

## Nectar production in *Pitcairnia imbricata* (Bromeliaceae)

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### Introduction

*Pitcairnia* is one of the largest genera in Bromeliaceae with about 321 species (Holst, 1994) and, except for one species in Africa, it is distributed principally in the neotropics. *Pitcairnia imbricata* (Brongniart) Regel is distributed mainly in México, Belize, Guatemala, British Honduras, Honduras, Salvador and Nicaragua (Smith and Downs, 1974). In México, this species is localized in the states of Chiapas, Guerrero, Jalisco, Nayarit, Oaxaca, Puebla, and Veracruz (Espejo-Serna *et al.*, 2005). This terrestrial and saxicolous species is an herb with 1 m. long leaves, black spines near the base of the leaf, red inflorescence bracts, yellow petals (about 6.4-7.5 mm. long) and reddish floral bracts that greatly exceed the sepals (Smith and Downs, 1974, Espejo-Serna *et al.*, 2005).

In bromeliads, nectar secretions have been reported inside the flower, which is quite common, and inclusive extrafloral nectaries that attract ant visitors have been documented (Galletto and Bernardello, 1992). In the family, the nectar secreted by flowers attracts several pollinators such as birds (hummingbirds and perching birds), insects and bats (Baker and Baker, 1983; Scogin and Freeman, 1984; Benzing, 2000). The nectar is the primary floral reward for many pollinators (Simpson and Neff, 1983) and it is a mixture of sugars that reaches 90 % by dry weight. The other 10 % consists of amino-acids, lipids, antioxidants and secondary components (Baker, 1977; Lüttge, 1977). This amount of sugars (glucose, fructose and sucrose) is very important for the pollinators because it is a reward they look for in flowers. Because of these components and their energizing properties bromeliads are very attractive especially for hummingbirds, butterflies and bees (Baker and Baker, 1983; Galletto and Bernardello, 2003).

Nectar-feeding species have been correlated with both sugar ratio (concentration) and composition, suggesting that the nectar characteristics are recognizable by specific pollinators (Hainsworth and Wolf, 1976; Baker and Baker, 1983; Baker and Baker, 1990; Galletto and Bernardello, 2003). In Bromeliads, particularly in *Pitcairnia*, the nectaries are in the base of the ovary (Sajo *et al.* 2004). Plants of *Pitcairnia*, like *Pitcairnia angustifolia* and *P. flammea*, are visited mainly by hummingbirds, flies and bees (Smith and Downs, 1974; Benzing, 2000; Wendt *et al.*, 2002).

This study reports new information about floral nectar and its production in *Pitcairnia imbricata*. Comparative notes are also presented on floral nectar from other bromeliad species.

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## Methodology

Nectar and floral material was collected from plants in cultivation at the Jardín Botánico de Xalapa, Veracruz-México. Nectar samples were extracted and the volume was measured with a graduated micropipette. Single measurements were obtained from separate flowers from two plants on two separate dates (from 10:00 - 12:30 pm) in 2002 and 2003. The average of nectar quantity for each plant is presented in the results obtained each year. The values represent the average of the nectar quantity collected once a day from the middle section of the inflorescence of 2-3 flowers.

The method for determining the “standing crop of nectar” suggested by Kearns and Inouye (1993) was followed. According to this method, the quantity and distribution of nectar are determined by randomly sampling patches of flowers, which provides a measure of the resource available as the average volume of nectar per flower at a single point in time. The sugar concentration of the nectar (°Brix) was measured with a hand-held Brix refractometer (model MT-032 ATC).

## Results

The terrestrial specimens of examined *Pitcairnia imbricata* plants were 1-1.3 m high with conspicuous red floral bracts, (10-14 cm long) and yellow petals 7-7.2 cm long (Figure 1).



Figure 1. *Pitcairnia imbricata*, terrestrial plant in habitat.

## Phenology

Apparently this cultivated plant blooms once a year principally in July, but as with other bromeliads, its flowers do not have a synchrony within the inflorescence, which means that all the flowers in the whole inflorescence are not blooming at the same time, as the flowers open from base to apex. The flowers examined were blooming in the middle of the inflorescence (Figure 2) while buds at the apex had not yet opened.

As observed, this plant was visited by hummingbirds, but the bird species was not identified.

## Nectar

The nectar presents a pale translucent color. The quantity and quality of the nectar

of *Pitcairnia imbricata* are shown in the table 1. During my research, a sticky solution was found in the external part of flowers presenting around 2 °brix.

