining-positive, non-flagellated and filamentous-shaped. Colonies are circular, convex, hard and yellow-colored after 7 days incubation on SCA at 30°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis and β-galactosidase activity, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MMS24-I3-26 (=NIBRBAC000512948) was isolated from soil in Hallim-eup, Jeju-si, Jeju-do, Republic of Korea (33°20′54.5″N, 126°19′45.6″E).

Description of *Nonomuraea wenchangensis* MMS24-T82

Cells are Gram-staining-positive, non-flagellated and spiral spore-shaped. Colonies are rough, spherical, hard and pale pink-colored after 6 days incubation on R2A at 30°C.

In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid and malic acid, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of capric acid, trisodium citrate and phenylacetic acid. Strain MMS24-T82 (=NIBRBAC000512963) was isolated from soil in Hallim-eup, Jeju-si, Jeju-do, Republic of Korea (33°21′20.7″N, 126°18′21.2″E).

Description of *Bacillus cereus* GR1UV-10

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are Irregular, raised, undulate and cream-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for arginine dihydrolase, esculin hydrolysis, gelatin hydrolysis, utilization of D-glucose, *N*-acetyl-D-glucosamine, D-maltose and malic acid, but negative for nitrate reduction, indole production, glucose acidification, urease activity, β-galactosidase activity, utilization of L-arabinose, D-mannose, D-mannitol, potassium gluconate, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain GR1UV-10 (=NIBRBAC000513041) was isolated from soil in Gangneung-si, Gangwon-do, Republic of Korea (37°50′14.6″N, 128°52′16.4″E).

Description of *Bacillus stercoris* 16S4S4

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are convex, rough and white-colored after 3 days incubation on R2A at 30°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid and trisodium citrate, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of capric acid and phenylacetic acid. Strain 16S4S4 (=NIBRBAC000512637) was isolated from sediment in Yangpyeong-gun, Gyeonggi-do, Republic of Korea (37°23′46.1″N, 127°29′28.5″E).

Description of *Pseudalkalibacillus salsuginis* SBCC-2510

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are circular, slightly convex, smooth and greyish yellow-colored after 7 days incubation on MA at 25°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, gelatin hydrolysis, utilization of D-glucose, D-mannose, D-mannitol, D-maltose and potassium gluconate, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, β-galactosidase activity, utilization of L-arabinose, *N*-acetyl-D-glucosamine, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain SBCC-2510 (=NIBRBAC000512864) was isolated from tidal flat in Taean-gun, Chungcheongnam-do, Republic of Korea (36°30′14″N, 126°20′14″E).

Description of *Rossellomorea arthrocnemi* SBCC-2540

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are circular, flat, smooth, glistening and greyish yellow-colored after 5 days incubation on MA at 25°C. In the API 20NE system, positive for esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, malic acid and trisodium citrate, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of L-arabinose, capric acid, adipic acid and phenylacetic acid. Strain SBCC-2540 (=NIBRBAC000512865) was isolated from tidal flat in Taean-gun, Chungcheongnam-do, Republic of Korea (36°30′14″N, 126°20′14″E).

Description of *Gorillibacterium massiliense* CAU 1781

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are circular, smooth, entire, convex and transparent-colored after 3 days incubation on NA at 30°C. In the API 20NE system, positive for esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine and D-maltose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, utilization of L-arabinose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CAU 1781 (=NIBRBAC000512786) was isolated from soil in Ongjin-gun, Incheon, Republic of Korea (37°31′44″N, 126°24′16″E).

Description of *Paenibacillus allorhizoplanae* SBCC-2362

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are circular, flat to slightly convex and milky white-colored after 7 days incubation on R2A at 25°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-D-glucosamine and D-maltose, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-mannitol, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain SBCC-2362 (=NIBRBAC000512870) was isolated from tidal flat in

Taean-gun, Chungcheongnam-do, Republic of Korea (36° 53′21″N, 126°19′44″E).

Description of *Paenibacillus kobensis* HH149

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are rhizoid, flat and white-colored after 4 days incubation on R2A at 28°C. In the API 20NE system, positive for esculin hydrolysis, β-galactosidase activity, utilization of D-glucose and L-arabinose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain HH149 (=NIBRBAC000512996) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (37°41′37.1″N, 127°52′02.3″E).

Description of *Paenibacillus luteus* MBLB4623

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are Irregular, entire, convex, smooth and cream-colored after 5 days incubation on R2A at 15°C. In the API 20NE system, positive for esculin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannitol and D-maltose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-glucose, D-mannose, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MBLB4623 (=NIBR BAC000512829) was isolated from soil in Inje-gun, Gangwon-do, Republic of Korea (37°25′54.7″N, 126°24′59.7″E).

