PLANTS WITH TOXIC PRINCIPLES EATEN BY THE AMAZONIAN MANATEE (*Trichechus inunguis*) (MAMMALIA, SIRENIA)

PLANTAS COM PRINCÍPIOS TÓXICOS CONSUMIDAS PELO PEIXE-BOI AMAZÔNICO (*Trichechus inunguis*) (MAMMALIA, SIRENIA)

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ABSTRACT

In the Amazon, a large number of native and exotic toxic plants and of suspected toxicity has been described (see Tokarnia et al., 2007). Amazonian aquatic and semi-aquatic plants are consumed by a variety of aquatic organisms, including the Amazonian manatee, an herbivorous aquatic mammal of wide distribution in the Amazonian ecosystem. This species has been historically hunted by local communities until current days. In a recent study about the diet of Amazonian manatees in the Mamirauá and Amanã sustainable development reserves, Guterres-Pazin (2010) reported on up to 49 plant species consumed by the manatee, most of which previously undescribed in the literature. Here we identify those plants of the Amazonian manatee diet that contain toxic principles and the effects of the toxic components on other (terrestrial) mammals.

PALAVRAS - CHAVE:

Dieta;

Toxicidade;

Amazônia Central;

Sirenia

RESUMO

Na Amazônia, um grande número de plantas tóxicas, nativas e exóticas, e de toxicidade suspeita, tem sido descrito (ver TOKARNIA et al., 2007). Plantas aquáticas e semi-aquáticas da Amazônia são ingeridas por uma variedade de organismos aquáticos, incluindo o peixe-boi amazônico (*Trichechus inunguis*), um mamífero aquático herbívoro de ampla distribuição no ecossistema amazônico. Animais dessa espécie têm sido historicamente caçados pelas comunidades humanas locais, até os dias de hoje. Em um estudo recente sobre a dieta de *T. inunguis* nas reservas de desenvolvimento sustentável Mamirauá e Amanã, Guterres-Pazin (2010) relatou 49 espécies de plantas ingeridas, a maioria das quais ainda não descritas na literatura. Nesta nota, identificamos algumas plantas componentes da dieta do peixe-boi amazônico que contêm princípios tóxicos e os efeitos dos componentes tóxicos em outros mamíferos (terrestres).

INTRODUCTION

One of the strategies of plants to avoid herbivory are the toxic properties of secondary compounds, produced and stored for defense (RICKLEFS, 1996). These compounds may promote metabolic changes in animals that eat them (e.g., poisoning), sometimes leading to death. The main chemical components of plants, called active principles, are alkaloids, cardiac glycosides, cyanogenetic glycosides, tannins, resins, saponins and toxic albumin. Minerals absorbed by plants, such as selenium, nitrate, oxalate and barium may also be responsible for toxicity (ANDRADE; MATTOS, 1968; CHEEKE, 1998). The toxicity of these compounds depends on the dosage and on the individual who consumes them, causing similar symptoms in mammals (ALBUQUERQUE, 1980).

The effects of toxic plants on animals are extensively studied in cattle due to the potential damage they can cause in livestock through reproductive disorders, weight loss and death of these animals (JAMES et al., 1992). Nowadays, there are at least 88 species of poisonous plants described in Brazil, belonging to 50 genera (RIET-CORREA; MEDEIROS, 2001).

In Amazonia, a large number of native and exotic toxic plants of suspected toxicity has been described (ALBUQUERQUE, 1980; TOKARNIA et al., 2007), but that number is still small because little is known in comparison to the rich biodiversity of plants on that biome. Amazonian aquatic and semi-aquatic plants are ingested by a variety of aquatic organisms, including the Amazonian manatee (*Trichechus inunguis*). Besides feeding on aquatic and semi-aquatic plants (BEST, 1984; GUTERRES et al., 2008; GUTERRES-PAZIN, 2010), this exclusively herbivorous aquatic mammal also feeds on the leaves of riverine trees during the flooded season (Guterres et al., 2008; GUTERRES-PAZIN, 2010.).

A total of 49 species of aquatic and semi-aquatic plants was identified in 246 fecal and stomach content samples of free-ranging Amazonian manatees from the Mamirauá (S 03 º 01 '10.2 ", W 064 ° 53' 43.9") and Amanã (S 02 ° 42'25 .6 ", W 64 ° 37'06 .5") sustainable development reserves in central Amazonia (GUTERRES-PAZIN, 2010).

In this study we review the literature record on toxic principles of those 49 plant species and their known effects on mammals; additionally we report possible effects on the Amazonian manatees.

RESULTS AND DISCUSSION

Guterres-Pazin (2010) analysed 246 faeces and stomach content samples of Amazonian manatees, collected in the Mamirauá and Amanã sustainable development reserves between 1994 and 2008. Among the material analyzed, 49 plant species consumed by the Amazonian manatee were found. Details on the method of sample analysis and the table of plant species comprising the Amazonian manatee diet may be found elsewhere (GUTERRES-PAZIN, 2010).

According to the literature on toxic components, nine (18.3%) of the 49 plant species of the Amazonian manatee diet contain toxic principles: four are laticiferous, four are cyanogenetic (one of which can accumulate nitrites and nitrates), and one contains saponin (Table 1).

