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# Description of unrecorded bacterial species belonging to the phylum *Actinobacteria* in Korea

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For the collection of indigenous prokaryotic species in Korea, 77 strains within the phylum *Actinobacteria* were isolated from various environmental samples, fermented foods, animals and clinical specimens in 2019. Each strain showed high 16S rRNA gene sequence similarity (>98.8%) and formed a robust phylogenetic clade with actinobacterial species that were already defined and validated with nomenclature. There is no official description of these 77 bacterial species in Korea. The isolates were assigned to 77 species, 31 genera, 18 families, 14 orders and 2 classes of the phylum *Actinobacteria*. All the strains except one *Coriobacteriia* strain were affiliated within the class *Actinomycetia*. Among them, the orders *Streptomycetales* and *Microbacteriales* were predominant. A number of strains were isolated from forest soils, riverside soils, and ginseng cultivated soils. Twenty-nine strains were isolated from 'Protected Ecosystem and Scenery Areas'. Morphological properties, basic biochemical characteristics, isolation source and strain IDs are described in the species descriptions.

Keywords: 16S rRNA gene sequence, *Actinobacteria*, unrecorded species


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## Introduction

The phylum *Actinobacteria* is one of the largest groups in the domain Bacteria (Goodfellow, 2012). In recent years, a proper hierarchical classification system for this group was established based on genome analysis. Consequently, on August 2020, the phylum *Actinobacteria* consisted of 6 classes, 46 orders, 78 families and more than 400 genera [LPSN (https://www.bacterio.net/); Salam *et al*., 2020].

Members of the phylum *Actinobacteria* showed great diversity in terms of their habitat, morphology and physiology (Goodfellow and Williams, 1983). Actinobacterial species are relatively abundant in terrestrial and aquatic environments where they are involved in the decomposition and recycling of organic matter (Servin *et al*., 2008). In addition to their saprophytic property, several genera, such as *Mycobacterium*, *Corynebacterium* (Dangle *et al*., 2019) and *Clavibacter* (Hwang *et al*., 2019), are pathogenic to animals (including humans) and plants (Qin *et al*., 2011). Also, endophytic actinobacteria have been isolated from a variety of healthy plants (Qin *et al*., 2011).

In Korea, 329 species with valid names were isolated from various natural environments, fermented foods, wastewater, compost and clinical specimens [LPSN (https://www.bacterio.net/); Bae *et al*., 2016]. Moreover, 249 un-

recorded species were also discovered up to 2018 (Choi *et al*., 2016; Kim *et al*., 2016; 2017; 2019; Ko *et al*., 2017; Lee *et al*., 2018).

In 2019, the authors isolated a great number of unrecorded prokaryotic species from diverse environmental samples, artificial sources and clinical specimens in Korea. In particular, included in the isolation sources were nine 'Protected Ecosystem and Scenery Areas' designated by the Ministry of Environment (http://www.cbd-chm.go.kr/). The present report focuses on the description of unrecorded species belonging to the phylum *Actinobacteria* which previously had not been isolated in Korea. Here we report 77 unrecorded actinobacterial strains in Korea.

## Materials and Methods

A total of 77 bacterial strains assigned to the phylum *Actinobacteria* were isolated from various environmental samples including forest soils, tidal sediments, seashore sands, cave soils, ginseng cultivated soil, fermented foods and clinical specimens in 2019 (Table 1). Each sample was processed separately, spread onto diverse culture agar media (Becton Dickinson) such as anaerobe basal (AB), blood (BA), international streptomyces project medium 7 (ISP7), Luria broth (LB), Mueller-Hinton (MH), marine (MA), Reasoner's 2A (R2A) and tryptic soy (TSA), and incubated at 20−37°C for 1−12 days. All strains were purified as single colonies and stored as 10−20% glycerol suspension at −80°C as well as lyophilized ampoules.

Colony morphology of the strains was observed on agar plates with a magnifying lens after cells grew up to stationary phase. Cellular morphology and cell size were examined by either transmission electron microscopy or scanning electron microscopy (Figs. 1 & 2). Biochemical characteristics were tested using API 20NE (for aerobic isolates) or API 20A (for anaerobic strains LPB0331 and LPB0332) galleries (bioMérieux) according to the manufacturer's instructions.

DNA extraction, PCR amplification and 16S rRNA gene sequencing were carried out as described previously (Chun and Goodfellow, 1995). The 16S rRNA gene sequences of the strains assigned to the phylum *Actinobacteria* were compared with the sequences held in GenBank by BLASTN and also analyzed using the EzTaxon-e server (http://www.ezbiocloud.net/; Yoon *et al*., 2017). For phylogenetic analyses, multiple alignments were performed using the ClustalW program (Thompson *et al*., 1994) and gaps were edited in the BioEdit program (Hall, 1999). Evolutionary distances were calculated using the Jukes-Cantor model (Jukes and Cantor, 1969). The phylogenetic trees were constructed by using the neighbor-joining (Saitou and Nei, 1987), the maximum likelihood (Felsenstein, 1981) and the maximum parsimony (Fitch, 1971) methods with the MEGA 6.0 (Tamura *et al*., 2013) with bootstrap values based on 1,000 replicates (Felsenstein, 1985).

## Results and Discussion

All the 77 strains belonged to the phylum *Actinobacteria* and were affiliated with 2 classes, 14 orders, 18 families and 31 genera (Table 1). All the strains except one were affiliated with the class *Actinomycetia*. Seventy-six strains were affiliated with 13 orders: *Streptomycetales* (29 strains), *Microbacteriales* (14 strains), *Mycobacteriales* (8 strains), *Micrococcales* (6 strains), *Micromonosporales* (4 strains), *Propionibacteriales* (3 strains), *Brevibacteriales* (3 strains), *Cellulomonadales* (2 strains), *Pseudonocardiales* (2 strains), *Bifidobacteriales*, *Bogoriellales*, *Dermabacterales* and *Dermatophilales* (each 1 strain). All the *Streptomycetales*, *Microbacteriales*, *Micrococcales*, *Micromonosporales*, *Propionibacteriales*, *Brevibacteriales* strains belonged to the single families *Streptomycetaceae*, *Microbacteriaceae*, *Micrococcaceae*, *Micromonosporaceae*, *Nocardioidaceae*, *Brevibacteriaceae*, *Pseudonocardiaceae*, *Bifidobacteriaceae*, *Bogoriellaceae*, *Dermabacteraceae* and *Intrasporangiaceae*, respectively. The strains belonging to the order *Mycobacteriales* were affiliated within four families: *Nocardiaceae* (5 strains), *Dietziaceae*, *Gordoniaceae* and *Mycobacteriaceae* (each 1 strain). Two families *Actinotaleaceae* and *Oerskoviaceae* were found in the order *Cellulomonadales*.

Only one isolate belonged to the family *Coriobacteriaceae* within the class *Coriobacteriia*.

The strains were isolated from diverse sources: 64 strains from soil including forest soils, riverside soils, ginseng-cultivated soils, meadow soils, and cave soils; 7 strains from tidal flat sediments or seashore sands; 2 strains each from animal intestines and fermented foods and one strain each from clinical specimen and seawater. Geographic regions of the strains were as follows: 28 strains from Gangwon Province; 16 strains from Gyeongsangbuk Province; 12 strains from Jeollanam Province; 4 strains each from Daejeon, Jeju and Chungcheongnam Province; 3 strains from Gyeonggi Province; 2 strains each from Seoul and Incheon and one strain each from Sejong and Chungcheongbuk Province. In particular, 29 strains were isolated from 'Protected Ecosystem and Scenery Areas'.

All isolates were Gram-stain-positive and chemoheterotrophic. Figure 3 shows the phylogenetic assignment of the strains based on 16S rRNA gene sequences.

Here we report the 77 unrecorded bacterial species in Korea belonging to the phylum *Actinobacteria*.