Description of *Paenibacillus marchantiophytorum* MBLB4462

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are round, entire, flat, smooth and cream-colored after 3 days incubation on R2A at 30°C. In the API 20NE system, positive for esculin hydrolysis, utilization of D-maltose and adipic acid, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, malic acid, trisodium citrate and phenylacetic acid. Strain MBLB4462 (=NIBR BAC000512830) was isolated from soil in Inje-gun, Gangwon-do, Republic of Korea (37°25′54.7″N, 126°24′59.7″E).

Description of *Paenibacillus pseudetheri* BSUV-10

Cells are Gram-staining-positive, non-flagellated and oval-shaped. Colonies are circular, slightly convex, entire and creamy white-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for esculin hydrolysis and β-galactosidase activity, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain BSUV-10 (=NIBR BAC000513029) was isolated from soil in Haeundae-gu, Busan, Republic of Korea (35°10′44.6″N, 129°8′13.6″E).

Description of *Paenibacillus algicola* CAU 1772

Cells are Gram-staining-positive, flagellated and rod-shaped. Colonies are circular, smooth, entire, convex, translucent and yellow-colored after 4 days incubation on MA at 30°C. In the API 20NE system, positive for esculin hydrolysis and β-galactosidase activity, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CAU 1772 (=NIBR BAC000512774) was isolated from sea water in Dogong-ro, Jeju-si, Jeju-do, Republic of Korea (33°30′32.0″N, 126° 28′10.5″E).

Description of *Lactobacillus gasseri* SBCC-2590

Cells are Gram-staining-positive, non-flagellated and rod-shaped. Colonies are circular to irregular, flat, slightly convex and milky white-colored after 2−3 days incubation on MRS at 30°C. In the API 20NE system, positive for esculin hydrolysis, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis and β-galactosidase activity. utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain SBCC-2590 (=NIBR BAC000512876) was isolated from breast milk in Suwon-si, Gyeonggi-do, Republic of Korea (37°17′45″N, 126°58′ 26″E).

Description of *Chitinophaga jiangningensis* MMS24-M95

Cells are Gram-staining-negative, non-flagellated and rod-shaped. Colonies are circular and yellow-colored after 7 days incubation on R2A at 30°C. In the API 20NE system, positive for nitrate reduction, glucose acidification, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-mannose,

N-acetyl-D-glucosamine and D-maltose, but negative for indole production, arginine dihydrolase, utilization of L-arabinose, D-mannitol, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MMS24-M95 (=NIBRBAC000512960) was isolated from soil in Boryeong-si, Chungcheongnam-do, Republic of Korea (36°20′01.9″N, 126°3729.9″E).

Description of *Belliella aquatica* SBCC-2388

Cells are Gram-staining-negative, non-flagellated and rod-shaped. Colonies are circular, slightly convex, smooth and vivid orange-colored after 7 days incubation on MA at 25°C. In the API 20NE system, positive for esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose and D-maltose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain SBCC-2388 (=NIBRBAC000512867) was isolated from tidal flat in Yeosu-si, Jeollanam-do, Republic of Korea (34°41′05″N, 127°45′35″E).

Description of *Flavobacterium geliluteum* HW162

Cells are Gram-staining-negative, flagellated and rod-shaped. Colonies are irregular, undulate and yellow-colored after 3 days incubation on R2A at 28°C. In the API 20NE system, positive for nitrate reduction, glucose acidification, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-D-glucosamine and D-maltose, but negative for indole production, utilization of D-mannitol, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain HW162 (=NIBRBAC000512722) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (38°09′23.1″N, 127°39′21.9″E).

Description of *Salinimicrobium oceani* CAU 1765

Cells are Gram-staining-negative, non-flagellated and rod-shaped. Colonies are circular, smooth, entire, convex, translucent and yellow-colored after 3 days incubation on MA at 30°C. In the API 20NE system, positive for esculin hydrolysis, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CAU 1765 (=NIBRBAC000512770) was isolated from sea sediment in Gangneung-si, Gangwon-do, Republic of Korea (37°84′94.3″N, 128°87′71.5″E).

Description of *Chryseobacterium indoltheticum* MMS24-S12

Cells are Gram-staining-negative, non-flagellated and rod-shaped. Colonies are circular, convex, entire and light brown-colored after 6 days incubation on R2A at 30°C. In the API 20NE system, positive for urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-mannose and D-maltose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, utilization of L-arabinose, D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MMS24-S12 (=NIBRBAC000512965) was isolated from soil in Andeok-myeon, Seogwipo-si, Jeju-do, Republic of Korea (33°15′44″N, 126°18′43″E).