Table 1. Frequency of occurrence of plants consumed by the Amazonian manatees, presenting groups with characteristic toxic compounds, according to Diaz et al. (1978[1]); Albuquerque (1980[2]); Medeiros et al. (2003[3]); Barbosa et al. (2007[4]); Guterres et al. (2008[5]); Riet-Corrêa et al. (2009[6]).

Family/species	Popular name in Brazil	Frequency of Occurrence (%)	Group of plant
Apocynaceae			
Rhabdadenia macrostoma	Cipó	0.8	Laticiferous[5]
Convolvulaceae			
Ipomoea squamosa	Batatarana	7.7	Laticiferous [5]
Euphorbiaceae			
Mabea nitida	Seringaí	5.7	Laticiferous [5]
Limnocharitaceae			
Limnocharis flava	Mureru	1.2	Laticiferous [5]
Poaceae			
Hymenachne amplexicaulis	Rabo de raposa	58.5	Cyanogenetic[1, 2]
Paspalum repens	Memeca	43.1	Cyanogenetic[1,2]
Brachiaria purpurascens	Braquiara	6.1	Cyanogenetic[1]
Panicum dichotomiflorum	Capim arroz	5.3	Contains saponin[6]
Echinochloa polystachya	Canarana	22.4	Cyanogenetic[1] and accumulates nitrate and nitrite[3,4]

It is possible, however, that plant species with toxic components other than the nine species listed in Table 1 occur in the diet of the Amazonian manatee. Yet, the lack of information about the chemical composition of many of those plants prevents conclusions in this regard.

Among the laticiferous plants only four were present in the diet of the Amazonian manatee, and in low frequency of occurrence (Table 1). This compound may contain polyisoprene hydrocarbons (rubber), triterpenes, fatty acids, phytosterols and alkaloids (VAN DIE, 1955; YODER; MAHLBERG, 1976). The production of latex represents a defense mechanism and protection against herbivory.

The plant containing saponin, *P. dichotomiflorum*, also had low frequency of occurrence in the diet of the manatee (Table 1). Despite being a highly palatable forage (HOLLAND et al., 1991) and widely distributed plant in Brazil, *P. dichotomiflorum* has caused hepatic photosensitization in sheep (HOLLAND et al., 1991; MILES; WILKINS, 1991; MUNDAY et al., 1993), horses (JOHNSON et al., 2006) and cattle (HOLLAND et al., 1991). The saponin, which acts as a protective barrier and chemical defense system of the plant (WINA et al., 2005), may cause, in ruminants, from irritation in the wall of the digestive tract to severe gastroenteritis (KINGSBURY, 1964). It has been associated with the deposition of crystalloid material in the biliary system and photosensitization in these animals. However, its action on the manatee, which is a non-ruminant herbivore, is still unknown.

Echinochloa polystachya, which accumulates nitrates and nitrites, has been responsible for

poisoning outbreaks by these components in cattle in Brazil (MEDEIROS et al., 2003) and elsewhere (RADOSTITS et al., 2000). This accumulation is closely related to the use of fertilizer and the concentration of wastes in soil and water (REYES et al., 1987). Nitrate is readily reduced to nitrite by the action of bacteria and acid pH in the body of mammals. Nitrites can combine with secondary amines to form nitrosamines - products considered carcinogenic, teratogenic and mutagenic (REYES et al., 1987). Nitrites also oxidize the iron ion in hemoglobin forming methemoglobin, which does not react with oxygen, causing cellular anoxia (MEDEIROS et al., 2003). Clinical signs in cattle are: dyspnea, anorexia, tremors, abdominal cramps, runny nose, among others (MEDEIROS et al., 2003). However, the effects of these substances in the manatee are still unknown, let alone concentration levels tolerated by the species or whether these animals have some mechanism to neutralize these compounds.

Cyanogenetic plants *H. amplexicaulis* and *P. repens* were strongly represented (above 43%) in the diet of the Amazonian manatee (Table 1), while *E. polystachya* and *B. purpurascens* occurred in the diet at 22.4% and 6.1%, respectively (Table 1). Diaz et al. (1978), analyzing specimens from the Amazon region, found a concentration of 23 mg of hydrogen cyanide (HCN) per kilogram of fresh plant in *H. amplexicaulis*, 24 mg in *P. repens*, 10 mg in *B. purpurascens* and 16 mg in *E. polystachya*. Plants that accumulate HCN may cause toxic effects through the action of cyanide ion, from hydrogen cyanide, which acts by inhibiting the enzyme cytochrome oxidase, therefore preventing cells from receiving oxygen from the red blood cells.

A case of food poisoning followed by death was reported in a captive Amazonian manatee at the National Institute of Amazonian Research (INPA), in the state of Amazonas, through accidental ingestion of cassava (*Manihot esculenta* Euphorbiaceae), which contains hydrogen cyanide (HCN) (D'AFFONSECA NETO; VERGARA-PARENTE, 2007). This fact shows that the Amazonian manatee is susceptible to toxic substances in plants. However, there are no other reports of the occurrence of either deaths or physiological, behavioral or physical changes caused by poisoning plants with toxic principles in this manatee species. Nevertheless, the absence of reports to this effect is probably related to the lack of studies addressing the toxicological effects in the Amazonian manatee.

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