

Consumption of the bark of *Albizia niopoides* (Mimosaceae) by *Sapajus cay* Illiger, 1815 (Cebidae: Primates) in the Atlantic Forest fragment of Rancho Laguna Blanca in Eastern Paraguay

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Self-medication in animals, (zoopharmacognosy) is the process by which wild animals use specific plants to combat disease or parasitic infections (Huffman, 2003; Jain et al., 2008). Zoopharmacognosy has been most widely studied in the African great apes with well-known examples including *Pan troglodytes*, *Gorilla gorilla* and *Pan paniscus* ingesting and defecating whole leaves to purge intestinal parasites (Huffman et al., 1996; Huffman, 1997; Huffman & Caton, 2001) and consuming potentially toxic plants with anti-parasitic properties (Clayton & Wolfe, 1993; Masi et al., 2012). In neotropical primates, examples of self-medication include *Ateles belzebuth* and *Alouatta seniculus* consuming soil at mineral licks (Link et al., 2011) and fur-rubbing with noxious invertebrates and strong smelling plants in *Cebus* and *Sapajus* species (Weldon et al., 2003; Leca et al., 2007; Lynch Alfaro et al., 2011), *Ateles geoffroyi* (Laska et al., 2007) and *Aotus* spp. (Jefferson et al., 2014).

The majority of reports of self-medication in capuchins focus on fur-rubbing behaviours (Fragaszy et al., 2004; Paukner & Suomi, 2012; Meuner et al., 2008). Here, we report on observations of Hooded Capuchins in Rancho Laguna Blanca (RLB), feeding on the bark of the tree *Albizia niopoides* (Mimosaceae), a possible case of self-medication.

Rancho Laguna Blanca (RLB) is an 804-ha reserve located in San Pedro, Paraguay (23°49 52.0 S and 56°17 42.2 W) in the Cerrado and Atlantic Forest ecoregions transitional zone. A 243-ha fragment of secondary Upper Paraná Atlantic Forest fragment, characterized by deciduous, mesophytic and broadleaf plants (Lowen et al., 1996), is located within the RLB, which is also home of to two groups of capuchins that have been observed since 2013. A study of the dietary diversity of the two groups (O and F) has been on-going since February 2016. Preliminary results show the capuchins consume at least 20 species of fruit, from 9 families, available throughout the year, as well as large amounts of bamboo, insects and agricultural crops (Smith et al., in prep). O Group consisted of 18 individuals (3 adult males, 5 adult females, 5 subadults, 4 juveniles and 1 infants) (Smith & Briggs, 2015) in February 2016 and one infant was born during the study. F Group consists of around 16 individuals and the exact demographic structure of this group is yet to be confirmed. Scan samples (Altmann, 1974) at one-minute intervals were carried out and when feeding behaviour was observed the food item and processing technique recorded.

Bark eating behaviour was witnessed on multiple occasions throughout the year by individuals of all ages in both capuchin groups. All individuals used the same technique for processing *A. niopoides* sticks, and juveniles were observed exhibiting begging behaviour for sticks that were already being processed by adult monkeys (Figure 1). When removing the bark from sticks the capuchins held the stick in two hands, with one hand at either end or both hands together close of the end of the stick that is inserted into the mouth. The stick was chewed slightly and then the incisor teeth were used to peel the bark from the stick. The bark was then ingested while the stick was thrown to the ground. Individuals spent up to two minutes processing a single stick. On one occasion, an adult male capuchin was observed repeatedly hammering a stick into a tree branch before processing it and consuming the bark. Only the bark of *A. niopoides* was observed being eaten by the capuchins.



Figure 1. Adult female Hooded Capuchin stripping *Albizia niopoides* bark and juvenile capuchin begging at Rancho Laguna Blanca (RLB), San Pedro, Paraguay.

Bark eating can be distinguished from stick chewing behaviour by processing technique. Stick chewing is carried out in order to break apart the twigs to access insect larvae inside (Perry & Manson, 2008) and has been observed in both capuchin groups in RLB (Smith pers obs.). When extracting larvae from sticks, individuals hold the stick in two hands, with both hands grasping the same end of the stick, or with a single hand, and insert the other end into their mouths. The stick is then fed through the mouth and chewed until the point at which the hands are within 1 – 3 cm of the mouth, when it is discarded.

It is currently unknown why Hooded Capuchins in RLB consume tree bark when there is an abundance of fruit, insects, leaves, vertebrates, and other high-energy, nutritious foods in both the wet and dry seasons. It may be that the capuchins consume the bark for health benefits rather than for sustenance.

Albizia niopoides is a tall, large-crowned tree with smooth, yellowish bark (Arce, 1992). It can reach heights of up to 30 metres, and has a broad geographic range, which includes Central America, the West Indies, and much of South America, with Paraguay being the southernmost area of its distribution (Arce, 1992). Although information on the medicinal properties of *A. niopoides* is very limited, multiple *Albizia* species are known to have medicinal properties, and are used in traditional medicine (Yadava & Tripathi, 2000; Jangwan et al., 2010). *Albizia julibrissin*, *Albizia lebbek*, *Albizia procera*, and *Albizia amara* are important species in Ayurvedic medicine (Kokila et al., 2013). *A. lebbek* is an astringent that is used in traditional medicine to treat various ailments, including boils, the flu, gingivitis, and abdominal tumours (Kokila et al., 2013). Phytochemical analysis of *Albizia* species has isolated bioactive compounds that have several beneficial properties including antitumor, bactericidal and antimalarial activities (Kokila et al., 2013). A new saponin, which showed cytotoxic activity against human aqueous cell carcinoma, was isolated from the bark extract of *A. lebbek* (Jangwan et al., 2010). *Albizia inundata* has shown cytotoxicity against human head and neck squamous cells (Zhang et al., 2011). Alkaloids isolated from

A. amara showed antiplatelets aggregation and antibacterial properties (Yadava & Tripathi, 2000). Derivatives of *Albizia julibrissin* were found to have high antioxidant activity (Lau et al., 2007). Extracts of alkaloids isolated from the bark and leaves of *Albizia adinocephala* were found to inhibit a malarial enzyme (Ovenden et al., 2002). *Albizia zygia* has been found to have antimalarial properties (Abdalla & Laatsch, 2012). This hypothesis that this behaviour is a form of self-medication needs to be tested by thorough phytochemical investigation of *A. niopoides* bark.

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