**Table 1.** The taxonomic affiliations of isolates belonging to the phylum *Actinobacteria*.

| Order* | Family | Genus | Strain ID | NIBR ID | Most closely related species | Similarity (%) | Isolation | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Source/Region† | Medium | Incubation condition |
| *Bifidobacteriales* | *Bifidobacteriaceae* | *Bifidobacterium* | LPB0331 | NIBRBAC000503355 | *B. longum* subsp. *longum* | 99.9 | A.I./CDS | AB | 30°C, 3d |
| *Bogoriellales* | *Bogoriellaceae* | *Georgenia* | N20 | NIBRBAC000503416 | *G. satyanarayanai* | 99.7 | G.S./Gb | R2A | 25°C, 3d |
| *Brevibacteriales* | *Brevibacteriaceae* | *Brevibacterium* | G24 | NIBRBAC000503412 | *B. avium* | 98.9 | G.S./Gb | R2A | 25°C, 3d |
| | | | G9 | NIBRBAC000503403 | *B. sandarakinum* | 98.8 | G.S./Gb | R2A | 25°C, 3d |
| | | | G37 | NIBRBAC000503413 | *B. siliguriense* | 98.9 | G.S./Gb | R2A | 25°C, 3d |
| *Cellulomonadales* | *Actinotaleaceae* | *Actinotalea* | 19D1G4 | NIBRBAC000503262 | *A. ferrariae* | 99.0 | R.S./Gw† | MH | 30°C, 4d |
| | *Oerskoviaceae* | *Oerskovia* | 19D1L6 | NIBRBAC000503263 | *O. jenensis* | 100.0 | R.S./Gw† | MH | 30°C, 4d |
| *Dermabacterales* | *Dermabacteraceae* | *Brachybacterium* | G56 | NIBRBAC000503405 | *B. alimentarium* | 99.6 | G.S./Gb | R2A | 25°C, 3d |
| *Dermatophilales* | *Intrasporangiaceae* | *Pedococcus* | 13H-3 | NIBRBAC000503224 | *P. soli* | 99.5 | M.S./Gw† | R2A | 30°C, 3d |
| *Microbacteriales* | *Microbacteriaceae* | *Agrococcus* | 19D1A19 | NIBRBAC000503254 | *A. citreus* | 99.8 | R.S./Gw† | MH | 30°C, 4d |
| | | | 19D1A72 | NIBRBAC000503256 | *A. versicolor* | 99.4 | R.S./Gw† | MH | 30°C, 4d |
| | | *Agromyces* | G36 | NIBRBAC000503404 | *A. fucosus* | 99.9 | G.S./Gb | R2A | 25°C, 3d |
| | | | CAU 1605 | NIBRBAC000503252 | *A. mangrove* | 99.2 | T.F./GSI | MA | 30°C, 3d |
| | | *Leucobacter* | N14 | NIBRBAC000503414 | *L. massiliensis* | 100.0 | G.S./Gb | R2A | 25°C, 3d |
| | | *Microbacterium* | KR3 | NIBRBAC000503401 | *M. flavum* | 100.0 | F.F./GSI | R2A | 25°C, 3d |
| | | | 19D1C16 | NIBRBAC000503259 | *M. invictum* | 98.8 | R.S./Gw† | MH | 30°C, 4d |
| | | | 19D1A9 | NIBRBAC000503253 | *M. lemovicicum* | 100.0 | R.S./Gw† | MH | 30°C, 4d |
| | | | SO98 | NIBRBAC000503304 | *M. murale* | 99.6 | F.S./Gb | R2A | 25°C, 3d |
| | | | LPB0322 | NIBRBAC000503354 | *M. nanhaiense* | 99.8 | S.S./CDS | R2A | 25°C, 3d |
| | | | SO111 | NIBRBAC000503305 | *M. shaanxiense* | 99.1 | F.S./Gb | TSA | 25°C, 3d |
| | | | N40 | NIBRBAC000503417 | *M. thalassium* | 99.0 | G.S./Gb | R2A | 25°C, 3d |
| | | | BSSP-R25 | NIBRBAC000503329 | *M. trichothecenolyticum* | 99.2 | T.F./CDS | R2A | 25°C, 3d |
| | | *Mycetocola* | 19D2C13 | NIBRBAC000503269 | *M. manganoxydans* | 99.1 | R.S./Gw† | MH | 30°C, 4d |
| *Micrococcales* | *Micrococcaceae* | *Arthrobacter* | 19D2A1 | NIBRBAC000503267 | *A. tumbae* | 99.6 | R.S./Gw† | MH | 30°C, 4d |
| | | *Paenarthrobacter* | 13H-2 | NIBRBAC000503223 | *P. ilicis* | 99.6 | M.S./Gw† | R2A | 30°C, 3d |

**Table 1.** Continued.

| Order* | Family | Genus | Strain ID | NIBR ID | Most closely related species | Similarity (%) | Isolation | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Source/Region† | Medium | Incubation condition |
| *Micrococcales* | *Micrococcaceae* | *Pseudarthrobacter* | 19D1F19 | NIBRBAC000503260 | *P. phenanthrenivorans* | 99.5 | R.S./Gw† | MH | 30°C, 4d |
| | | | JBTF-M16 | NIBRBAC000503335 | *P. polychromogenes* | 99.3 | T.F./GSI | MA | 30°C, 2d |
| | | *Rothia* | LPB0310 | NIBRBAC000503349 | *R. aeria* | 100.0 | H.S./GSI | BA | 37°C, 3d |
| | | | KYW1971 | NIBRBAC000503307 | *R. amarae* | 99.9 | S.W./Jn | MA | 25°C, 2d |
| *Micromonosporales* | *Micromonosporaceae* | *Longispora* | R21 | NIBRBAC000503218 | *L. urticae* | 99.1 | F.S./Gw† | R2A | 30°C, 3d |
| | | *Micromonospora* | R_77 | NIBRBAC000503392 | *M. avicenniae* | 99.0 | F.S./CDS | ISP7 | 30°C, 3d |
| | | | G92 | NIBRBAC000503406 | *M. oryzae* | 100.0 | G.S./Gb | R2A | 25°C, 3d |
| | | | BT360 | NIBRBAC000503002 | *M. schwarzwaldensis* | 99.6 | F.S./Jj | R2A | 25°C, 3d |
| *Mycobacteriales* | *Dietziaceae* | *Dietzia* | SR3 | NIBRBAC000503402 | *D. lutea* | 99.2 | F.F./GSI | R2A | 25°C, 3d |
| | *Gordoniaceae* | *Williamsia* | FS100 | NIBRBAC000503294 | *W. limnetica* | 100.0 | F.S./Jn | R2A | 25°C, 3d |
| | *Mycobacteriaceae* | *Mycolicibacterium* | S5 | NIBRBAC000503408 | *M. wolinskyi* | 99.0 | F.S./Gb | R2A | 25°C, 3d |
| | *Nocardiaceae* | *Nocardia* | 19D2V10 | NIBRBAC000503270 | *N. alba* | 99.5 | R.S./Gw† | MH | 30°C, 4d |
| | | | 19D1S1 | NIBRBAC000503264 | *N. grenadensis* | 99.4 | R.S./Gw† | MH | 30°C, 4d |
| | | | 19D1V24 | NIBRBAC000503272 | *N. nova* | 99.8 | R.S./Gw† | MH | 30°C, 4d |
| | | | JDB110 | NIBRBAC000503295 | *N. tengchongensis* | 99.7 | F.S./Jn† | TSA | 25°C, 4d |
| | | *Rhodococcus* | R12 | NIBRBAC000503418 | *R. artemisiae* | 99.4 | G.S./Gb | R2A | 25°C, 3d |
| *Propionibacteriales* | *Nocardioidaceae* | *Aeromicrobium* | BSSP-M28 | NIBRBAC000503336 | *A. marinum* | 98.9 | T.F./CDS | MA | 25°C, 5d |
| | | *Marmoricola* | 19D1C14 | NIBRBAC000503258 | *M. aquaticus* | 99.6 | R.S./Gw† | MH | 30°C, 4d |
| | | *Nocardioides* | BT343 | NIBRBAC000502998 | *N. phosphati* | 99.1 | F.S./Jj | R2A | 25°C, 3d |
| *Pseudonocardiales* | *Pseudonocardiaceae* | *Lentzea* | BSSP-M29 | NIBRBAC000503328 | *L. albidocapillata* subsp. *albidocapillata* | 99.7 | T.F./CDS | MA | 30°C, 3d |
| | | | BT46 | NIBRBAC000502986 | *L. guizhouensis* | 99.1 | F.S./Gw | R2A | 25°C, 3d |
| *Streptomycetales* | *Streptomycetaceae* | *Kitasatospora* | MMS19-T35 | NIBRBAC000503382 | *K. purpeofusca* | 99.9 | F.S./Jn | R2A | 30°C, 3d |
| | | | LPB0280 | NIBRBAC000503341 | *K. xanthocidica* | 100.0 | F.S./GSI | TSA | 25°C, 3d |
| | | *Streptacidiphilus* | S36 | NIBRBAC000503409 | *S. carbonis* | 98.9 | F.S./Gb | R2A | 25°C, 3d |

**Table 1.** Continued.

| Order* | Family | Genus | Strain ID | NIBR ID | Most closely related species | Similarity (%) | Isolation | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Source/Region† | Medium | Incubation condition |
| *Streptomycetales* | *Streptomycetaceae* | *Streptomyces* | R-5 | NIBRBAC000503388 | *S. albogriseolus* | 100.0 | R.S./Jn† | R2A | 37°C, 3d |
| | | | 19D2C16 | NIBRBAC000503276 | *S. amakusaensis* | 99.7 | R.S./Gw† | MH | 30°C, 4d |
| | | | BT63 | NIBRBAC000502992 | *S. aureus* | 99.9 | F.S./Gw | 1/10LB | 25°C, 3d |
| | | | 9C-1 | NIBRBAC000503221 | *S. badius* | 99.6 | F.S./Gw† | R2A | 30°C, 3d |
| | | | SO100 | NIBRBAC000503306 | *S. brevispora* | 99.8 | F.S./Gb | R2A | 25°C, 4d |
| | | | BG138 | NIBRBAC000503380 | *S. cacaoi* subsp. *asoensis* | 100.0 | F.S./Jn | TSA | 30°C, 3d |
| | | | EAC34 | NIBRBAC000503282 | *S. cavourensis* | 100.0 | F.S./Jj | R2A | 25°C, 3d |
| | | | 19D1L39 | NIBRBAC000503274 | *S. coelescens* | 100.0 | R.S./Gw† | MH | 30°C, 4d |
| | | | R-9 | NIBRBAC000503387 | *S. corchorusii* | 99.0 | R.S./Jn† | R2A | 30°C, 3d |
| | | | MMS19-T27 | NIBRBAC000503371 | *S. europaeiscabiei* | 99.2 | F.S./Jn | R2A | 30°C, 3d |
| | | | 5C-2 | NIBRBAC000503220 | *S. finlayi* | 99.9 | C.S./Gw | R2A | 30°C, 3d |
| | | | 5C-1 | NIBRBAC000503219 | *S. formicae* | 99.2 | C.S./Gw | R2A | 30°C, 3d |
| | | | 13H-1 | NIBRBAC000503222 | *S. fragilis* | 99.9 | M.S./Gw† | R2A | 30°C, 3d |
| | | | 19D2F17 | NIBRBAC000503277 | *S. fulvissimus* | 99.9 | R.S./Gw† | MH | 30°C, 4d |
| | | | CAU 1564 | NIBRBAC000503235 | *S. globosus* | 100.0 | S.S./GSI | NA | 37°C, 3d |
| | | | EAC30 | NIBRBAC000503283 | *S. griseorubiginosus* | 100.0 | F.S./Jj | TSA | 25°C, 7d |
| | | | SO94 | NIBRBAC000503297 | *S. hydrogenans* | 100.0 | F.S./Gb | R2A | 25°C, 3d |
| | | | 19D2S3 | NIBRBAC000503278 | *S. netropsis* | 100.0 | R.S./Gw† | MH | 30°C, 4d |
| | | | JDB244 | NIBRBAC000503303 | *S. nigrescens* | 99.9 | F.S./Jn† | R2A | 25°C, 5d |
| | | | R-21 | NIBRBAC000503389 | *S. phaeoluteichromatogenes* | 99.5 | R.S./Jn† | R2A | 37°C, 3d |
| | | | DS-12 | NIBRBAC000503377 | *S. populi* | 99.2 | F.S./CDS | R2A | 30°C, 3d |
| | | | 19D1T8 | NIBRBAC000503275 | *S. pratensis* | 100.0 | R.S./Gw† | MH | 30°C, 4d |
| | | | F-111 | NIBRBAC000503378 | *S. pseudovenezuelae* | 100.0 | F.S./CDS | R2A | 30°C, 3d |
| | | | MMS19-T31 | NIBRBAC000503372 | *S. recifensis* | 99.8 | F.S./Jn | R2A | 30°C, 3d |
| | | | EAC17 | NIBRBAC000503284 | *S. tanashiensis* | 99.9 | F.S./Cb | R2A | 25°C, 3d |
| | | | MMS19-T12 | NIBRBAC000503384 | *S. virginiae* | 99.9 | F.S./Jn | R2A | 30°C, 3d |
| | | | 19D1A31 | NIBRBAC000503273 | *S. zaomyceticus* | 99.9 | R.S/Gw† | MH | 30°C, 4d |
| *Coriobacteriales* | *Coriobacteriaceae* | *Collinsella* | LPB0332 | NIBRBAC000503339 | *C. aerofaciens* | 99.9 | A.I./CDS | AB | 30°C, 3d |

