



Journal of Biological Sciences

ISSN 1727-3048

science
alert

ANSI*net*
an open access publisher
<http://ansinet.com>

Plants Composing the Diet of Marsh and Pampas Deer in the Brazilian Pantanal Wetland and Their Ethnomedicinal Properties

¹Sônia S. Costa, ¹Daniela B. Oliveira, ²Aniela M. Manço, ¹Giany O. De Melo,
³José Luis P. Cordeiro, ⁴Solange Zaniolo, ⁴Raquel Negrelle and ²Luiz F.B. Oliveira
¹Núcleo de Pesquisas de Produtos Naturais, UFRJ 21 941-590, Rio de Janeiro, RJ, Brazil
²Seção de Mastozoologia, Museu Nacional, UFRJ Quinta da Boa Vista 20 940-040,
Rio de Janeiro, RJ, Brazil
³Centro de Ecologia, Laboratório de Geoprocessamento, UFRGS Cx. Postal 15 007, 91501-970,
Porto Alegre, RS, Brazil
⁴Laboratório Oikos, Departamento de Botânica, UFPR Cx. Postal 19 023, 81531-970, Curitiba, PR, Brazil

Abstract: Marsh deer *Blastocerus dichotomus* (Illiger, 1815) and pampas deer *Ozotoceros bezoarticus* (Linnaeus, 1758) are two wild endangered species of South America whose foraging habits are still little known. This study focuses on the plant species consumed by both deer living at a Private Natural Heritage Reserve in the Brazilian Pantanal wetland as well as the ethnomedicinal properties of those plants. The diet composition was determined by direct observation of foraging activity of these animals during wet and dry seasons. Twenty-one plant species, belonging to thirteen botanical families, were inventoried. Among them, eight plant species, identified as *Andira cuyabensis*, *Cecropia pachystachya*, *Desmodium distortum*, *Lippia alba*, *Ludwigia nervosa*, *Phyllanthus amarus*, *Polygonum acuminatum* and *Vernonia scabra*, are used in Brazil for their healing properties. Five other plant species belong to medicinal botanical genera such as *Mimosa*, *Pavonia*, *Sabicea*, *Sebastiania* and *Sida*. Marsh and pampas deer seem to behave as grazer and browser into the delimited area chosen for our study, feeding on grasses, shoots, leaves and flowers of several shrubs and trees. This study contributes to the knowledge of the feeding habits of those deer and may help with the management of conservation strategies into that Natural Reserve.

Key words: *Blastocerus dichotomus*, *Ozotoceros bezoarticus*, medicinal plants, pantanal wetland, plant diet, ungulates

INTRODUCTION

The population of marsh deer *Blastocerus dichotomus* (Illiger, 1815) and pampas deer *Ozotoceros bezoarticus* (Linnaeus, 1758) two South American native herbivores, has been seriously reduced due to the environmental destruction, hunting and diseases (Andriolo *et al.*, 2001; Gonzáles *et al.*, 1998; Tomas *et al.*, 2001). The knowledge of their particular feeding habits could contribute to their conservation. However, scarce data are available on the food composition of these animals, especially in the Brazilian Pantanal habitat (Jackson and Giulietti, 1988; Tomas and Salis, 2000). For this reason, a multidisciplinary program for the study of the plants used by these deer living in a Private Natural Heritage Reserve (RPPN-SESC Pantanal), created in 1998 at the Pantanal wetland region of Barão de Melgaço (Mato Grosso State, Brazil), has been undertaken.

Plants have provided food and medicine to man. There is no a clear dividing line between food and medicinal plants, mainly in indigenous communities. Food can be used as a medicine and vice-versa (Etkin and Ross, 1982; Moerman, 1996; Ogle *et al.*, 2003; Rivera *et al.*, 2003). Assumed health benefits of some foods allow calling them medicinal foods (Cooper *et al.*, 2005; Sovak, 2001).

Some secondary metabolites occurring in wild plants and not directly involved in plant physiology can be considered as resulting from a response against pathogens and herbivores, reducing the likelihood and extent of attack (Jason, 2005; Krief *et al.*, 2005; Lawler *et al.*, 1998). However, mammalian herbivores ingest many foods containing these secondary metabolites, using both behavioral and physiological strategies to minimize their negative effects (Dearing *et al.*, 2005; Jason, 2005).

