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Non-photosynthetic bacteria and the lichen symbiosis

Common knowledge dictates that the lichen thallus is formed solely by a fungus that develops a symbiotic relationship with an alga and/or cyanobacterium. However, many lichens are able to grow on extremely nutrient-poor substrates, raising the question of how they are able to maintain themselves without a substantial source of nitrogen and other crucial micronutrients. Though non-photosynthetic bacteria have never been accepted as an essential part of the lichen symbiosis, the metabolic processes that they perform may play a vital role in providing the fungi and algae with necessary nutrients and facilitating interactions between them. Here we present evidence that certain non-photosynthetic bacteria may be crucial in the maintenance and evolution of the lichen symbiosis. As part of this study, we have developed several PCR primer sets that target 16S ribosomal sequences of non-photosynthetic eubacteria, but exclude sequences derived from chloroplasts and cyanobacteria. PCR-based surveys were conducted using a fast new method known as Heterogeneous Amplicon Pool Sequence Analysis (HAPSA). Our analyses have revealed a number of interesting and potentially important bacterial lineages associated with lichens. We present several hypotheses concerning the role of non-photosynthetic bacteria in the development, maintenance, and evolution of lichen thalli in nature.

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