*The order *Coriobacteriales* belongs to the class *Coriobacteriia*; the rests to the class *Actinomycetia*.
Abbreviations of the source: G.S., Ginseng-cultivated soil; F.S., forest soil; R.S, riverside soil; M.S., meadow soil; C.S., cave soils; T.F., tidal flat sediment; S.S., seashore sand; A.I., animal intestine; F.F., fermented food; H.S., clinical specimen; S.W., seawater.
Abbreviations of the region: Gw, Gangwon; Gb, Gyeongbuk; Jn, Jeonnam; Jj, Jeju; CDS, Chungnam/ Daejeon/Sejong; GSI, Gyeonggi/Seoul/Incheon; Cb, Chungbuk. †Denotes the 'Protected Ecosystem and Scenery Areas.'
Abbreviations of the agar medium: AB, Anaerobe basal; BA, Blood;.ISP7, international streptomyces project medium 7; LB, Luria broth; MH, Mueller Hinton; MA, marine; R2A, Reasoner's 2A; TSA, tryptic soy.

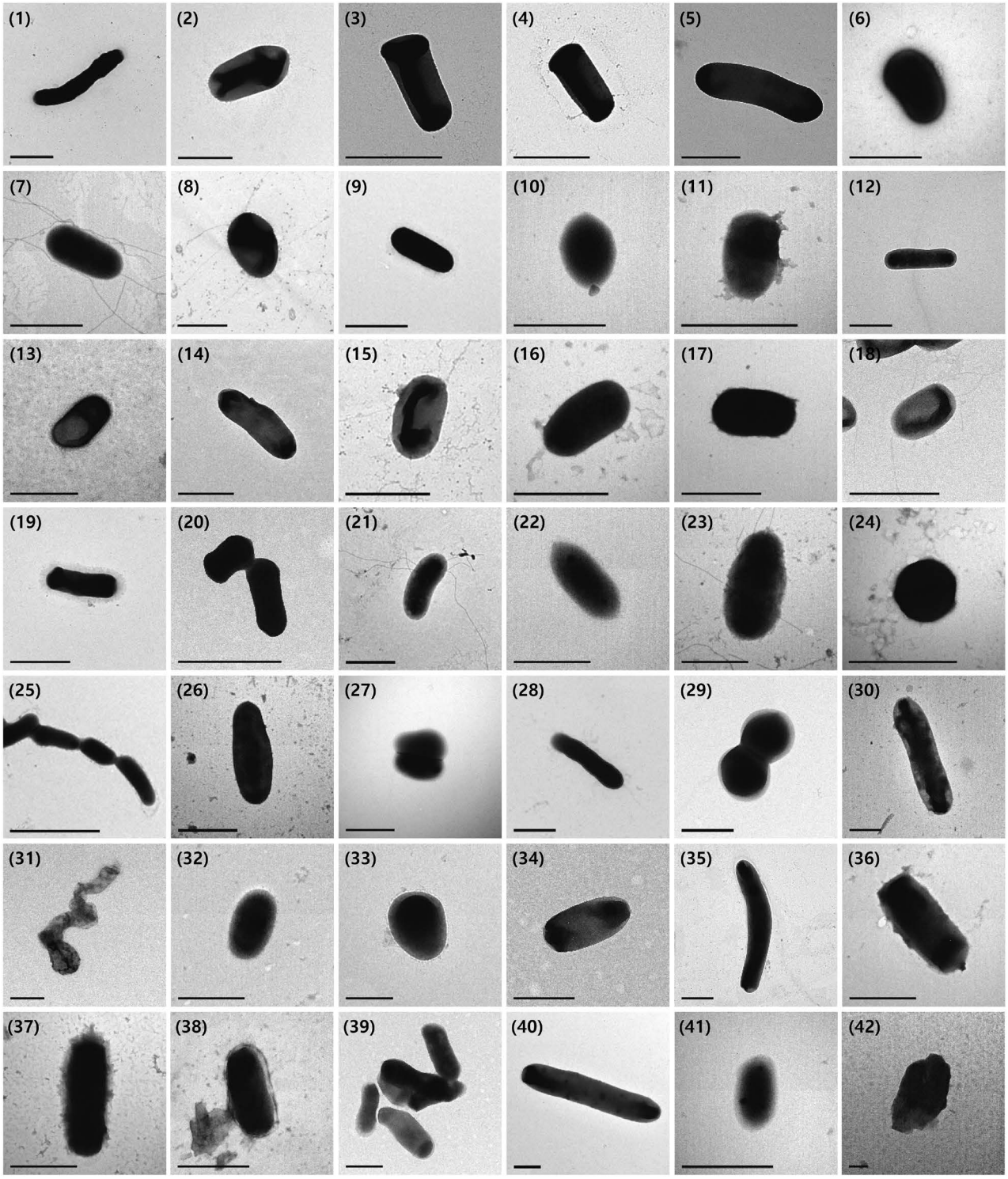


**Fig. 1.** Transmission electron micrographs of cells of the isolates. Bar, 1 μm. Strains: 1, LPB0331; 2, N20; 3, G24; 4, G9; 5, G37; 6, 19D1G4; 7, 19D1L6; 8, G56; 9, 13H-3; 10, 19D1A19; 11, 19D1A72; 12, G36; 13, CAU 1605; 14, N14; 15, KR3; 16, 19D1C16; 17, 19D1A9; 18, SO98; 19, LPB0322; 20, SO111; 21, N40; 22, BSSP-R25; 23, 19D2C13; 24, 19D2A1; 25, 13H-2; 26, 19D1F19; 27, JBTF-M16; 28, LPB0310; 29, KYW1971; 30, R21; 31, R_77; 32, BT360; 33, SR3; 34, FS100; 35, S5; 36, 19D2V10; 37, 19D1S1; 38, 19D1V24; 39, JDB110; 40, R12; 41, BSSP-M28; 42, 19D1C14; 43, BT343; 44, BSSP-M29; 45, BT46; 46, MMS19-T35; 47, LPB0280; 48, R-5; 49, 19D2C16; 50, BT63; 51, 9C-1; 52, BG138; 53, EAC34; 54, 19D1L39; 55, R-9; 56, MMS19-T27; 57, 5C-2; 58, 5C-1; 59, 13H-1; 60, 19D2F17; 61, CAU 1564; 62, 19D2S3; 63, R-21; 64, DS-12; 65, 19D1T8; 66, F-111; 67, MMS19-T31; 68, EAC17; 69, MMS19-T12; 70, 19D1A31; 71, LPB0332.