Description of *Chryseobacterium lacus* GYM17

Cells are Gram-staining-negative, flagellated and rod-shaped. Colonies are circular, smooth and yellow-colored after 3 days incubation on R2A at 30°C. In the API 20NE system, positive for esculin hydrolysis, utilization of D-glucose and D-mannose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, β-galactosidase activity, utilization of L-arabinose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid and trisodium citrate. Strain GYM17 (=NIBRBAC000512635) was isolated from soil in Anseong-si, Gyeonggi-do, Republic of Korea (37°00′15.5″N, 127°14′01.3″E).

Description of *Chryseobacterium potabilaquae* 16H3F4

Cells are Gram-staining-negative, non-flagellated and rod-shaped. Colonies are mucous, elevated and pale yellow-colored after 3 days incubation on R2A at 30°C. In the API 20NE system, positive for urease activity, esculin hydrolysis, gelatin hydrolysis, β-galactosidase activity, utilization of D-glucose, D-mannose and trisodium citrate, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, β-galactosidase activity, utilization of L-arabinose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid and phenylacetic acid. Strain 16H3F4 (=NIBRBAC000512643) was isolated from sediment in Gangnam-gu, Seoul, Republic of Korea (37°32′02.1″N, 127°02′15.6″E).

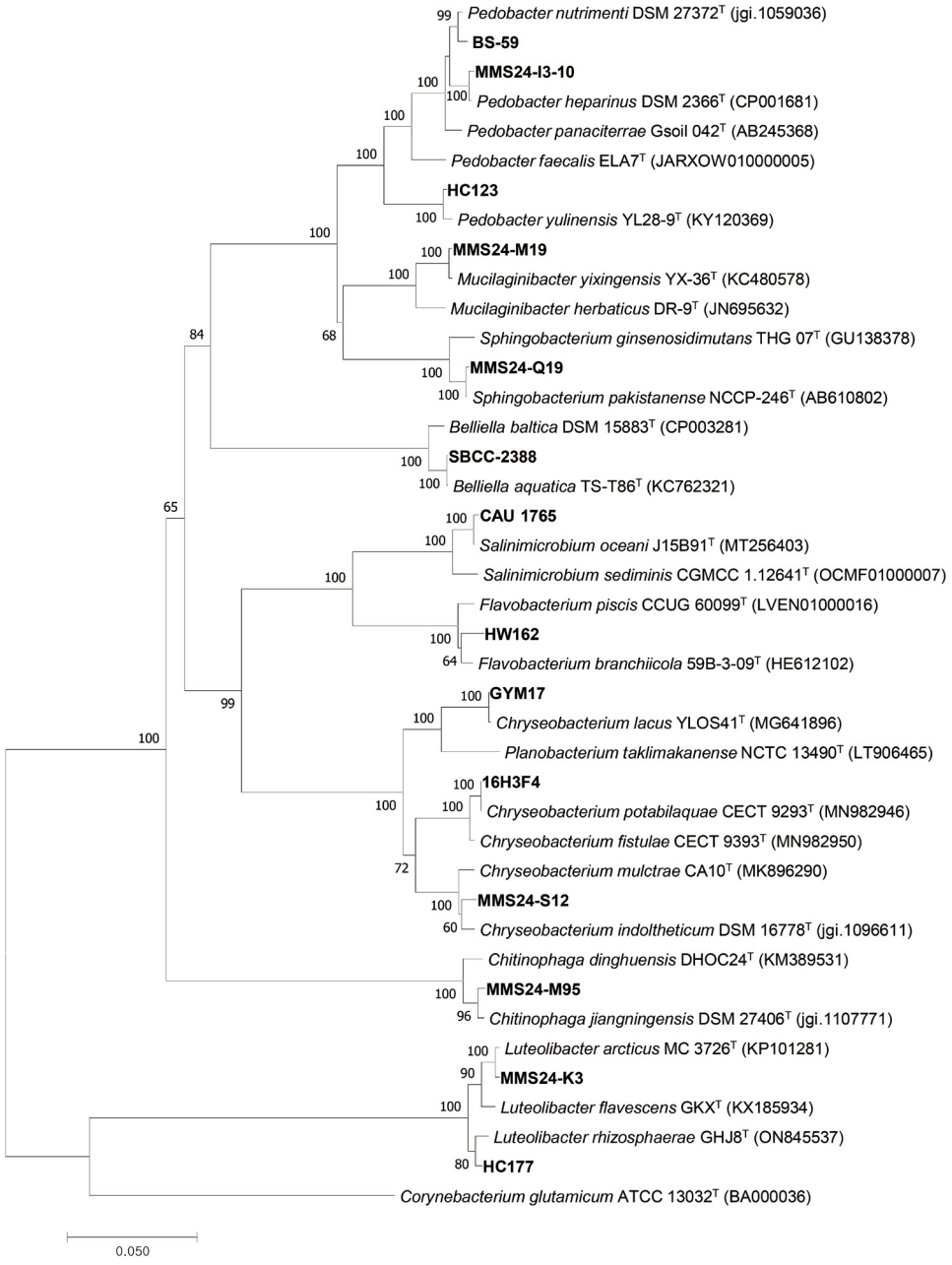

Fig. 5. Neighbor-joining phylogenetic tree based on 16S rRNA gene sequences, showing the relationship between the strains in the phylum *Bacteroidota* and *Verrucomicrobiota*. Bootstrap values (>60%) based on 1,000 replications are shown on the branches. The tree was constructed using the neighbor-joining method. Bar, 0.05 substitutions per nucleotide position.

