Photosynthetic characteristics of lichens of genus *Umbilicaria* from SW Greenland (Nuuk area) in reponse to thallus dehydration

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Introduction

It is well etablished that lichens, typical poikilohydric organisms, are capable to perform photosynthesis under a wide range of water loss from their thalli. However, species-specific response of their photosynthesis, particular processes in photosystem II (PS II) of symbiotic algae, to dehydration is not fully understood. In our study, we used three different approaches to assess photosynthetic process in Antarctic lichens *Umbilicaria arctica* and *Umbilicaria hyperborea* to evaluate desiccation-induced changes to structure and function of photosynthetic apparatus.

(1) Evaluation of effective quantum yield of photosynthetic processes in PS II in response to decreasing water potential
(2) Assesment of spectral reflectance indices PRI, NDVI
(3) Analysis of fast induction kinetics of chlorophyll fluorescence (OJIP)

Material and Methods

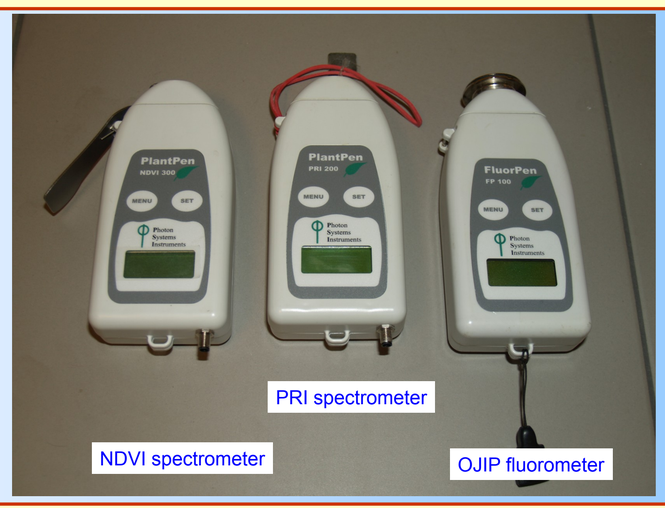
Sample collection

Thalli of foliose epilithic lichens *Umbilicaria arctica* and *U.hyperborea* were collected on the rocks at several locations in the neighbourhood of Nuuk, and transported to the Czech Republic where kept in dry state in dark at 5 oC before experiments. After 48 h rehydration, simultaneous measurements of

Photosynthetic parameters

Effective quantum yield
Lichen thalli were let to follow natural desiccation. The water potential (WP) was measured simultaneously with several photosynthetic characteristics (see below). During gradual dehydration, changes in WP were measured each 30 min, by a dew point water potential meter (WP4T; Decagon Devices, USA), together with **effective quantum yield of photosynthetic processes** in PSII (a fluorometer, PAM 2000, Germany) using saturation pulse method.

Fast fluorescence kinetics (OJIP)
were measured by a FluorPen FP 100 (Photon System Instruments, Czech Republic). This method measures and records a polyphasic rise of fluorescence during the first 3 s after (of sample exposition to continuous light. On the curve resulting from such measurement (OJIP), four typical chlorophyll fluorescence levels can be distinguished. They represent points O, J, I and P, numeric value of which reflects processes of light absorption and efficiency of energy flow through photosystem II and plastoquinone pool

