Biotechnological Potential of Bacteria Associated to Lichens

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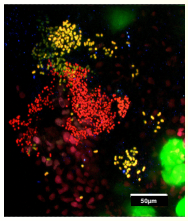
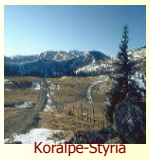
Introduction

Lichens are symbiotic associations of a fungus with a photosynthetic partner. The association allows both partners to develop complex and exposed thallus structures under environmental situations that would usually not be favourable for them in biological solitude. Since most lichens are long-living (up to 1000 years), slow-growing organisms and endure extreme ecological conditions, they may provide a stable and unique niche, wich hosts additional microorganisms. Lichens harbour high abundances of bacteria but their potential for applications in biotechnology is still unexplored. This work had the aim to provide an overview about the biotechnological potential of bacteria associated to lichens.

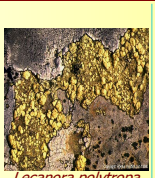
Material and Methods



Bacterial colonies associated with the lichen *Umbilicaria cylindrica*



Koralpe-Styria



Lecanora polytropa

Umbilicaria cilindrica

Cladonia arbuscula

Antagonistic Activity Against

- •Plant Pathogens:
  - *a) Botrytis cinerea*
  - *b) Rhizoctonia solani*
  - *c) Phytophora infestans*
  - *d) Verticillium dahliae*
- • Human Pathogens:
  - *a) Staphylococcus aureus*
  - *b) Erwinia carotovora*

A total of 263 Bacteria were isolated from *Cladonia arbuscula*, *Umbilicaria cilindrica* and *Lecanora polytropa* (Koralpe Styria-Austria)

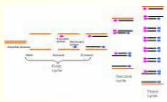
Production of extracellular metabolites

- • Proteases
- • Phosphate solubilization
- • Glucanases
- • Siderophores
- • Auxin production
- • Nitrogen fixation

C. arbuscula, *U. cilindrica* and *L. polytropa* were sampled in Koralpe-Styria

Community DNA Extraction

Presence of PHB synthase genes analysed by PCR using specific primers for phbC gene.



Results

Antagonistic Potential

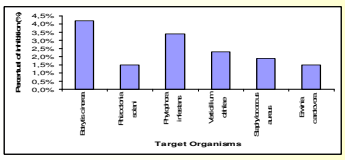
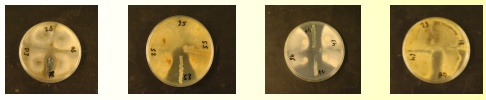


Fig. 1 Evaluation of the antagonistic potential of bacteria isolated from lichens against pathogenic microrganisms.

• It was possible to detect antibacterial and antifungal activity among the tested strains. However, the number of bacteria with antagonistic potential was relatively low. The fungi are more sensitive to the substances produced by the tested microrganisms. Less than 1% of bacterial isolates were active against two or more target organisms

Botrytis cinerea | *Rhizoctonia solani* | *Phytophora infestans* | *Verticillium dahliae*



Metabolic Potential

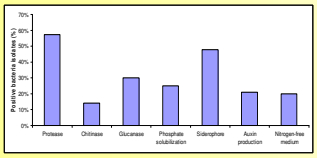
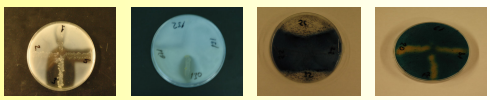


Fig. 2 Metabolic activity of bacteria associated to lichens

• Many of our cultivable strains were able to display enzymatic activities (proteolytic: 58%, chitinolytic: 14%, glucanolytic: 30%), whereas 25% of the strains showed phosphate-solubilizing activity; the ability to excrete siderophores in iron-limited medium and growth in a nitrogen-free medium was observed respectively in 48% and 20% of the strains. The production of auxin was detected among 21% of the tested-isolates.

Proteases | Phosphate solubilization | Glucanases | Siderohpores



Poly-3-hydroxybutyrate Producing Bacteria

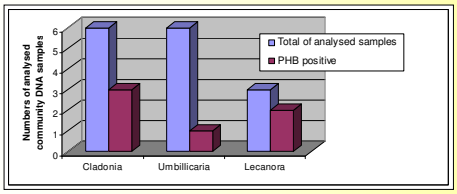


Fig. 3 Determination of PHB *synthase gene* among the tested lichens

• The presence of PHB gene was detected in all three lichens. Out of 15 analysed bacteria-communities from *Cladonia*, *Umbilicaria* and *Lecanora* 6 samples carry the PHBC gene.

Conclusion and future perspectives

- • Lichens contain diverse, rich and very peculiar communities of bacteria with a considerable biotechnological potential.
- • The results showed the bacteria hold a very interesting extracellular metabolic potential; however against the selected pathogens the antagonistic activity was not so efficient.
- • The presence of PHB genes suggest a potential role of bacteria associated to lichens for biopolymer production.
- • The interactions between lichens and bacteria will be investigated in detail to find out more about their importance for biotechnological proposes.