Description of *Mucilaginibacter yixingensis* MMS24-M19

Cells are Gram-staining-negative, flagellated and rod-shaped. Colonies are circular and yellow-colored after 7 days incubation on R2A at 30°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis and β-galactosidase activity, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MMS24-M19 (=NIBRBAC000512959) was isolated from soil in Boryeong-si, Chungcheongnam-do, Republic of Korea (36°20′01.9″N, 126°3729.9″E).

Description of *Pedobacter heparinus* MMS24-I3-10

Cells are Gram-staining-negative, non-flagellated and oval-shaped. Colonies are round, raised, smooth, sharpness and pale yellow-colored after 7 days incubation on SCA at 30°C. In the API 20NE system, positive for nitrate reduction, urease activity, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, adipic acid and malic acid, but negative for indole production, glucose acidification, arginine dihydrolase, gelatin hydrolysis, utilization of capric acid, trisodium citrate and phenylacetic acid. Strain MMS24-I3-10 (=NIBRBAC000512952) was isolated from soil in Hallim-eup, Jeju-si, Jeju-do, Republic of Korea (33°20′54.5″N, 126°19′45.6″E).

Description of *Pedobacter nutrimenti* BS-59

Cells are Gram-staining-negative, non-flagellated and oval-shaped. Colonies are circular, slightly convex, undulate and creamy white-colored after 3 days incubation on R2A at 25°C. In the API 20NE system, positive for nitrate reduction, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose and D-maltose, but negative for indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-mannitol, *N*-acetyl-D-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain BS-59 (=NIBRBAC000513032) was isolated from soil in Haeundae-gu, Busan, Republic of Korea (35°10′44.6″N, 129°8′13.6″E).

Description of *Pedobacter yulinensis* HC123

Cells are Gram-staining-negative, non-flagellated and rod-shaped. Colonies are circular, convex, smooth and light pink-colored after 4 days incubation on R2A at 28°C. In the API 20NE system, positive for nitrate reduction, glucose acidification, β-galactosidase activity and utilization of malic acid, but negative for indole production, arginine dihydrolase, urease activity, esculin hydrolysis, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain HC123 (=NIBRBAC000512995) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (37°41′30.4″N, 127°52′10.5″E).

Description of *Sphingobacterium pakistanense* MMS24-Q19

Cells are Gram-staining-negative, non-flagellated and oval-shaped. Colonies are round, raised, smooth, fuzziness and gray-colored after 7 days incubation on R2A at 30°C. In the API 20NE system, positive for urease activity, esculin hydrolysis, β-galactosidase activity, utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-D-glucosamine and D-maltose, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, gelatin hydrolysis, utilization of D-mannitol, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MMS24-Q19 (=NIBRBAC000512953) was isolated from soil in Yuseong-gu, Daejeon, Republic of Korea (36°21′59.4″N, 127°20′13.9″E).

Description of *Luteolibacter arcticus* MMS24-K3

Cells are Gram-staining-negative, non-flagellated and rod-shaped. Colonies are circular, convex, smooth and yellow-colored after 7 days incubation on R2A at 30°C. In the API 20NE system, positive for esculin hydrolysis and β-galactosidase activity, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain MMS24-K3 (=NIBRBAC000512946) was isolated from soil in Daejeong-eup, Seogwipo-si, Jeju-do, Republic of Korea (33°17′12.2″N, 126°16′13.1″E).

Description of *Luteolibacter rhizosphaerae* HC177

Cells are Gram-staining-negative, non-flagellated and rod-shaped. Colonies are round, entire, raised and yellow-colored after 2 days incubation on R2A at 28°C. In the API 20NE system, positive for esculin hydrolysis and β-galactosidase activity, but negative for nitrate reduction, indole production, glucose acidification, arginine dihydrolase, urease activity, gelatin hydrolysis, utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-D-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain HC177 (=NIBRBAC000512714) was isolated from soil in Hongcheon-gun, Gangwon-do, Republic of Korea (37°43′30.1″N, 127°56′33.4″E).

Conflicts of Interest

The authors of this paper have no affiliation with any interests and are solely responsible for the paper.

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