Sample	date	year	Volume (µl) average	Nectar concentration (°brix) average
1	July 12, 2002	2002	65	20.08
2	July 30, 2002	2002	60	19.95
3	July 03, 2003	2003	70	17.5
4	July 04,2003	2003	55	17.3
Average		2002-2003	62.5	18.7

Table 1: Nectar properties of *Pitcairnia imbricata*. Each sample represents the average of 2-3 flowers measured in the same plant. Samples 1 and 3 were taken from the same plant in different years; the same occurs with samples 2 and 4.

## Discussion

*Pitcairnia imbricata* is a polycarpic species, which means that after giving blooms and fruits, the plant produces ramets in order to repeat the cycle (Benzing, 2000). This polycarpic species blooms every year principally in July (pers. obs.). The tubular flowers with yellow long petals and red floral bracts (Figure 3) are visual signals for pollinators that could be attracted by nectar quantity and quality. There are many hypotheses about the influence of the color and the shape of flowers on the attraction of the pollinators. It is accepted that most yellow and orange flowers are melittophilous (bee-pollinated) and brightly pigmented bracts are a signal for many bird-pollinated Bromeliaceae (Benzing, 2000).



Figure 2. *Pitcairnia imbricata*, details of inflorescence.



Figure 3. *Pitcairnia imbricata*, details of flowers.

The nectar, an important source of energy for birds and other animals, has been little studied in bromeliads. Some interesting research in species of *Tillandsia* and *Puya* reveal differences in nectar  
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concentration (Scogin and Freeman, 1984; Baker and Baker, 1990; Bernardello *et al.*, 1991; Hornung-Leoni *et al.*, *in prep.*).

In *Pitcairnia imbricata* the values of concentration and volume did not vary significantly when measured in 2002 and 2003 (table 1). The nectar concentration of *P. imbricata* (18.7 ° brix in average) showed values similar to other bromeliads. The genus *Pitcairnia* has been considered to be closely related to *Puya* (Smith and Downs, 1974; Holst, 1993; Hornung and Sosa, *in prep.*) However, phylogenetic studies suggest that *Puya* is more related to Bromelioideae than to Pitcairnioideae (Terry *et al.*, 1997; Horres *et al.*, 2000; Crayn *et al.*, 2004; Barfuss *et al.*, 2005). Previous nectar studies refer that species like *Tillandsia complanata* present 21% sugar (Bernardello *et al.*, 1994). In *Puya* subgenus *Puyopsis* nectar sugar concentrations ranged from 21.6 to 33.8 % of sugars (Scogin and Freeman, 1984). However, nectar was reported more diluted (around 8.2-12.6 %) in species like *P. chilensis* and *P. alpestris*, both from subgenus *Puya* (Scogin and Freeman, 1984). One exception in this subgenus is *P. raimondii* in which a higher nectar sugar concentration was found (Hornung *et al.*, *in prep.*), similar to the concentration values documented in subgenus *Puyopsis*.

Flowers of *Pitcairnia imbricata* have a great volume of nectar and during this research extrafloral nectar (outside of sepals) was found with a 2 ° brix of sugar between the floral bracts. It has been suggested that extrafloral nectar is not involved in the pollination and could be of benefit for plants by reducing the number of ants visiting the flowers (Bentley, 1977; Wagner and Kay, 2002). However the function of the extrafloral secretion in this species has not yet been studied.

Many papers deal with the influence of the nectar characteristics on pollinator visit frequency, and its relation to floral form (Hainsworth and Wolf, 1976; Pike and Waser, 1981; Baker and Baker, 1983; Eckhart, 1991; Benzing, 2000; Galetto and Bernardello, 2003). An average concentration of 26% in nectar of flowers visited by hummingbirds has been reported in tropical islands (Pike and Waser, 1981). *P. imbricata* has abundant but more diluted nectar, when compared with other bromeliads, even though the nectar of flowers visited by hummingbirds is usually diluted (Baker, 1975, Pike and Waser, 1981). The floral morphology of *Pitcairnia imbricata* (tubular flowers with long yellow petals), the observed visitors and the nectar characteristics, suggest that the principal visitor and possibly the main pollinator could be hummingbirds. As noted, one hummingbird (unidentified) actually visited the *Pitcairnia* flowers; however other animals could also be routine nectar feeders of *P. imbricata*.

In Bromeliaceae there are species with similar sugar concentrations of nectar that differ in volume and chemical composition. Due to these similarities in nectar concentration, and in order to better understand these relationships with floral visitors, it is recommended that future studies include observation of the visitors, volume and

concentration of nectar, as well as the chemical composition of the nectar.

In Bromeliads, the study of the nectar is an interesting area that varies enormously and represents a scenario to be complemented by the pollination and floral visitors data.

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