

Diversity of Culturable Microorganisms Associated with Antarctic and Arctic Lichens

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ABSTRACT

Lichens have been regarded as symbiosis between fungi (mycobiont) and green algae or cyanobacteria (photobiont). Although the major parts of lichens are composed of mycobiont and photobiont, other microorganisms (mycobiont) also have been found to have specific relationships with lichens. Through FISH and metagenomic sequence analyses, it has been proposed that *Alphaproteobacteria* was the dominant bacterial taxa in the lichens. Although direct observation through in situ detection and metagenomic approaches provided lots of information on the diversity and distribution of microorganisms in the lichen tissues, studies of culturable microorganism may provide other opportunities to understand the roles of microbiome in lichen ecosystems. In the current study, we isolated 105 microbial cultures from *Cetraria* sp., *Cladonia* sp., *Cladonia borealis*, *Flavocetraria* sp., *Ochrolechia* sp., *Psoroma* sp., *Rhizocarpon* sp., *Stereocaulon* sp., *Umbilicaria* sp., and *Usnea* sp. from Arctic and Antarctic areas. Among them, fifty one bacterial isolates were included in *Actinobacteria* (16 isolates), *Alphaproteobacteria* (9 isolates), *Bacteroidetes* (2 isolates), *Betaproteobacteria* (15 isolates), *Firmicutes* (1 isolate), and *Gammaproteobacteria* (8 isolates), and fifty four fungal isolates were included in *Agaricomycotina* (27 isolates), *Pucciniomycotina* (21 isolates) and *Pezizomycotina* (3 isolates). They were affiliated with *Dothideomycetes*, *Lecanoromycetes*, *Cryptococcus*, *Mrakia*, *Rhodotorula*, *Sporobolomyces*, and *Tremella*. Some of the species such as *Burkholderia*, *Rhodanobacter*, *Sphingomonas*, and *Tremella* were recovered from many different lichen species.

Lichen Samples

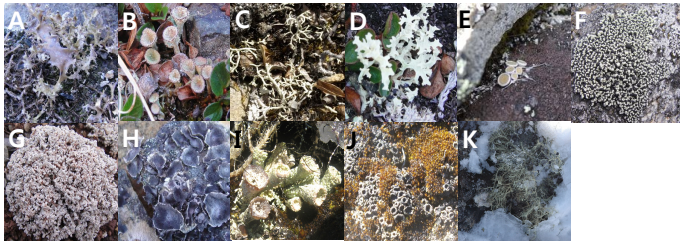
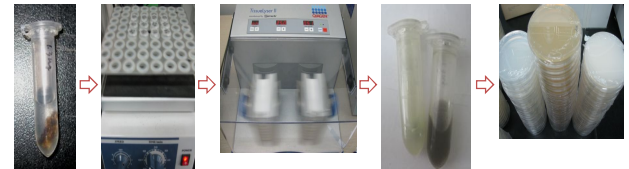


Fig. 1 A, *Cetraria* sp., Arctic; B, *Cladonia pioxidata*, Arctic; C, *Cladonia* sp., Arctic; D, *Flavocetraria* sp., Arctic; E, *Ochrolechia* sp., Arctic; F, *Rhizocarpon* sp., Arctic; G, *Stereocaulon* sp., Arctic; H, *Umbilicaria* sp., Arctic; I, *Cladonia borealis*, Antarctic; J, *Psoroma* sp., Antarctic; K, *Usnea* sp., Antarctic

Isolations and identifications of microorganisms



(1) Wash lichen tissues 5 times with sterilized 0.85% NaCl using multi-shaker for 1 min. (2) Add a autoclaved bullet in the tube and crush samples by shaking vigorously at speed 25.0 frequency/s for 3 minute (3) Spread on R2A, MY, ISP media and incubate at 10 °C (4) Isolation of microorganisms in pure culture (5) Phylogenetic analyses based on 16S rDNA sequences for bacteria and nuLSU rDNA sequences for fungi