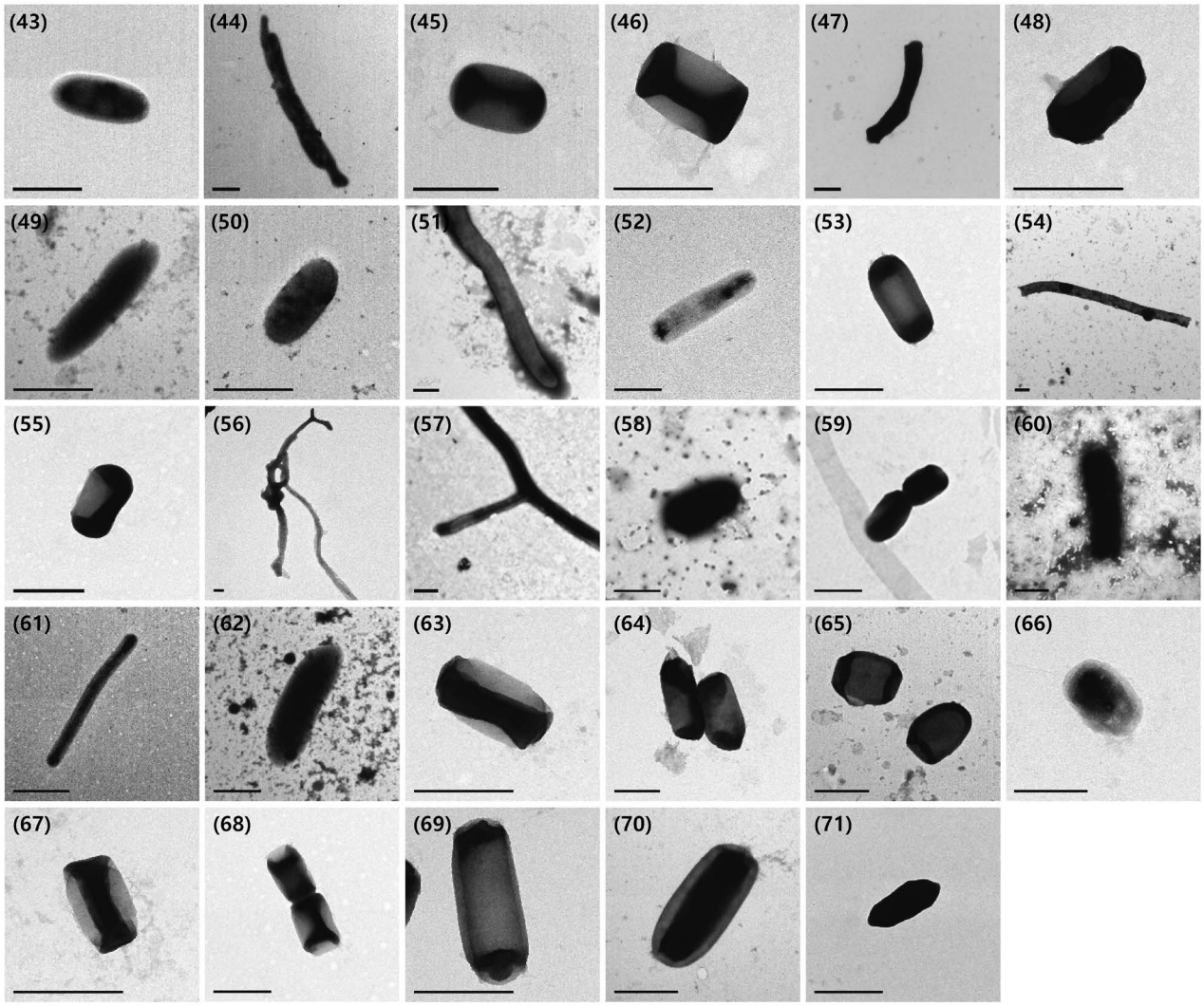


**Fig. 1.** Continued.

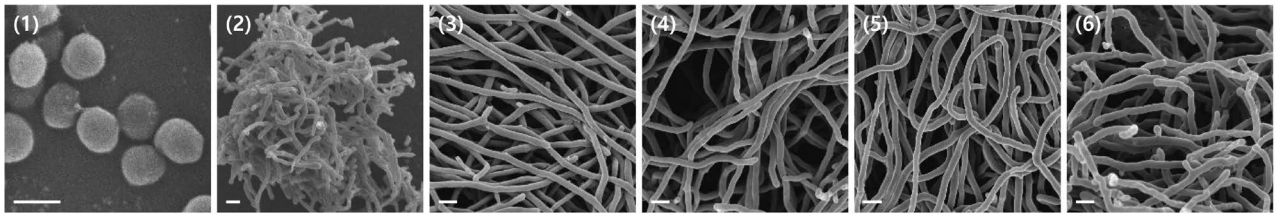


**Fig. 2.** Scanning electron micrographs of cells of the isolates. Bar, 1 μm. Strains: 1, G92; 2, S36; 3, SO100; 4, EAC30; 5, SO94; 6, JDB244.

## Description of *Bifidobacterium longum* subsp. *longum* LPB0331

Cells are anaerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, convex, entire and cream colored after incubation for 3 days on anaerobe basal medium at 30°C. In the API 20A system, positive reaction for esculin hydrolysis, acid production from salicin (weak), glycerol, D-cellobiose, D-rhamnose and D-trehalose. In the API 20A system, negative reaction for oxidase activity, indole formation, urease activity, gelatin hydrolysis and acid production from D-glucose, D-mannitol, D-lactose, sucrose, D-maltose, D-xylose, L-arabinose, D-mannose, D-melezitose, D-raffinose and D-sorbitol.

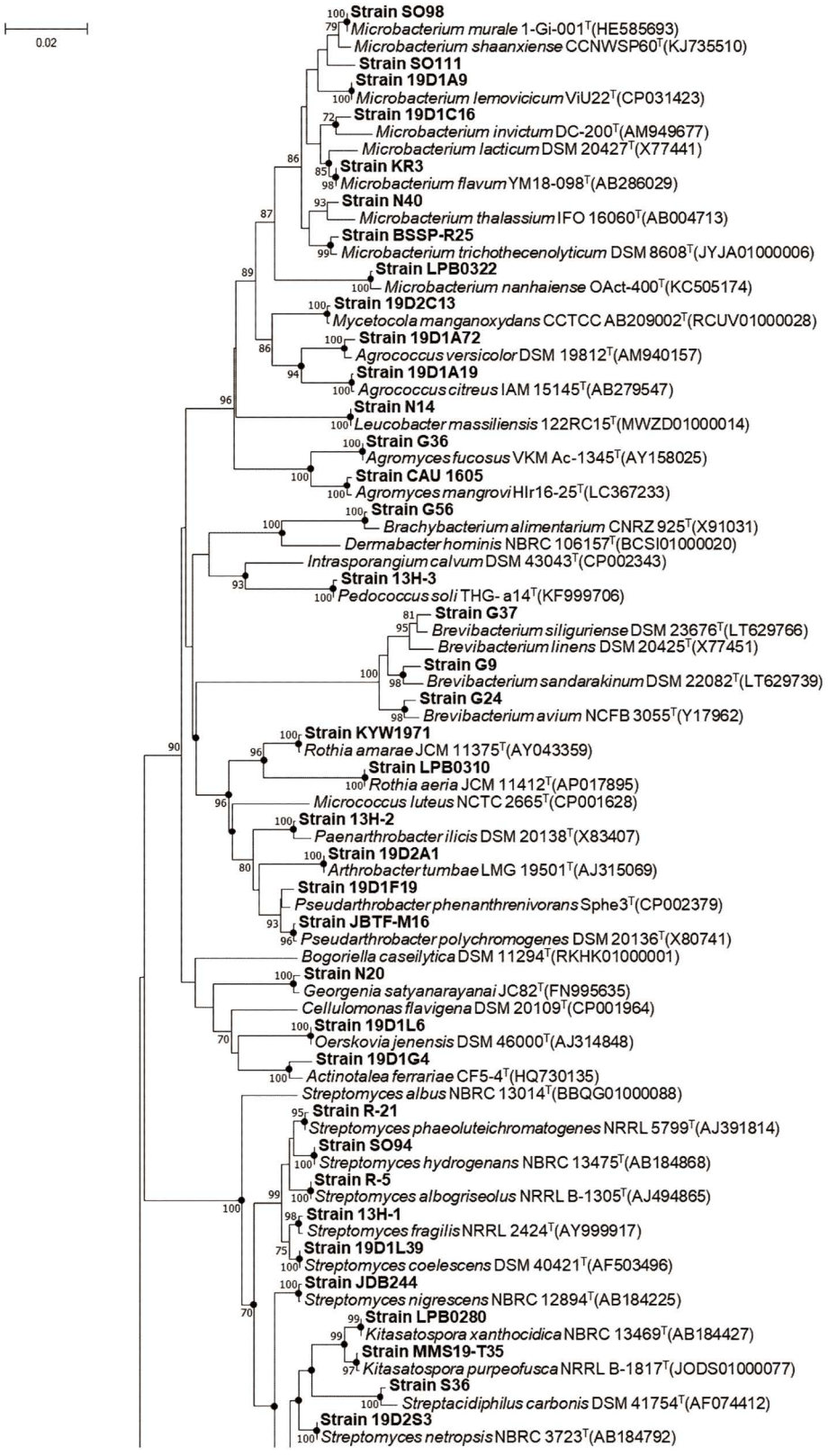


**Fig. 3.** Neighbor-joining phylogenetic tree, based on 16S rRNA gene sequences, showing the relationship between the isolates and their relatives of the phylum *Actinobacteria*. Evolutionary distances, generated using the model of Jukes & Cantor (1969), are based on 1155 unambiguously aligned nucleotides. Bootstrap values (>70%) are shown above nodes. Filled circles indicate the nodes recovered by three other treeing methods including maximum likelihood, maximum parsimony and neighbor-joining. Bar, 0.02 substitutions per nucleotide position.