The role of secondary metabolites in the human diet for preventing diseases and improving health is continuously stimulating efforts of researchers all over the World (Singh *et al.*, 2003). The influence of the chemical composition of fruits and vegetables in the human's health has been extensively studied, showing that rich diets in these foods protect against several diseases (Kris-Etherton *et al.*, 2002; Singh *et al.*, 2002). In contrast, very few studies have been so far realized with regard to wild animal diet and little is known about the possible medicinal benefits of ingestion of non-nutritional metabolites for animals, in general (Athanasiadou and Kyriazakis, 2004; Cousins and Huffman, 2002; Greathead, 2003).

In this study we focused our attention on the plant species foraged by marsh and pampas deer at the RPPN-SESC Pantanal as well as their potential beneficial effects for the health of these animals. With this aim, those plants consumed by marsh and pampas deer were investigated under an ethnomedicinal point of view, taking into account the difficulty of interpreting popular pharmacological uses.

STUDY AREA

The Private Natural Heritage Reserve SESC Pantanal (Reserva Particular do Patrimônio Natural SESC Pantanal), fully owned by the Serviço Nacional do Comércio (SESC) and established in 1998 at Mato Grosso State (106,500 ha; 56°-57° W and 16-17° S), constitutes a significant and representative sample of the large Pantanal wetlands. According to Silva and Abdon (1998), the study area belongs to the Pantanal of Barão de Melgaço, described as an unit between Cuiabá and Piquiri/Itiquira rivers. The site landscape characteristics-a mosaic composed by permanent rivers, seasonal streams, permanent and seasonal floodplain fresh water lakes, shrub-dominated wetlands and seasonally flooded forests-allowed the designation of the RPPN SESC Pantanal as a Wetland of International Importance in 2002, according to Ramsar (2005).

The study area (6661.2 ha) for the feeding deer observation, delimited in the central-north region of the RPPN SESC Pantanal Reserve (16° 41' 13.08"S; 56° 10' 29.89"W), is characterized by a landscape composed by grassland of native and exotic grasses, termite mounds and some isolated trees and shrubs. In this area - a continuous grass layer interrupted by shrubs and trees in varying proportions - the main growth patterns are associated with an alternating of wet and dry seasons.

MATERIALS AND METHODS

Plant diet inventory: The inventory of plants used by marsh and pampas deer was carried out during two

surveys (approximately 35 days; 8-10 h/day of visual observation). With basis on the visual observation of deer feeding behavior, grasses, herbs, foliages, flowers and buds from shrubs and trees composing their diet were recorded and inventoried. Specimens of those plants, which were observed being consumed at least once by deer, were collected for botanical identification in wet (one survey in December) or dry (one survey in June) seasons (Table 1).

A sample of each plant species was dried, identified by botanists and incorporated in the following Herbaria: UPCB at Universidade Federal do Paraná (PR, Brazil); HNUP at Núcleo de Pesquisas Limnológicas, Universidade Estadual de Maringá (PR, Brazil) and FUEL at Fundação Universidade Estadual de Londrina (PR, Brazil). The identification of these voucher specimens followed standard plant identification, based upon morphological characters of the flowers and fruits. Species identification was accomplished through analytical keys and comparison of materials deposited in different herbaria.

Survey of the ethnomedicinal properties of plants composing the deer's diet:

After the botanical identification of each plant species consumed by marsh and pampas deer we carried out a survey on the ethnobotanical and ethnomedicine uses of those plant species in Brazil. With the aim, we search for the medicinal popular use of each plant species in some of the most representative books and articles published on this subject (Almeida *et al.*, 1998; Berg, 1993; Branch and Silva, 1983; Calixto *et al.*, 1998; Cavalcante, 1973; Corrêa, 1984; Martins *et al.*, 1995; Mors *et al.*, 2000; Pott and Pott, 1994; Pott and Pott, 2000; Rodrigues and Carvalho, 2001; Schwenk and Silva, 1998; Silva and Sales, 2004; Torres *et al.*, 2003).

