RESPONSE OF VASCULAR AND NONVASCULAR PLANTS UNDER WATER STRESS BY INFRARED SPECTROSCOPY

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Introduction. Most plants are sensitive to water stress, which leads to the loss of a large amount of agricultural crops in the world (1); however, the study of the physiological responses of plants highly tolerant to water stress, as *Sellaginella lepidophylla* (vascular plant) and *Pseudocrossidium replicatum* (nonvascular plant), may contribute to the understanding of the mechanisms that allow these plants to adapt to water stress conditions (2). Fourier transform Infrared spectroscopy has been used in recent years as an alternative technique to simultaneously identify and quantify metabolites in biological systems, in a quickly and without sample processing fashion (3).

The aim of this work was to analyze the response of vascular and nonvascular plants under water stress conditions, analyzing the sugars and proteins behavior with respect to water loss.

Methods. Vegetative tissues of *P. replicatum* and *S. lepidophylla* were maintained in an atmosphere at 90% RH for 24 h. The stress treatment consisted of dehydration in a controlled atmosphere at 30% RH. The weight loss and photosynthetic efficiency was determined every 10 min, and the absorbance was measured in the mid-infrared region (650 to 4000 cm^{-1}) using infrared spectroscopy technique in the ATR mode every 2 min.

Results. The loss of weight kinetics show that the decrease in weight is proportional to water loss in tissues, as shown in fig. 1a. For both species it is observed a similar weight decay behavior during 225 mins; however, *S. lepidophylla* losses 50% of its weight and *P. replicatum* 70%, thus the nonvascular plant shows a greater protoplasmatic dehydration tolerance. Figure 1b shows the photosynthetic efficiency of the plant tissues during dehydration, as a physiological parameter. The nonvascular plant shows a different behavior in response to water stress, as a sharp decline on photosynthetic activity occurs at 20 min, while the vascular plant photosynthesis does not decline markedly even during 140 mins.

For both species a water retention time is observed (fig. 2a), 80 mins for *S. lepidophylla* and 15 mins for the moss. This water retention time is not detected in the weight loss kinetics showing the sensitivity of the FTIR analysis.

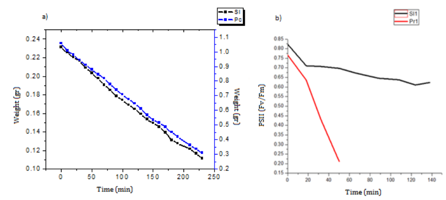

Fig 1. Kinetics of weight loss (a), and photosynthetic efficiency (b) of *P. replicatum* and *S. lepidophylla* during dehydration at 30% RH.

During the water retention time observed above there was an increase in absorbance of sugars (fig. 2b) and proteins (fig. 2c). For the vascular plant *S. lepidophylla* this increase in absorbance might be due to the synthesis of sugars as osmolytes which protect proteins and membranes during the stress (2); as well as synthesis of proteins involved in stress response. In contrast the sugars and proteins absorbance decay only after 40 mins in the nonvascular plant.

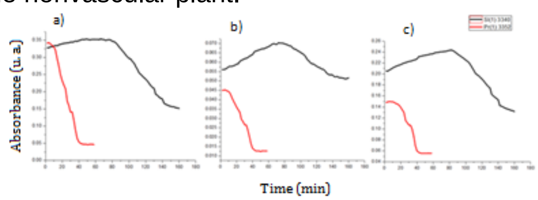

Fig. 2 Kinetic behavior of water (a), proteins (b) and sugars (c), obtained during water stress of vascular and non-vascular plants by FTIR analisys.

Conclusions. The infrared technique was shown to be an effective and sensitive tool in the analysis of plants under water stress, which allows there monitoring the differences in behavior on stress tolerant vascular and nonvascular plants. We showed that the moss has greater protoplasmatic dehydration tolerance.

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References.

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