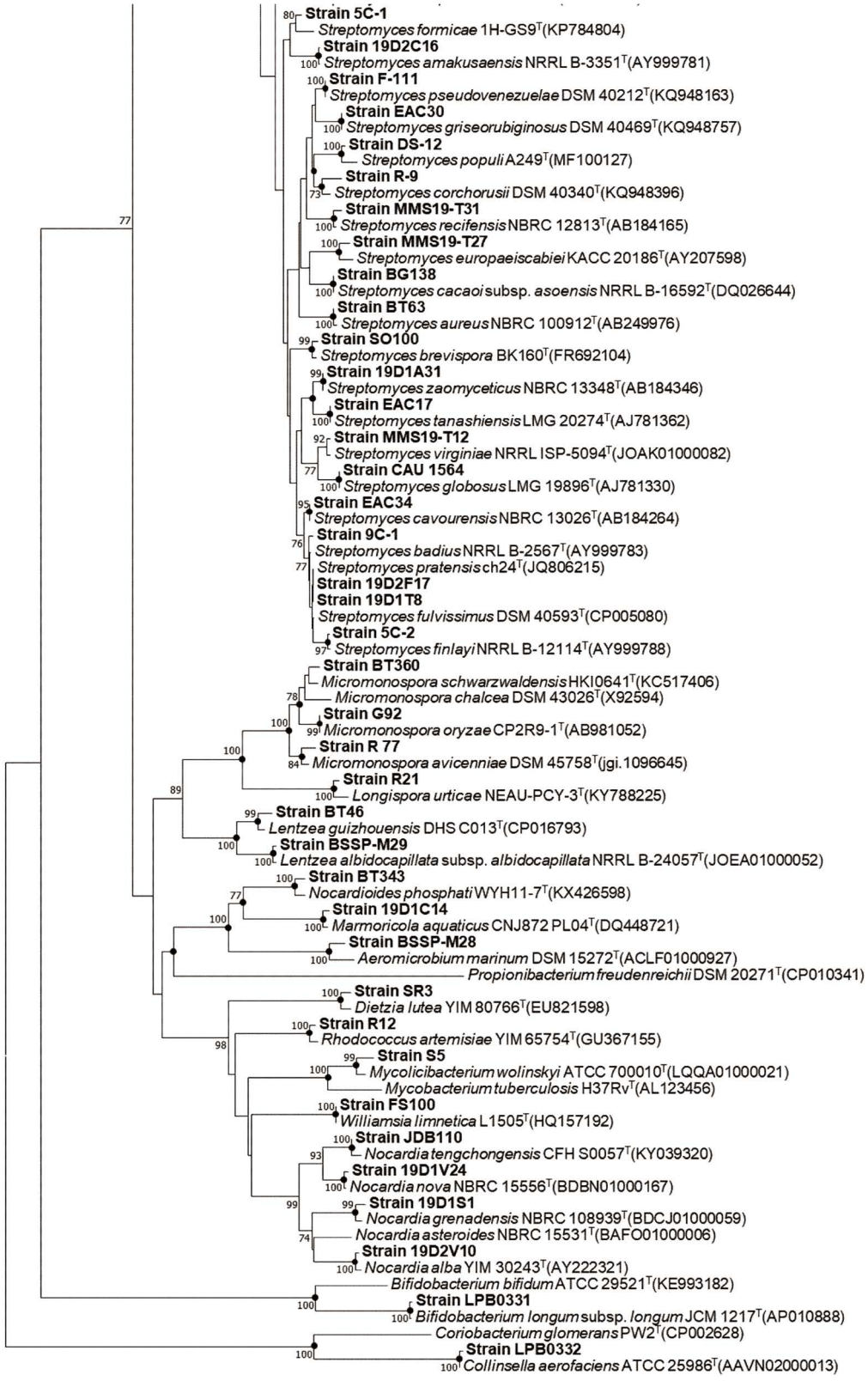


**Fig. 3.** Continued.

Strain LPB0331 (=NIBRBAC000503355) was isolated from the intestine of a laboratory mouse in Daejeon, Korea (36°23′56.11″N 127°23′41.76″E).

**Description of *Georgenia satyanarayanai* N20**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, convex, entire and white colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis of esculin, oxidase activity and utilization of D-glucose, D-mannose, *N*-acetyl-glucosamine, D-maltose and potassium gluconate. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of gelatin, β-galactosidase activity and utilization of L-arabinose, D-mannitol, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain N20 (=NIBRBAC000503416) was isolated from ginseng-cultivated soil in Yeongju, Gyeongsangbuk Province, Korea (36°53′51.5″N 128°28′02.3″E).

**Description of *Brevibacterium avium* G24**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, smooth and cream colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction and utilization of D-glucose, L-arabinose, D-mannitol, potassium gluconate, capric acid, malic acid, trisodium citrate and phenylacetic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity, oxidase activity and utilization of D-mannose, *N*-acetyl-glucosamine, D-maltose and adipic acid. Strain G24 (=NIBRBAC000503412) was isolated from ginseng-cultivated soil in Yeongju, Gyeongsangbuk Province, Korea (36°53′51.5″N 128°28′02.3″E).

**Description of *Brevibacterium sandarakinum* G9**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, smooth and orange colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction and utilization of D-glucose, D-mannitol, potassium gluconate, malic acid and trisodium citrate. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity, oxidase activity and utilization of L-arabinose, D-mannose, *N*-acetyl-glucosamine, D-maltose, capric acid, adipic acid and phenylacetic acid. Strain G9 (=NIBRBAC000503403) was isolated from ginseng-cultivated soil in Yeongju, Gyeongsangbuk Province, Korea (36°53′51.5″N 128°28′02.3″E).

**Description of *Brevibacterium siliguriense* G37**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, smooth and light orange colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction and utilization of D-glucose, D-mannose, D-mannitol, potassium gluconate, capric acid, malic acid, trisodium citrate and phenylacetic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity, oxidase activity and utilization of L-arabinose, *N*-acetyl-glucosamine, D-maltose and adipic acid. Strain G37 (=NIBRBAC000503413) was isolated from ginseng-cultivated soil in Yeongju, Gyeongsangbuk Province, Korea (36°53′51.5″N 128°28′02.3″E).

**Description of *Actinotalea ferrariae* 19D1G4**

Cells are aerobic, Gram-staining-positive, non-flagellated and short rod shaped. Colonies are circular, convex, glistening and yellow colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, glucose fermentation, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, D-mannose, *N*-acetyl-glucosamine (weak) and D-maltose. In the API 20NE system, negative reaction for indole production, arginine dihydrolase, urease activity, oxidase activity and utilization of L-arabinose, D-mannitol, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 19D1G4 (=NIBRBAC000503262) was isolated from soil around the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Oerskovia jenensis* 19D1L6**

Cells are facultatively aerobic, Gram-staining-positive, flagellated and rod shaped. Colonies are circular, convex, glistening and light yellow colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, glucose fermentation, urease activity, esculin hydrolysis, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-glucosamine, D-maltose and potassium gluconate. In the API 20NE system, negative reaction for indole production, arginine dihydrolase, gelatin hydrolysis, oxidase activity and utilization of D-mannitol, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 19D1L6 (=NIBRBAC000503263) was iso-

lated from soil around the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Brachybacterium alimentarium* G56**

Cells are aerobic, Gram-staining-positive, non-flagellated and coccoid or ovoid. Colonies are circular, smooth, glistening and yellow colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for urease activity, hydrolysis of esculin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose and potassium gluconate. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, hydrolysis of gelatin, oxidase activity and utilization of capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain G56 (=NIBRBAC000503405) was isolated from ginseng-cultivated soil in Yeongju, Gyeongsangbuk Province, Korea (36°53′51.5″N 128°28′02.3″E).

**Description of *Pedococcus soli* 13H-3**

Cells are aerobic, Gram-staining-positive, non-flagellated and coccoid. Colonies are circular and white colored after incubation for 3 days on R2A agar at 20−40°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, potassium gluconate, malic acid and trisodium citrate. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of D-maltose, capric acid, adipic acid and phenylacetic acid. Strain 13H-3 (=NIBRBAC 000503224) was isolated from meadow soil in Yeongwol, Gangwon Province, Korea (37°23′04.0″N 128°41′01.3″E).

**Description of *Agrococcus citreus* 19D1A19**

Cells are aerobic, Gram-staining-positive, non-flagellated and ovoid or short rod shaped. Colonies are circular, convex, glistening and yellow colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for esculin hydrolysis and β-galactosidase activity. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, gelatin hydrolysis, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 19D1A19 (=NIBRBAC000503254) was isolated from soil around the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Agrococcus versicolor* 19D1A72**

Cells are aerobic, Gram-staining-positive, non-flagellated and ovoid or short rod shaped. Colonies are circular, convex, glistening and orange colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin and β-galactosidase activity. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 19D1A72 (=NIBRBAC000503256) was isolated from soil around the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Agromyces fucosus* G36**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are entire, convex and yellow colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for hydrolysis of esculin and utilization of L-arabinose, D-mannitol, *N*-acetyl-glucosamine and phenylacetic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of gelatin, β-galactosidase activity, oxidase activity and utilization of D-glucose, D-mannose, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid and trisodium citrate. Strain G36 (=NIBR BAC000503404) was isolated from ginseng-cultivated soil in Yeongju, Gyeongsangbuk Province, Korea (36°53′51.5″ N 128°28′02.3″E).

**Description of *Agromyces mangrovi* CAU 1605**

Cells are aerobic, Gram-staining-positive, non-flagellated and short rod shaped. Colonies are circular, convex, smooth, shiny, opaque and yellow colored after incubation for 2−3 days on marine agar at 30°C. In the API 20NE system, positive reaction for esculin hydrolysis and β-galactosidase activity. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, gelatin hydrolysis and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CAU 1605 (=NIBRBAC000503252) was isolated from tidal flat sediment in Incheon, Korea (37°32′41.0″N 126°25′ 53.9″E).

**Description of *Leucobacter massiliensis* N14**

Cells are aerobic, Gram-staining-positive, non-flagella-

ted and rod shaped. Colonies are circular, convex, glistening and yellow colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for hydrolysis of esculin, oxidase activity and utilization of D-mannitol. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain N14 (=NIBRBAC000503414) was isolated from ginseng-cultivated soil in Yeongju, Gyeongsangbuk Province, Korea (36°53′51.5″N 128°28′02.3″E).

**Description of *Microbacterium flavum* KR3**

Cells are aerobic, Gram-staining-positive, non-flagellated and ovoid or rod shaped. Colonies are circular, convex and yellow colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for hydrolysis of esculin, β-galactosidase activity and utilization of D-glucose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, malic acid and trisodium citrate. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of gelatin, oxidase activity and utilization of L-arabinose, capric acid, adipic acid and phenylacetic acid. Strain KR3 (=NIBRBAC000503401) was isolated from salted, fermented scallop (jeotgal) in Anseong, Gyeonggi Province, Korea (37°0′39.15″N 127°15′50.82″E).

**Description of *Microbacterium invictum* 19D1C16**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, convex, glistening and light yellow colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin (weak) and β-galactosidase activity. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 19D1C16 (=NIBRBAC000503259) was isolated from soil around the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Microbacterium lemovicicum* 19D1A9**

Cells are aerobic, Gram-staining-positive, non-flagellated and short rod shaped. Colonies are circular, convex, glistening and yellow colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, β-galactosidase activity and oxidase activity. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 19D1A9 (=NIBRBAC000503253) was isolated from soil around the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Microbacterium murale* SO98**

Cells are aerobic, Gram-staining-positive, non-flagellated and short rod shaped. Colonies are circular, smooth, opaque and yellow colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, esculin hydrolysis and utilization of D-glucose, L-arabinose, D-mannose and D-mannitol. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, gelatin hydrolysis, β-galactosidase activity, oxidase activity and utilization of *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain SO98 (=NIBRBAC000503304) was isolated from forest soil in Yeongju, Gyeongsangbuk Province, Korea (36°51′27.2″N 128°27′28.6″E).

**Description of *Microbacterium nanhaiense* LPB0322**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, convex, entire and yellow colored after incubation for 3 days on R2A agar medium at 25°C. In the API 20NE system, positive reaction for esculin hydrolysis, β-galactosidase activity and utilization of potassium gluconate. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, gelatin hydrolysis, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain LPB0322 (=NIBRBAC000503354) was isolated from seashore sand in Taean, Chungcheongnam Province, Korea (36°29′14.5″N 126°20′4.67″E).

