Mechanisms of Antarctic lichens resistance to cold and sub-zero temperature. Case study on *Usnea* sp.

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INTRODUCTION

Lichens are important components of vegetation in polar regions. They are resistant to low temperature and even freezing events because they survive polar winter season in dormant state, typically with dry thallus. In dry state, all physiological processes are inhibited. The resistence of wet lichens to freezing temperature, however, is much less understood because several protective mechanisms are activated in wet lichen thalli when they are exposed to sub-zero temperature. Therefore, physiological responses to sub-zero temperature were investigated in two Antarctic representatives of genus *Usnea* in this study.

MATERIAL AND METHODS

Biometrical parameters of *Usnea aurantiaco-atra*, and *U. sphacelata* were studied using thallus cross-sections taken at basal, middle, and apical parts of thallus. The thallus diameter (TD), the thickness of the upper cortex (UCT), distribution of symbiotic alga (*Trebouxia* sp.) in the algal layer, the thickness of medulla (MT), central cord diameter, and area (CCD, CCA) were measured. Estimation of optimum growth temperature of symbiotic alga was done using gradient cultivator approach. Moreover, response of *Trebouxia* sp.) to sub-zero temperature was investigated by linear cooling (from +20 to -30°C) and shock freezing in liquid nitrogen – for details *see* Hájek et al. (2021).

RESULTS AND DISCUSSION

U. sphacelata had comparable relative UCT (0.080 – 0.110, relative to diameter) to *U. aurantiaco-atra* (0.085 – 0.130). The relative MT was higher in *U. sphacelata* (0.240 – 0.300) than *U. aurantiaco-atra* (0.080 – 0.180). In *U. aurantiaco-atra*, the CCA was two times larger than that in *U. sphacelata*. Shock freezing of thalli led to an increase in TD, UCT, CCD because of intrathalline ice crystals formation. Cultivation of symbiotic alga at different temperatures (1.5, 6.0, 15.0, 22.0, and 28.0°C) with repetitive chlorophyll fluorescence parameters measurements showed growth optimum of 15.0°C as indicated by the highest values of potential (F_V/F_M) and effective quantum yield (Φ_{PSII}) reached at this temperature. In linear cooling experiment the temperature-response curves of F_V/F_M and Φ_{PSII} were found triphasic with critical temperature about -20°C.

REFERENCES

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Acknowledgements: Support from the CzechPolar-2 infrastructure, and ECOPOLARIS Project is acknowledged. Help and support of the Extreme Environments Life laboratory team (Masaryk University) is acknowledged as well.