

Institute: Institute of Botany

Topic: The accumulation rate of essential and trace elements, including heavy metals in usnic acid containing lichen species in the Arctic

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Background information:

One of the most important and widely studied lichen metabolite is usnic acid (2,6-diacetyl-7,9-dihydroxy-8,9b-dimethyl-1,3 (2H, 9bH)-dibenzo-furandione). Its pharmacological potential (antibacterial, antiviral, anti-inflammatory, analgesic, and cytotoxic activity) is well documented (Gallanty et al. 2021). Most of reports published to date have confirmed a relationship between sunlight exposure and usnic acid content in several lichen species, which was linked to its well-known photoprotective effect. Lichens can accumulate essential and trace elements, including heavy metals, in their thalli, as a result of the lack of cuticle or any other system that would block the absorption of different contaminants. This makes them good bioindicators of air pollution, however the interrelationships between metabolites and heavy metals accumulation in their thalli is still unclear (Węgrzyn et al., 2016, 2018). Some authors indicate that lichen metabolites, e.g. usnic acid or atranorin, may act as chelators of cations, including heavy metals, and thus perform a protective role against their toxic effect to the lichen cells. The main aim of the research will be to determine the impact of the varied concentration of the usnic acid in the thallus of selected lichen species occurring in the Arctic tundra on the rate of accumulation of heavy and trace metals as a result of environmental pollution. The research will be carried out based on materials collected in the 1980s and in the present time, in the areas of the Belsund fiord in the western part of Spitsbergen (Svalbard).

The main question to be addressed in the project:

The importance of usnic acid in the process of accumulation of environmental pollutants (essential and trace elements, including heavy metals) in the Arctic tundra lichens.

Information on the methods/description of work:

The main research tasks will be: 1) Collecting fresh material in Spitsbergen and selecting herbarium material from the 1980s for analyses; 2) Determination of the levels of usnic acid and selected essential and trace elements, including heavy metals in historical and fresh samples; 3) Data analysis aimed at determining the relationship between the studied variables.

Additional information:

Advanced knowledge in statistical methods and Geographic Information System.

Place/name of potential foreign collaborator:

UNIS - University of Svalbard

References:

- Galanty A., Wietrzyk-Pełka P., Węgrzyn M.H., Fołta M., Krośniak M., Podolak I., Zagrodzki P. 2021. Quantitative variations of usnic acid and selected elements in terricolous lichen *Cladonia mitis* Sandst., with respect to different environmental factors - A chemometric approach. *Phytochemistry* 192: 112948.
- Węgrzyn, M., Wietrzyk, P., Lisowska, M., Klimek, B., Nicia, P. 2016. What influences heavy metals accumulation in arctic lichen *Cetrariella delisei* in Svalbard? *Polar Science* 10: 532–540.
- Węgrzyn M. H., Wietrzyk-Pełka P., Nicia P., Lehman-Konera S., Olech M. 2018. Short-term monitoring of Arctic trace metal contamination based on *Cetrariella delisei* bioindicator in Svalbard. *Acta Societatis Botanicorum Poloniae* 87: 3600.