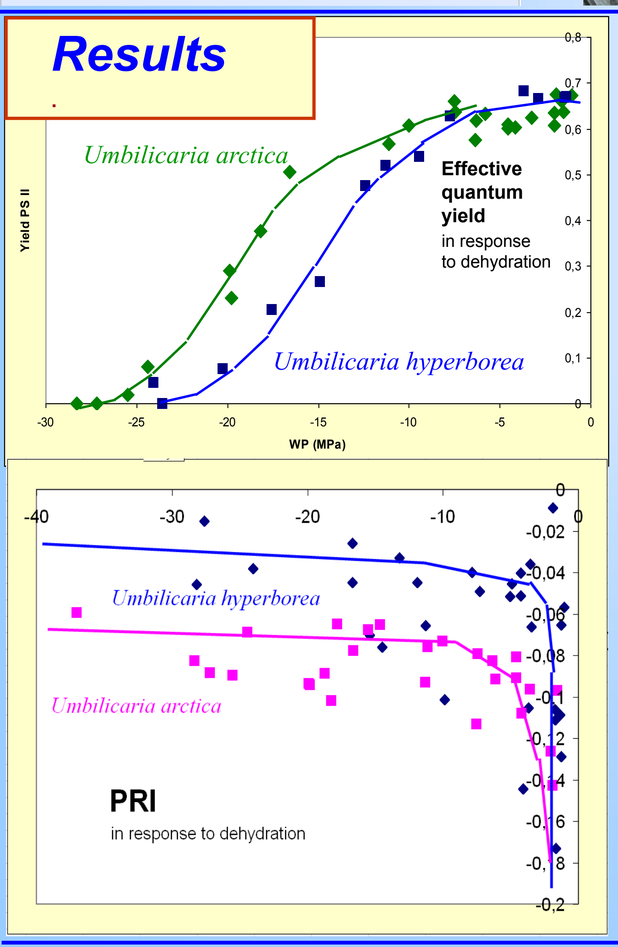


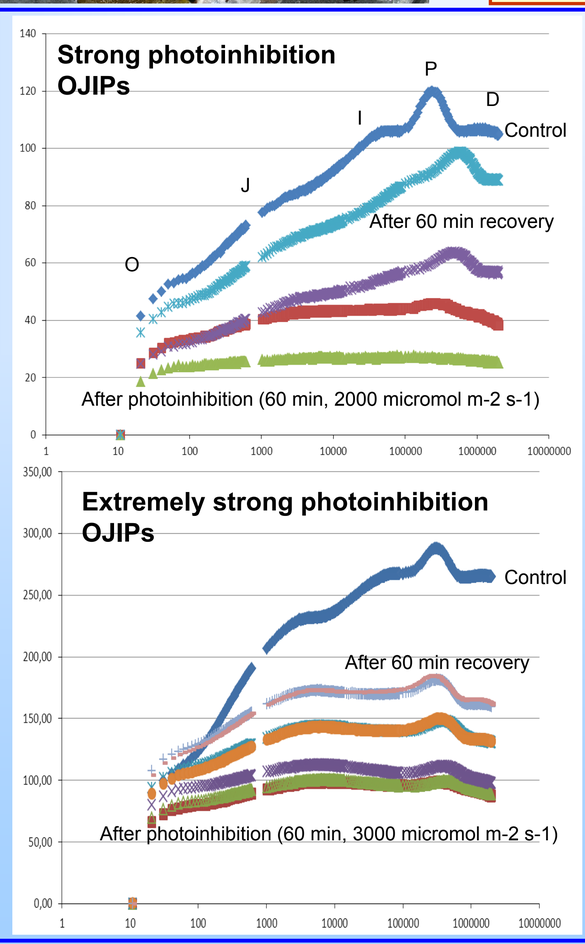
Spectral indices NDVI, PRI

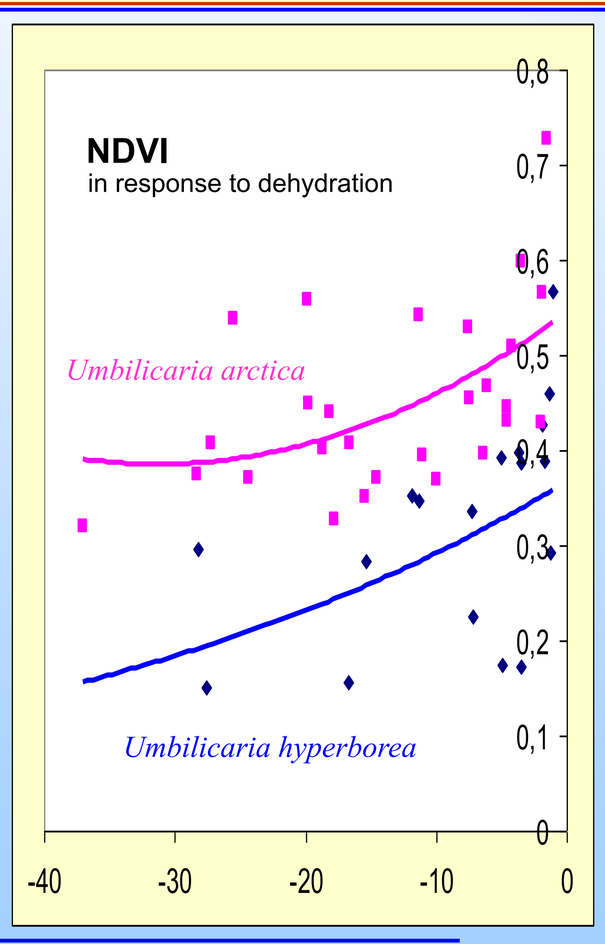
During gradual dehydration of lichen thalli, two commonly used indices, NDVI and PRI, were measured at each WP. Normalized difference vegetation index (NDVI) was measured by PlantPen NDVI 300 (Photon System Instruments, Czech Republic), while photosyntetic reflectance index (PRI) was measured by PlantPen PRI 200 (Photon System Instruments, Czech Republic). Both instruments use particular spectral reflectances (at below-specified wavelengths) for calculation of the indices using the below equations.

NDVI = (R740 – R660)/(R740 + R660)
PRI = (R570-R531)/(R570+R531)

Results







Conclusions

•In our study, *U.arctica* showed higher YieldPSII and less sensitivity to dehydration than *U.hyperborea* in the WP range of -5 to -20 MPa.

•PRI in *U.arctica* and *U.hyperborea* exhibited curvi- linear increase with dehydration. The relation of PRI to WP was,however, species-specific.

•NDVI, a vigor indicator, decreased with dehydration in both species, however, due to generally black color of *U. hyperborea*, the NDVI values were lower throughout all range of dehydrationin the species.

•OJIPs recorded in fully hydrated thalli showed typical polyphasic curves with peak chlorophyll fluorescence level "P„ found at 150-300 ms followed by a dip "D„. With more pronounced dehydration, OJIPs exhibited a decrease in chlorophyll fluorescence signal and photosynthetic parameters derived from OJIPS.

•The results presented in this study indicated a high degreeof tolerance of the two *Umbilicaria* species to partial dehydration stress. However, interspecific differences in photosynthetic parameters were apparent in response to thalli dehydration.

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