Diversity of bacterial and yeast isolates

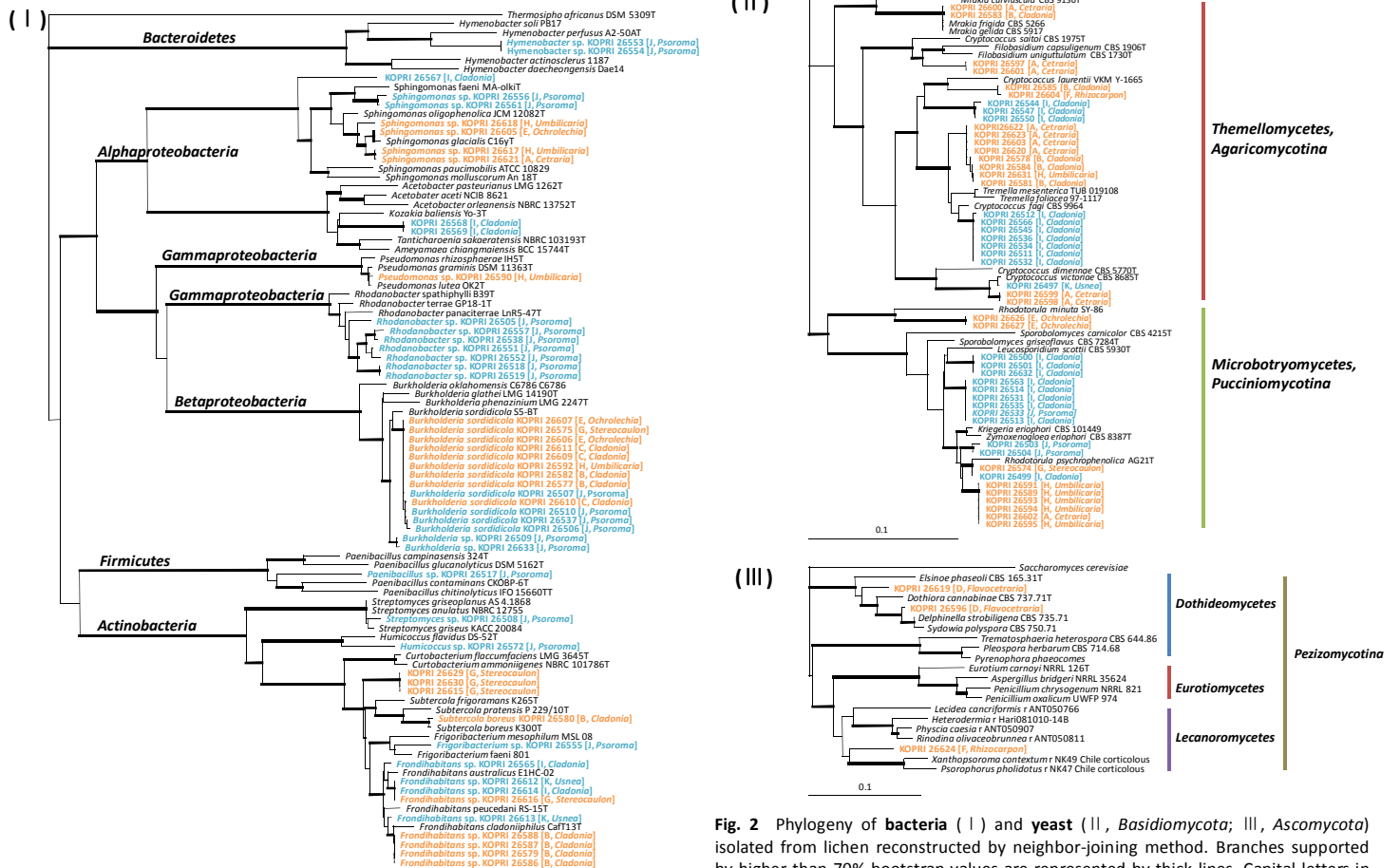


Fig. 2 Phylogeny of bacteria (I) and yeast (II , Basidiomycota; III , Ascomycota) isolated from lichen reconstructed by neighbor-joining method. Branches supported by higher than 70% bootstrap values are represented by thick lines. Capital letters in the bracket indicate the source material presented in the Fig.1.

[F-09]

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