**Description of *Microbacterium shaanxiense* SO111**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, smooth, opaque and cream colored after incubation for 3 days on TSA at

25°C. In the API 20NE system, positive reaction for nitrate reduction, esculin hydrolysis and β-galactosidase activity. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, gelatin hydrolysis, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain SO111 (=NIBRBAC 000503305) was isolated from forest soil in Yeongju, Gyeongsangbuk Province, Korea (36°51′27.2″N 128°27′ 28.6″E).

**Description of *Microbacterium thalassium* N40**

Cells are aerobic, Gram-staining-positive, flagellated and rod shaped. Colonies are circular, convex and yellow colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, glucose fermentation, hydrolysis of esculin and gelatin and utilization of D-glucose, D-mannose, D-mannitol, D-maltose and potassium gluconate. In the API 20NE system, negative reaction for indole production, arginine dihydrolase, urease activity, β-galactosidase activity, oxidase activity and utilization of L-arabinose, *N*-acetyl-glucosamine, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain N40 (=NIBRBAC000503417) was isolated from ginseng-cultivated soil in Yeongju, Gyeongsangbuk Province, Korea (36°53′51.5″N 128°28′02.3″E).

**Description of *Microbacterium trichothecenolyticum* BSSP-R25**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, slightly convex, glistening and light yellowish pink colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose and D-maltose. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of D-mannitol, *N*-acetyl-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain BSSP-R25 (=NIBRBAC000503329) was isolated from tidal flat sediment in Boryeong, Chungcheongnam Province, Korea (36°20′15″N 126°53′93″E).

**Description of *Mycetocola manganoxydans* 19D2C13**

Cells are aerobic, Gram-staining-positive, flagellated and rod shaped. Colonies are circular, convex, glistening and yellow colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for esculin hydrolysis, β-galactosidase activity and utilization of D-glucose (weak), L-arabinose, D-mannose, D-mannitol and D-maltose (weak). In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, gelatin hydrolysis, oxidase activity and utilization of *N*-acetyl-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 19D2C13 (=NIBRBAC000503269) was isolated from soil around the Dong River, Gangwon Province, Korea (37°18′48.5″N 128°37′37.6″E).

**Description of *Arthrobacter tumbae* 19D2A1**

Cells are aerobic, Gram-staining-positive, non-flagellated and coccoid. Colonies are circular, convex, smooth and cream colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for esculin hydrolysis, β-galactosidase activity and utilization of D-mannitol and D-maltose. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, gelatin hydrolysis, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 19D2A1 (=NIBRBAC000503267) was isolated from soil around the Dong River, Gangwon Province, Korea (37°18′48.5″N 128°37′37.6″E).

**Description of *Paenarthrobacter ilicis* 13H-2**

Cells are aerobic, Gram-staining-positive, non-flagellated and coccoid or rod shaped. Colonies are circular and yellow colored after incubation for 3 days on R2A agar at 20−40°C. In the API 20NE system, positive reaction for urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, malic acid, trisodium citrate and phenylacetic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, oxidase activity and utilization of capric acid and adipic acid. Strain 13H-2 (=NIBRBAC000503223) was isolated from meadow soil in Yeongwol, Gangwon Province, Korea (37°23′04.0″N 128°41′01.3″E).

**Description of *Pseudarthrobacter phenanthrenivorans* 19D1F19**

Cells are facultatively aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, raised, glistening and light yellow colored after incubation

for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, esculin hydrolysis, β-galactosidase activity and utilization of D-glucose, D-mannose, D-mannitol, D-maltose, potassium gluconate, adipic acid, malic acid, trisodium citrate and phenylacetic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, gelatin hydrolysis, oxidase activity and utilization of L-arabinose, *N*-acetyl-glucosamine and capric acid. Strain 19D1F19 (=NIBRBAC000503260) was isolated from soil around the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Pseudarthrobacter polychromogenes* JBTF-M16**

Cells are aerobic, Gram-staining-negative, non-flagellated and rod shaped. Colonies are circular, convex, glistening and yellowish white colored after incubation for 2 days on marine agar medium at 30°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, malic acid, trisodium citrate and phenylacetic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of L-arabinose, capric acid and adipic acid. Strain JBTF-M16 (=NIBRBAC000503335) was isolated from tidal flat sediment in Jebu Island, Gyeonggi Province, Korea (37°9′48″N 126°37′1″E).

**Description of *Rothia aeria* LPB0310**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, rhizoid, umbonate and white colored after incubation for 3 days on blood agar at 37°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis (weak) of esculin and gelatin and oxidase activity. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain LPB0310 (=NIBRBAC000503349) was isolated from a human respiratory organ in Seoul, Korea (37°34′47.74″N 126°59′56.12″E).

**Description of *Rothia amarae* KYW1971**

Cells are aerobic, Gram-staining-positive, non-flagellated and coccoid. Colonies are circular, convex, smooth, opaque and white colored after incubation for 2 days on marine agar at 25°C. In the API 20NE system, positive reaction for urease activity, hydrolysis of esculin and gelatin and utilization of D-glucose, D-mannose, D-mannitol and D-maltose. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, β-galactosidase activity, oxidase activity and utilization of L-arabinose, *N*-acetyl-glucosamine, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain KYW1971 (=NIBRBAC000503307) was isolated from seawater in Gwangyang, Jeollanam Province, Korea (34°54′24.83″N 127°44′01.47″E).

**Description of *Longispora urticae* R21**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular and yellowish white colored after incubation for 3 days on R2A agar at 10−37°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis of gelatin, β-galactosidase activity, oxidase activity and utilization of potassium gluconate. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain R21 (=NIBRBAC000503218) was isolated from a soil in Yeongwol, Gangwon Province, Korea (37°15′38.4″N 128°36′28.7″E).

**Description of *Micromonospora avicenniae* R_77**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, convex, rough, entire and orange colored after incubation for 3 days on ISP7 agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, D-maltose, potassium gluconate, adipic acid, malic acid and phenylacetic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of *N*-acetyl-glucosamine, capric acid and trisodium citrate. Strain R_77 (=NIBRBAC000503392) was isolated from soil in Sejong, Korea (36°28′42.4″N 127°15′42.0″E).

**Description of *Micromonospora oryzae* G92**

Cells are aerobic, Gram-staining-positive and coccoid. Colonies are filamentous, umbonate and orange colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for arginine dihydrolase, urease activity, hydrolysis of esculin and gelatin and

utilization of D-glucose, L-arabinose, D-maltose and potassium gluconate. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, β-galactosidase activity, oxidase activity and utilization of D-mannose, D-mannitol, *N*-acetyl-glucosamine, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain G92 (=NIBRBAC 000503406) was isolated from ginseng-cultivated soil in Yeongju, Gyeongsangbuk Province, Korea (36°53′51.5″N 128°28′02.3″E).

**Description of *Micromonospora schwarzwaldensis* BT360**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, smooth and orange colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis of gelatin (weak), β-galactosidase activity (weak) and oxidase activity. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain BT360 (=NIBRBAC000503002) was isolated from soil in Jeju Island, Korea (33°28′58.6″N 126°30′44.6″E).

**Description of *Dietzia lutea* SR3**

Cells are aerobic, Gram-staining-positive, non-flagellated and coccoid. Colonies are circular, convex and light orange colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for utilization of D-glucose, D-mannose, potassium gluconate and adipic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity, oxidase activity and utilization of L-arabinose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, capric acid, malic acid, trisodium citrate and phenylacetic acid. Strain SR3 (=NIBR BAC000503402) was isolated from salted, fermented shrimp (jeotgal) in Anseong, Gyeonggi Province, Korea (37°0′39.15″N 127°15′50.82″E).

**Description of *Williamsia limnetica* FS100**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, convex, smooth, opaque and pale pink colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, glucose fermentation, urease activity and utilization of D-mannitol, potassium gluconate, malic acid and trisodium citrate. In the API 20NE system, negative reaction for indole production, arginine dihydrolase, hydrolysis of esculin and gelatin, β-galactosidase activity, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-glucosamine, D-maltose, capric acid, adipic acid and phenylacetic acid. Strain FS100 (=NIBRBAC000503294) was isolated from soil in Suncheon, Jeollanam Province, Korea (34°58′12.4″N 127°28′53.0″E).

**Description of *Mycolicibacterium wolinskyi* S5**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, convex and cream colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for oxidase activity and utilization of D-glucose, D-mannose, D-mannitol, potassium gluconate and malic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of L-arabinose, *N*-acetyl-glucosamine, D-maltose, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain S5 (=NIBR BAC000503408) was isolated from forest soil in Yeongju, Gyeongsangbuk Province, Korea (36°54′12.67″N 128°27′ 32.36″E).

**Description of *Nocardia alba* 19D2V10**

Cells are facultatively aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, flat and white colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, urease activity, hydrolysis of esculin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, potassium gluconate, adipic acid and malic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, hydrolysis of gelatin, oxidase activity and utilization of D-maltose, capric acid, trisodium citrate and phenylacetic acid. Strain 19D2V10 (=NIBRBAC000503270) was isolated from soil in the Dong River, Gangwon Province, Korea (37°18′48.5″N 128°37′37.6″E).

**Description of *Nocardia grenadensis* 19D1S1**

Cells are facultatively aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, umbonate and white colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for hydrolysis of esculin and utilization of D-glucose, potassium gluconate, adipic acid and malic acid. In the API 20NE system, negative reaction for nitrate reduction,

indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of gelatin, β-galactosidase activity, oxidase activity and utilization of L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, capric acid, trisodium citrate and phenylacetic acid. Strain 19D1S1 (=NIBRBAC000503264) was isolated from soil in the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Nocardia nova* 19D1V24**

Cells are facultatively aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, umbonate and white colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for hydrolysis of esculin and utilization of adipic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of gelatin, β-galactosidase activity, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, malic acid, trisodium citrate and phenylacetic acid. Strain 19D1V24 (=NIBRBAC000503272) was isolated from soil in the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Nocardia tengchongensis* JDB110**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, flat, smooth, opaque and white colored after incubation for 4 days on TSA at 25°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis of esculin and utilization of *N*-acetyl-glucosamine and malic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of gelatin, β-galactosidase activity, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, D-maltose, potassium gluconate, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain JDB110 (=NIBRBAC000503295) was isolated from soil in Goheung, Jeollanam Province, Korea (34°27′29.29″N 127°11′14.21″E).

