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Can the content of bryophyte ultraviolet-absorbing compounds be estimated by non-destructive methods? A case study in the Colombian Andes

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Bryophytes inhabiting high mountains like the Andes are exposed to harsh environmental conditions, such as high levels of ultraviolet (UV) radiation. The bryophyte UV protection capacity is usually evaluated by quantifying their amount of phenolic UV-absorbing compounds (PUVAC) by spectrophotometry or HPLC. Unfortunately, these methods are destructive and not applicable under field conditions. However, Dualex[®] (Force-A) is a portable instrument allowing the non-destructive estimation of PUVAC in plants, although it has rarely been tested (if ever) on bryophytes. In this study, we measured the bulk level of PUVAC in 56 samples of 28 bryophyte species (18 mosses, 9 liverworts and 1 hornwort) by both destructive (methanolic extracts and then spectrophotometry) methods in the laboratory and non-destructive (Dualex[®]) methods in the field. Our aim was to evaluate the potential use of Dualex[®] to assess the UV protection capacity of bryophytes under field conditions. The experiment took place in the Colombian Andes in July 2018 and bryophytes were collected in an elevation range of 700-3500 m under different sun exposures, from full sun to deep shade. For the spectrophotometrical measurements, we differentiated the PUVAC present in vacuolar soluble forms (S-PUVAC) from those present in cell wall-bound insoluble forms (I-PUVAC), because each type of compounds may represent a different modality of UV protection. We also calculated the total PUVAC (T-PUVAC) as the sum of S-PUVAC and I-PUVAC. Regarding Dualex[®] measurements, we obtained both the flavonol index (Flav) and the anthocyanin index (Anth), given that flavonols and anthocyanins belong to different PUVAC families. Mosses showed higher contents of I-PUVAC and T-PUVAC than liverworts, whereas liverworts showed higher contents of S-PUVAC than mosses, as occurred in temperate bryophytes. The only hornwort collected showed higher contents of T-PUVAC and S-PUVAC than mosses and liverworts, respectively, and similar I-PUVAC contents to liverworts. Flav (but not Anth) reproduced the same results of T-PUVAC for mosses and liverworts. In addition, Flav was strongly and positively correlated with I-PUVAC, in both mosses and liverworts, but no correlation was found between Flav and S-PUVAC. Thus, Dualex[®] have certain limitations to be used in the non-destructive evaluation of UV protection in bryophytes.

Keywords: Ultraviolet protection, Dualex[®], mountain bryophytes, phenolic compounds, flavonoids