

学 位 論 文 の 要 旨

論文題目 **Bacterial microbiomes associated with rock-dwelling lichens**
(岩石着生性地衣類に共在する細菌相に関する研究)

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Lichens are mutually symbiotic systems consisting of fungal and algal symbionts. While diverse lichen-forming fungal species are known, limited species of algae form lichens. Plasticity in the combination of fungal and algal species with different eco-physiological properties may contribute to the worldwide distribution of lichens, even in extreme habitats. Lichens have been studied systematically for more than 200 years; however, plasticity in fungal–algal/cyanobacterial symbiotic combinations are still unclear. In addition, the association between non-cyanobacterial bacteria and lichens has attracted attention in recent years. The types, diversity, and functions of lichen-associated bacteria have been studied using both culture-based and culture-independent methods. In this study, Rock tripe lichens (*Umbilicariaceae*) were collected from Continental and Maritime Antarctic biological, Arctic and Subarctic Areas in North America and Northern Europe, Alpine Areas in Eastern Alps and Equatorial Africa and Japanese regions; Non-*Umbilicaria* lichens were collected from Guiana and South Africa regions; in order to compare their bacterial floras and potential metabolism. Bulk DNA extracted from the

lichen samples was used to amplify the 18S rRNA gene and the V3-V4 region of the 16S rRNA gene, whose amplicons were Sanger- and MiSeq-sequenced, respectively. The data of each sample were analyzed by regions, and the results of *Umbilicaria* and Non-*Umbilicaria* lichens were comparing respectively. Finally, the results of the overall rock-dwelling lichens were integrated and analyzed.

This doctoral dissertation consists of seven chapters: Chapter 1. Introduction: Chronicle of Research into Lichen-associated Bacteria; Chapter 2. Microbiomic Analysis of Bacteria Associated with Rock Tripe Lichens in Continental and Maritime Antarctic Regions; Chapter 3. Bacterial Microbiomes Associated with Rock Tripe Lichens from Arctic/Subarctic Areas in North America and Northern Europe; Chapter 4. Microbiome Analysis of Bacteria Associated with Rock Tripe Lichens from Alpine Areas in Eastern Alps and Equatorial Africa; Chapter 5. Microbiomes associated with rock tripe lichens dwelling on montane rocks and cliffs in western Japan; Chapter 6. Microbiomes Associated with Epilithic Non-*Umbilicaria* Lichens from the Venezuelan Guiana Shield and the South African Highveld Plateau; Chapter 7. General discussion of approximate global rock-dwelling lichens.