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Gum exudation in South-American species of *Prosopis* L. (Mimosaceae)

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Abstract

Prosopis species exude a water-soluble gum that has been used as a substitute for arabic gum. The objective of this work was to evaluate the occurrence of natural gum exudation in seven South-American species of *Prosopis* and the productivity of induced-gum exudation. Natural exudates were found in three species: *P. flexuosa*, *P. chilensis* and *P. nigra*. In the latter two, exudates were dark, liquid and bitter, while in *P. flexuosa*, up to 1.6 kg tree^{-1} of amber-clear gum was harvested. High-productive trees were old, with very little vegetative growth and were growing on sandy soils. In order to induce gum exudation, trees were wounded. Wounds exuded copiously during 7 months. Exudation increased during late Summer and Fall, after fruits were ripen.

Keywords: Algarrobo; Gums; Exudates, Patagonia and Monte regions; Argentina

1. Introduction

The arid and semi-arid lands of the world have been providers of chemicals used by man as sources of raw materials such as resins, essential oils, rubber, phenols

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(dyes) and gums, among others (Bates, 1985). These kind of carbon-based secondary metabolites are accumulated preferentially in plants native to arid environments, although their production is low on a per plant basis, due to an inherently low net primary productivity of these ecosystems (Brown and Lomolino, 1998; Ravetta and Soriano, 1998).

Water-soluble gums, a group of chemically related compounds derived from algae and plants, are among these carbon-based metabolites. Chemically, gums are compounds of very high molecular weight composed of sugar units (glycosyl units such as mannose, galatose, etc) branched or linear (Whistler and BeMiller, 1993). They are hydrophilic and form highly viscous, stable aqueous solutions by absorption of water or dispersion in it. They are used as additives in food, cosmetics, paper products, paints, and explosives, among other uses (Ganter and Reicher, 1999).

Commercial plant-gums are obtained from the seeds or by tapping or collecting them from the surface of several species of trees and shrubs, mostly found in arid and semiarid environments (Mantell, 1949; Whistler and BeMiller, 1993). Most of the gum-producing plants belong to the Legume family in genera such as *Astragalus* L. (gum tragacanth), *Acacia* Miller (gum arabic), *Cyamopsis* DC (guar gum), *Cercidium* Tul.(brea gum), *Ceratonia* L.(locust bean gum), and *Prosopis* L. (mesquite gum), among others. These gums can be found in the seeds (Cruz, 1999) and pods (Kalman, 2000), or as gum exudates from the trunk of trees and shrubs (Cerezo, 1969; León de Pinto et al., 1994).

Prosopis species exude a water-soluble gum, that has been used as a substitute for gum arabic during periods of restricted trading or international market shortages. The botanical origin of commercial "mesquite gum" has commonly been attributed in the chemical literature to *P. juliflora* (Swartz) DC, but there are doubts about the true identity of the material used in these studies (Anderson and Farquhar, 1982). The composition of the ash indicates that mesquite gum is predominantly in the form of a calcium salt (Smith and Montogomery, 1959). The molecular weight of gum exuded by *Prosopis alba* Grisebach (South-American species) is 4.6 ($M_W \times 10^5$), while for different North-American *Prosopis* species (*P. glandulosa* Torrey., *P. velutina* Wooton, *P. laevigata* (Humboldt & Bonpland ex Willdenow) M.C. Johnson and *P. juliflora*) this value varies between 0.83 and 8.0 (M_W x 10^5). For all of them, the main sugars found after hydrolysis are arabinose and galactose, with lesser amounts of methylglucuronic acid, glucuronic acid, and rhamnose. In terms of sugar composition *Prosopis* gums contain the same sugar residues as *Acacia* exudates, and has been considered a suitable substitute for gum arabic (Anderson and Farquhar, 1982).

While the chemical composition of the gum is the key aspect in determining the chances of utilization of a particular gum exudate, the amount of exudation per tree/year sets the limits for profitable commercialization of the gum. Natural exudation of gums has been of great commercial importance for centuries, but, although exuded gums have been studied chemically since the 1950s, very little information is published on the tree productivity or the biotic or abiotic factors that modulate the process. Anderson and Farquhar (1982), suggested that conditions that impose