DK-Proposal 20

Submitted by
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Bioactive Compounds from Arctic Microorganisms

Place:
All environments in Greenland, cold and hot springs, acidic environments, alkaline ikaite tufa columns, arid and cold environments, etc.

Disciplines:
Microbiology, Biotechnology, Biochemistry, Chemistry, Ecology.

Motivation:
To describe the microbial diversity in selected Arctic environments and to develop cold active enzymes and bioactive compounds from Arctic microorganisms.
In recent years, cold-active organisms, the so-called *psychrophiles*, and their enzymes have attracted great interest due to their interesting basic research properties and not the least because of their application potentials. Living at temperatures close to 0ºC requires several cellular, metabolic, and structural adaptations, like expression of bio-active compounds and enzymatic activities, structure of enzymes, and membrane stability and permeability. Enzymes and compounds active at low temperatures have been shown to be important in the development of industrial products and processes, which are more efficient, economical, and environmentally safe. Consequently, organisms from the Arctic constitute an important resource for such new bioactive compounds and enzymes, which are active at low temperatures.

In a preliminary project, we have investigated the application potentials of microorganisms from various ecological niches in Greenland. We have collected samples from *e.g*. cold, homothermic springs, hot springs, saline lakes, alkaline ikaite tufa columns, soil, sediment and sea water, and we have isolated more than 5,000 different microbial strains. The strains have been screened for a number of enzymatic activities, and we have characterized in detail cold-active enzymes and their corresponding genes. Up till now, we have isolated several cold-active beta-galactosidases, chitinases, chitosanases, and proteases from cultivable microorganisms from different environments in Greenland.
However, as only 1% or less of the organisms present in Nature may be cultivated, the organisms investigated so far represent only a minority of the total amount of organisms present in an ecological niche. Therefore, uncultivable microorganisms from Greenland represent a new, hitherto untapped resource of enzymes and bioactive compounds.

Research:
This project shall comprise the following activities:
1. Sampling of biological material from different environments in Greenland. Biological samples will be collected from a wide range of different environments in Greenland, including cold and hot springs, acidic environments, alkaline ikaite tufa columns, arid and cold environments.
2. Phylogenetic characterization of cultivable and uncultivable organisms in samples. DNA will be extracted from samples and from cultivable microorganisms and investigated with respect to 16S rRNA sequence analysis.

3. Establishment of strain collections and gene banks. Cultivable microorganisms shall be selected on a variety of cultivation media and arranged in a strain collection, which facilitates high throughput screening for bioactive compounds. DNA will be extracted directly from the samples and used for construction of environmental DNA libraries, similarly arranged in "high throughput screening" format.
4. Screening for cold-active enzymes and bioactive compounds. Strain collections and environmental libraries shall be screened for bioactive compounds and enzymes in high throughput screening in laboratory robots. Bioactive compounds with antimicrobial activity will beisolated in addition to other molecules with biomedical and pharmaceutical application potentials. Similarly, biomedical, biotechnology, and food enzymes shall be isolated.
5. Characterization and evaluation of application potential of enzymes and bioactive compounds. Enzymes and bioactive compounds will be characterized further with respect to their application potentials. Antimicrobial activity and other biomedical applications will be investigated, and enzymes for biomedicin, biotechnology and food applications shall be studied.

Logistics and Synergy:
Sampling of biological material will require extensive logistics support, including research vessels and helicopter services. Consequently, this project may share logistics with other projects operating in difficult accessible and remote areas. Thus, strong synergy exists between this project and DK-Proposal 3: *Bioactive Compounds from Arctic Plants* from The Danish University of Pharmaceutical Sciences. The synergy comprises not only sampling and transport of biological material but also activities as extraction and characterization of bioactive compounds.

References:
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