**Description of *Rhodococcus artemisiae* R12**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are smooth, convex and pink colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for indole production, urease activity, hydrolysis of gelatin and utilization of D-glucose, L-arabinose and D-mannose. In the API 20NE system, negative reaction for nitrate reduction, glucose fermentation, arginine dihydrolase, hydrolysis of esculin, β-galactosidase activity, oxidase activity and utilization of D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain R12 (=NIBRBAC000503418) was isolated from ginseng-cultivated soil in Yeongju, Gyeongsangbuk Province, Korea (36°53′51.5″N 128°28′02.3″E).

**Description of *Aeromicrobium marinum* BSSP-M28**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, slightly convex, glistening and yellowish white colored after incubation for 5 days on marine agar at 25°C. In the API 20NE system, positive reaction for hydrolysis of gelatin and utilization of D-glucose. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin, β-galactosidase activity, oxidase activity and utilization of L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain BSSP-M28 (=NIBRBAC000503336) was isolated from tidal flat sediment in Boryeong, Chungcheongnam Province, Korea (36°20′15″N 126°53′93″E).

**Description of *Marmoricola aquaticus* 19D1C14**

Cells are aerobic, Gram-staining-positive, non-flagellated and pleomorphic. Colonies are circular, convex and orange colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose (weak), D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, adipic acid (weak) and malic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of capric acid, trisodium citrate and phenylacetic acid. Strain 19D1C14 (=NIBRBAC000503258) was isolated from soil in the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Nocardioides phosphati* BT343**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, convex, smooth and white colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, arginine dihydrolase, urease activity and utilization of D-glucose, L-arabinose (weak), *N*-acetyl-glucosamine (weak), potassium gluconate, capric acid (weak), adipic acid (weak), malic acid and trisodium citrate. In the

API 20NE system, negative reaction for indole production, glucose fermentation, hydrolysis of esculin and gelatin, β-galactosidase activity, oxidase activity and utilization of D-mannose, D-mannitol, D-maltose and phenylacetic acid. Strain BT343 (=NIBRBAC000502998) was isolated from soil in Jeju Island, Korea (33°28′30.5″N 126°30′39.4″E).

**Description of *Lentzea albidocapillata* subsp. *albidocapillata* BSSP-M29**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular and yellowish gray colored after incubation for 3 days on marine agar at 30°C. In the API 20NE system, positive reaction for arginine dihydrolase, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose and malic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, oxidase activity and utilization of potassium gluconate, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain BSSP-M29 (=NIBRBAC000503328) was isolated from tidal flat sediment in Boryeong, Chungcheongnam Province, Korea (36°20′15″N 126°53′93″E).

**Description of *Lentzea guizhouensis* BT46**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, convex, smooth and white colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis (weak) of esculin and gelatin and β-galactosidase activity (weak). In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain BT46 (=NIBRBAC000502986) was isolated from soil in Pyeongchang, Gangwon Province, Korea (37°42′21.1″N 128°43′01.9″E).

**Description of *Kitasatospora purpeofusca* MMS19-T35**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous or rod shaped. Colonies are circular, convex, erose and brown colored after incubation for 3 days on R2A agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis of gelatin, β-galactosidase activity and utilization of D-glucose, *N*-acetyl-glucosamine, potassium gluconate and malic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin, and utilization of L-arabinose, D-mannose, D-mannitol, D-maltose, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain MMS19-T35 (=NIBRBAC000503382) was isolated from soil in Gurye, Jeollanam Province, Korea (35°16′25.9″N 127°28′34.5″E).

**Description of *Kitasatospora xanthocidica* LPB0280**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are irregular, undulate, flat and cream colored after incubation for 3 days on TSA at 25°C. In the API 20NE system, positive reaction for hydrolysis of esculin (weak), oxidase activity and utilization of D-glucose, L-arabinose (weak), *N*-acetyl-glucosamine, potassium gluconate, malic acid (weak) and trisodium citrate (weak). In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of gelatin, β-galactosidase activity and utilization of D-mannose, D-mannitol, D-maltose, capric acid, adipic acid and phenylacetic acid. Strain LPB0280 (=NIBRBAC000503341) was isolated from soil in Seoul, Korea (37°35′5.01″N 127°1′35.69″E).

**Description of *Streptacidiphilus carbonis* S36**

Cells are aerobic, Gram-staining-positive and filamentous. Colonies are filamentous, umbonate and white colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for hydrolysis of esculin and utilization of D-glucose, D-mannitol, *N*-acetyl-glucosamine and potassium gluconate. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of gelatin, β-galactosidase activity, oxidase activity and utilization of L-arabinose, D-mannose, D-maltose, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain S36 (=NIBRBAC000503409) was isolated from forest soil in Yeongju, Gyeongsangbuk Province, Korea (36°54′12.67″N 128°27′32.36″E).

**Description of *Streptomyces albogriseolus* R-5**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are filamentous, raised, undulate and cream colored after incubation for 3 days on R2A agar at 37°C. In the API 20NE system, positive reaction for nitrate reduction, glucose fermentation (weak), hydrolysis of esculin (weak) and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, adipic acid (weak), malic acid and trisodium

citrate. In the API 20NE system, negative reaction for indole production, arginine dihydrolase, urease activity and utilization of capric acid and phenylacetic acid. Strain R-5 (=NIBRBAC000503388) was isolated from soil in Gurye, Jeollanam Province, Korea (35°11′16.0″N 127°33′02.5″E).

**Description of *Streptomyces amakusaensis* 19D2C16**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, raised and brown colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, oxidase activity and utilization of D-glucose, *N*-acetyl-glucosamine, potassium gluconate, adipic acid and malic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, β-galactosidase activity and utilization of L-arabinose, D-mannose, D-mannitol, D-maltose, capric acid, trisodium citrate and phenylacetic acid. Strain 19D2C16 (=NIBRBAC000503276) was isolated from soil around the Dong River, Gangwon Province, Korea (37°18′48.5″N 128°37′37.6″E).

**Description of *Streptomyces aureus* BT63**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, smooth and yellow colored after incubation for 3 days on 1/10 LB agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, urease activity, hydrolysis of gelatin (weak), β-galactosidase activity (weak) and oxidase activity. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, hydrolysis of esculin and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain BT63 (=NIBRBAC000502992) was isolated from soil in Pyeongchang, Gangwon Province, Korea (37°42′04.5″N 128°42′49.1″E).

**Description of *Streptomyces badius* 9C-1**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, spore-forming and yellow colored after incubation for 3 days on R2A agar at 20−40°C. In the API 20NE system, positive reaction for urease activity, hydrolysis of esculin and gelatin and β-galactosidase activity. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 9C-1 (=NIBRBAC 000503221) was isolated from soil in Yeongwol, Gangwon Province, Korea (37°13′52.7″N 128°28′59.0″E).

**Description of *Streptomyces brevispora* SO100**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, smooth, opaque and white to gray colored after incubation for 4 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-glucosamine, D-maltose and potassium gluconate. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, oxidase activity and utilization of D-mannitol, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain SO100 (=NIBRBAC000503306) was isolated from soil in Yeongju, Gyeongsangbuk Province, Korea (36°51′27.2″N 128°27′28.6″E).

**Description of *Streptomyces cacaoi* subsp. *asoensis* BG138**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, convex, entire and cream colored after incubation for 3 days on TSA at 30°C. In the API 20NE system, positive reaction for nitrate reduction, glucose fermentation (weak), arginine dihydrolase (weak), urease activity (weak), hydrolysis of esculin and gelatin, β-galactosidase activity, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose (weak), potassium gluconate, adipic acid (weak), malic acid (weak) and trisodium citrate (weak). In the API 20NE system, negative reaction for indole production and utilization of capric acid and phenylacetic acid. Strain BG138 (=NIBRBAC 000503380) was isolated from soil in Gurye, Jeollanam Province, Korea (35°16′25.9″N 127°28′34.5″E).

**Description of *Streptomyces cavourensis* EAC34**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, umbonate, opaque and creamy white colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, indole production, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, *N*-acetyl-glucosamine, potassium gluconate, malic acid and trisodium citrate. In the API 20NE system, negative reaction for glucose fermentation, arginine dihydrolase, oxidase activity and utilization of L-arabinose, D-mannose, D-mannitol,

D-maltose, capric acid, adipic acid and phenylacetic acid. Strain EAC34 (=NIBRBAC000503282) was isolated from soil in Jeju Island, Korea (33°24′33.6″N 126°20′26.3″E).

**Description of *Streptomyces coelescens* 19D1L39**

Cells are facultatively aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, convex and orange colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid, trisodium citrate and phenylacetic acid (weak). In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, oxidase activity and utilization of capric acid. Strain 19D1L39 (=NIBRBAC000503274) was isolated from soil around the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Streptomyces corchorusii* R-9**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are filamentous, raised, undulate and light beige colored after incubation for 3 days on R2A agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose (weak), D-mannitol, D-maltose (weak), potassium gluconate and malic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity and utilization of *N*-acetyl-glucosamine, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain R9 (=NIBRBAC000503387) was isolated from soil in Gurye, Jeollanam Province, Korea (35°11′16.0″N 127°33′02.5″E).

**Description of *Streptomyces europaeiscabiei* MMS19-T27**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, convex, erose and brown colored after incubation for 3 days on R2A agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, urease activity (weak), hydrolysis of esculin and gelatin, β-galactosidase activity, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, adipic acid and malic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase and utilization of capric acid, trisodium citrate and phenylacetic acid. Strain MMS 19-T27 (=NIBRBAC000503371) was isolated from soil in Gurye, Jeollanam Province, Korea (35°16′25.9″N 127°28′34.5″E).

