CARBOHYDRATES AS MODULATORS OF TROPICAL SPECIES ECOPHYSIOLOGICAL PROCESSES AND AS ENVIRONMENTAL STRESS RESPONSES MARKERS

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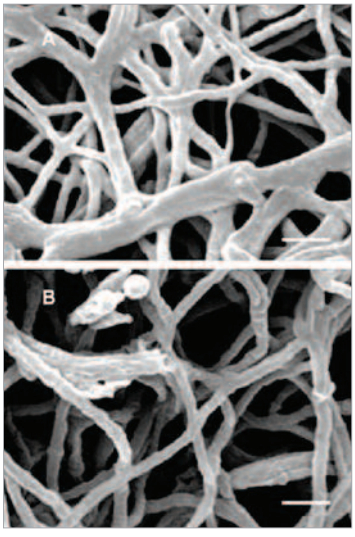
Cerrado general view and native herbaceous species. A restricted cerrado area at Mogi-Guaçu, SP, Brazil (A), Vernonia herbacea *(Vell) Rusby (B),* Viguiera discolor *Baker (C) and* Gomphrena macrocephala *St Hil.(D). Figueiredo-Ribeiro et al. 2007. In: Silva, J.T. (ed.),* Functional Ecosystems and Communities. *Global Science Books Ltd. (UK), Kenobe, Japan.* ***2****: 42-48*

The role of carbohydrates in physiological and biochemical processes in plants has been investigated primarily using crops from temperate climates as model plants. Recent studies performed by our group, with Cerrado and Atlantic Forest native tropical species have shown a high structural, metabolic, and functional diversity of carbohydrates, indicating the presence of a great variety of plant adaptive strategies to environmental conditions. Additionally, our studies has demonstrated the biotechnological potential of carbohydrates and the molecules related to their metabolism, which have novel and specific characteristics. Therefore, the main goal of this project is to study carbohydrates of native tropical species, focusing on their role as modulators of physiological processes and markers of stress conditions in plants. Three model systems were chosen to perform our studies: 1) seeds with different desiccation tolerance, from native species that accumulate different storage carbohydrates, for the analysis of the relationship between these carbohydrates and drought tolerance, maturity and defense; 2) tropical trees explants and fungal cultures cultivated *in vitro*, for the evaluation of carbohydrates as inducers and markers of specific steps in the somatic and zygotic embryogenesis and in morphological differentiation of filamentous fungi; 3) leaves and thickened underground organs of native species, storing starch and soluble sugars, for the investigation of carbohydrates roles as markers of developmental processes and environmental stress responses.

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

Differences in cell wall composition and concentration of soluble sugars and fatty acids between recalcitrant and orthodox tropical legume seeds suggest that these compounds are related to desiccation and freezing tolerance. Fragments of *Sesbania virgata* seed storage carbohydrates induce the production of allelochemicals in the seeds, revealing that cell wall polysaccharides, besides being used as reserve, contain in their own structure, signal molecules that may trigger defensive responses during the plantlet establishment. Seven putative orthologs of *Populus tremuloides* cellulose synthase (*CesA*) genes have been isolated and identified in *Hymenaea courbaril*. These genes are important in understanding the evolution and functional diversification of the *CesA* gene family and may be used for gene expression analysis in woody native species. Studies performed with *Vernonia herbacea*, an herbaceous plant that accumulates fructans, showed that, water deficiency, and low temperature, have caused changes in the activity of the fructan metabolizing enzymes, resulting in increased oligosaccharides level, compounds related to osmoregulation under stress conditions. A fructan exohydrolase (FEH) cDNA sequence was obtained from *V. herbacea* rhizophores, and the functional protein showed to hydrolyze predominantly inulin-type fructans. This is the first study concerning the cloning and functional analysis of a 1-FEH from the Brazilian Cerrado native species. Nutritional studies revealed that nitrogen increase plant growth and productivity in *V. herbacea*. Other environmental stressing factors, such as ozone and high CO_2, have also shown to affect plant growth and fructan metabolism in native and cultivated species. Studies performed with *Penicillium janczewskii*, a filamentous fungus that produce invertases and inulinases, has indicated that changes in the carbon source led to the production of extracellular β-fructofuranosidases with different properties and mycelia walls with altered physical and biological properties. These differences have been attributed to the presence of fructose in the medium. These results highlight the importance of the carbon source for the production of fungal β-fructofuranosidases for biotechnological purposes.



Scanning electron micrographs of Penicillium janczewskii *mycelium grown for 5 days on Czapek solid medium containing (A) sucrose or (B) inulin. Scale bars = 5.0µm. Pessoni et al. 2005.* Mycologia. ***97****: 304–311*

MAIN PUBLICATIONS

Simões K, Du J, Kretzschmar FS, Broeckling CD, Stermitz FR, Vivanco JM, Braga MR. 2008. Phytotoxic catechin leached by seeds of the tropical weed *Sesbania virgata*. *J. Chem. Ecol.* **34**: 681-687.

Figueiredo-Ribeiro RCL, Carvalho MAM, Pessoni RAB, Braga MR, Dietrich SMC. 2007. Inulin and microbial inulinases from the Brazilian Cerrado: Occurrence, Characterization and Potential Uses. In: Silva, J.T. (ed.), *Functional Ecosystems and Communities*. Global Science Books Ltd. (UK), Kenobe, Japan. **2**: 42-48.

Pessoni RAB, Braga MR, Figueiredo-Ribeiro RCL. 2007. Purification and properties of exo-inulinases from *Penicillium janczewskii* growing on distinct carbon sources. *Mycologia.* **99**: 495-503.

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