**Description of *Streptomyces finlayi* 5C-2**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, spore-forming and gray white colored after incubation for 3 days on R2A agar at 20–40°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, D-mannitol, D-maltose, potassium gluconate and malic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of L-arabinose, D-mannose, *N*-acetyl-glucosamine, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain 5C-2 (=NIBRBAC000503220) was isolated from cave soil in Yeongwol, Gangwon Province, Korea (37°07′46.2″N 128°31′58.6″E).

**Description of *Streptomyces formicae* 5C-1**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, spore-forming and brown white colored after incubation for 3 days on R2A agar at 20–40°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, malic acid and trisodium citrate. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of L-arabinose, capric acid, adipic acid and phenylacetic acid. Strain 5C-1 (=NIBRBAC000503219) was isolated from cave soil in Yeongwol, Gangwon Province, Korea (37°07′46.2″N 128°31′58.6″E).

**Description of *Streptomyces fragilis* 13H-1**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, spore-forming and yellow colored after incubation for 3 days on R2A agar at 20–40°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-maltose and potassium gluconate. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of D-mannose, D-mannitol, *N*-acetyl-glucosamine, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain 13H-1

(=NIBRBAC000503222) was isolated from meadow soil in Yeongwol, Gangwon Province, Korea (37°23′04.0″N 128°41′01.3″E).

**Description of *Streptomyces fulvissimus* 19D2F17**

Cells are facultatively aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, raised and yellow colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose (weak), D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose (weak), potassium gluconate, adipic acid (weak), malic acid and trisodium citrate (weak). In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, oxidase activity and utilization of capric acid and phenylacetic acid. Strain 19D2F17 (=NIBRBAC 000503277) was isolated from soil around the Dong River, Gangwon Province, Korea (37°18′48.5″N 128°37′37.6″E).

**Description of *Streptomyces globosus* CAU 1564**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, smooth, convex, shiny and cream colored after incubation for 3 days on nutrient agar at 37°C. In the API 20NE system, positive reaction for utilization of L-arabinose, D-mannose, *N*-acetyl-glucosamine (weak) and D-maltose. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, D-mannitol, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain CAU 1564 (=NIBRBAC000503235) was isolated from seashore sand in Incheon, Korea (37°31′50.8″N 126°25′53.1″E).

**Description of *Streptomyces griseorubiginosus* EAC30**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are wrinkled, wavy, hilly, opaque and brown colored after incubation for 7 days on TSA at 25°C. In the API 20NE system, positive reaction for hydrolysis of esculin, β-galactosidase activity and oxidase activity. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of gelatin and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain EAC30 (=NIBR BAC000503283) was isolated from soil in Jeju Island, Korea (33°24′33.6″N 126°20′26.3″E).

**Description of *Streptomyces hydrogenans* SO94**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, smooth, opaque and pale yellow colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, indole production, urease activity, hydrolysis of esculin and gelatin and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, potassium gluconate, adipic acid, malic acid, trisodium citrate and phenylacetic acid. In the API 20NE system, negative reaction for glucose fermentation, arginine dihydrolase, β-galactosidase activity, oxidase activity and utilization of *N*-acetyl-glucosamine, D-maltose and capric acid. Strain SO94 (=NIBRBAC000503297) was isolated from soil in Yeongju, Gyeongsangbuk Province, Korea (36°51′27.2″N 128°27′28.6″E).

**Description of *Streptomyces netropsis* 19D2S3**

Cells are facultatively aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are irregular, flat and brown colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity, oxidase activity and utilization of D-glucose, D-mannose, *N*-acetyl-glucosamine, potassium gluconate, adipic acid (weak), malic acid, trisodium citrate and phenylacetic acid (weak). In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase and utilization of L-arabinose, D-mannitol, D-maltose and capric acid. Strain 19D2S3 (=NIBRBAC000503278) was isolated from soil around the Dong River, Gangwon Province, Korea (37°18′48.5″N 128°37′37.6″E).

**Description of *Streptomyces nigrescens* JDB244**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are wavy, wrinkled, opaque and white to gray colored after incubation for 5 days on R2A agar at 25°C. In the API 20NE system, positive reaction for hydrolysis of gelatin. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, hydrolysis of esculin, β-galactosidase activity, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, capric acid, adipic acid, malic acid, trisodium citrate and phenylacetic acid. Strain JDB244 (=NIBRBAC000503303) was isolated from soil in Goheung, Jeollanam Province, Korea (34°27′29.33″N 127° 11′14.21″E).

**Description of *Streptomyces phaeoluteichromatogenes* R-21**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are filamentous, raised, undulate and brown colored after incubation for 3 days on R2A agar at 37°C. In the API 20NE system, positive reaction for nitrate reduction, arginine dihydrolase, urease activity, hydrolysis of esculin and gelatin, β-galactosidase activity (weak) and utilization of D-glucose, L-arabinose (weak), D-mannitol, *N*-acetyl-glucosamine, D-maltose (weak), potassium gluconate, malic acid (weak) and phenylacetic acid (weak). In the API 20NE system, negative reaction for indole production, glucose fermentation and utilization of D-mannose, capric acid, adipic acid and trisodium citrate. Strain R-21 (=NIBRBAC000503389) was isolated from soil in Gurye, Jeollanam Province, Korea (35°11′16.0″N 127°33′02.5″E).

**Description of *Streptomyces populi* DS-12**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous or rod shaped. Colonies are circular, raised, erose and light gray colored after incubation for 3 days on R2A agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid, trisodium citrate and phenylacetic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of D-mannitol and capric acid. Strain DS-12 (=NIBRBAC000503377) was isolated from soil in Daejeon, Korea (36°22′35.4″N 127°20′37.2″E).

**Description of *Streptomyces pratensis* 19D1T8**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, convex, umbonate and cream colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, β-galactosidase activity, oxidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid, trisodium citrate and phenylacetic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity and utilization of capric acid. Strain 19D1T8 (=NIBRBAC000503275) was isolated from soil around the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Streptomyces pseudovenezuelae* F-111**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, convex, filamentous and light yellow colored after incubation for 3 days on R2A agar at 30°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannitol, potassium gluconate and adipic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of D-mannose, *N*-acetyl-glucosamine, D-maltose, capric acid, malic acid, trisodium citrate and phenylacetic acid. Strain F-111 (=NIBRBAC000503378) was isolated from soil in Daejeon, Korea (36°22′33.4″N 127°20′33.8″E).

**Description of *Streptomyces recifensis* MMS19-T31**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, convex, erose and brown colored after incubation for 3 days on R2A agar at 30°C. In the API 20NE system, positive reaction for hydrolysis of esculin and gelatin, β-galactosidase activity (weak) and utilization of D-glucose, L-arabinose (weak), D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate and malic acid. In the API 20NE system, negative reaction for nitrate reduction, indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain MMS19-T31 (=NIBRBAC000503372) was isolated from soil in Gurye, Jeollanam Province, Korea (35°16′25.9″N 127°28′34.5″E).

**Description of *Streptomyces tanashiensis* EAC17**

Cells are aerobic, Gram-staining-positive, non-flagellated and rod shaped. Colonies are circular, smooth, convex, opaque and gray colored after incubation for 3 days on R2A agar at 25°C. In the API 20NE system, positive reaction for nitrate reduction, hydrolysis of esculin and gelatin, β-galactosidase activity and utilization of D-glucose, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, malic acid and trisodium citrate. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, urease activity, oxidase activity and utilization of L-arabinose, D-mannose, D-mannitol, capric acid, adipic acid and phenylacetic acid. Strain EAC17 (=NIBRBAC000503284) was isolated from soil in Chungju, Chungcheongbuk Province, Korea (37°08′ 23.8″N 127°54′41.8″E).

**Description of *Streptomyces virginiae* MMS19-T12**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous or rod shaped. Colonies are circular, convex, erose and pink colored after incubation for 3 days

on R2A agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, arginine dihydrolase, urease activity, hydrolysis of esculin and gelatin and utilization of D-glucose, D-mannose, *N*-acetyl-glucosamine, D-maltose and malic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, β-galactosidase activity and utilization of L-arabinose, D-mannitol, potassium gluconate, capric acid, adipic acid, trisodium citrate and phenylacetic acid. Strain MMS19-T12 (=NIBR BAC000503384) was isolated from soil in Gurye, Jeollanam Province, Korea (35°16′25.9″N 127°28′34.5″E).

**Description of *Streptomyces zaomyceticus* 19D1A31**

Cells are aerobic, Gram-staining-positive, non-flagellated and filamentous. Colonies are circular, flat and dark cream colored after incubation for 4 days on MH agar at 30°C. In the API 20NE system, positive reaction for nitrate reduction, urease activity, hydrolysis of esculin and gelatin (weak), β-galactosidase activity and utilization of D-glucose, L-arabinose, D-mannose, D-mannitol, *N*-acetyl-glucosamine, D-maltose, potassium gluconate, adipic acid, malic acid, trisodium citrate and phenylacetic acid. In the API 20NE system, negative reaction for indole production, glucose fermentation, arginine dihydrolase, oxidase activity and utilization of capric acid. Strain 19D1A31 (=NIBRBAC000503273) was isolated from soil around the Dong River, Gangwon Province, Korea (37°22′56.8″N 128°40′01.2″E).

**Description of *Collinsella aerofaciens* LPB0332**

Cells are anaerobic, Gram-staining-positive, non-flagellated and ovoid shaped. Colonies are circular, convex, entire and cream colored after incubation for 3 days on anaerobe basal medium at 30°C. In the API 20A system, positive reaction for esculin hydrolysis and acid production from D-mannitol, sucrose, D-maltose, salicin, D-xylose, L-arabinose, glycerol, D-cellobiose, D-melezitose, D-raffinose, D-sorbitol, D-rhamnose and D-trehalose. In the API 20A system, negative reaction for oxidase activity, indole formation, urease activity, gelatin hydrolysis and acid production from D-glucose, D-lactose and D-mannose. Strain LPB0332 (=NIBRBAC000503339) was isolated from the intestine of a laboratory mouse in Daejeon, Korea (36°23′56.11″N 127°23′41.76″E).

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