RESULTS AND DISCUSSION

Twenty-one plant species have been inventoried as important items of these deer's diet (Table 1). Monocotyledon (19.1%) and dicotyledon (80.9%) species from 13 families constitute the main forage diet in the chosen area. Members of Poaceae family showed to be the most representative (19.1%), followed by shrubs and herbs belonging to Fabaceae (14.3%), then Euphorbiaceae (9.5%), Malvaceae (9.5%) and Mimosaceae (9.5%). The Poaceae and Fabaceae families contribute with 4 and 3 species, respectively, while the three last families contribute with 2 species of each. Besides the exotic grass *Brachiaria humidicola*, which was early introduced for cattle forage in the Pantanal region, native dicotyledonous species composing pastures such as *Desmodium*, *Discolobium* and *Mimosa* are also consumed (Allem and Valls, 1987).

Table 1: Plants species composing the diet of marsh deer (*Blastoceros dichotomus*) and pampas deer (*Ozotoceros bezoarticus*) at the Private Natural Heritage Reserve SESC-Pantanal

Plants (Registration No.)	Organ plant eaten		
	<i>O. bezoarticus</i>	<i>B. dichotomus</i>	Collection
Dicotyledon	<i>O. bezoarticus</i>	<i>B. dichotomus</i>	Collection
Asteraceae			
<i>Vernonia scabra</i> Pers. (UPCB 46141)	n.o.	Stems, buds, young leaves	Jun/2002
Cecropiaceae			
<i>Cecropia pachystachya</i> Trec. (HNUP 2076)	Leaves	Young leaves	Jun/2002
Euphorbiaceae			
<i>Phyllanthus amarus</i> Schum. et Thon. (UPCB 48068)	Aerial parts	n.o.	Dec/2001
<i>Sebastiania brasiliensis</i> Spreng (UPCB 461560)	Stems, leaves and flowers	n.o.	Dec/2001
Fabaceae			
<i>Andira cuyabensis</i> Bth. (UPCB 48067)	Fruits	n.o.	Jun/2002
<i>Desmodium distortum</i> (Aubl.) J. F. Macbr. (UPCB 48065)	n.o.	Young leaves, buds	Dec/2001
<i>Discolobium pulchellum</i> Benth. (UPCB 48069)	n.o.	Stems, young leaves, buds	Jun/2002
Malvaceae			
<i>Pavonia angustifolia</i> Bth. (UPCB 48070)	n.o.	Stems, leaves and flowers	Jun/2002
<i>Sida santaremensis</i> Mont. (UPCB 48060)	n.o.	Stems, leaves, buds, flowers	Jun/2002
Melastomataceae			
<i>Rynchanthera novemnervia</i> DC. (UPCB 49264)	n.o.	Leaves, flowers	Jun/2002
Mimosaceae			
<i>Mimosa debilis</i> H&B. ex. Willd. (UPCB 47549)	Buds, leaves, fruits	n.o.	Dec/2001
<i>Mimosa xanthocentra</i> Mart. (UPCB 48062)	Buds, fruits	Buds, fruits	Dec/2001
Onagraceae			
<i>Ludwigia nervosa</i> (Poir.) Hara (UPCB 49194)	Leaves	Leaves	Dec/2001
Polygonaceae			
<i>Polygonum acuminatum</i> H.B.K. (UPCB 48071)	n.o.	Stems and leaves	Jun/2002
Rubiaceae			
<i>Sabicea aspera</i> Aubl. (UPCB 48066)	n.o.	Buds, young leaves	Jun/2002
Sterculiaceae			
<i>Melochia villosa</i> (Mill.) Faw et R. (UPCB 47445)	Stems, leaves, buds	Stems, leaves and buds	Dec/2001
Verbenaceae			
<i>Lippia alba</i> (Mill.) N. E. Brown. (UPCB 48064)	Aerial parts	Aerial parts	Jun/2002
Monocotyledon	<i>O. bezoarticus</i>	<i>B. dichotomus</i>	
Poaceae			
<i>Axonopus purpusii</i> (Mez) Chase (UPCB 48072)	Stems, leaves, inflorescences	n.o.	Jun/2002
<i>Brachiaria humidicola</i> (Rendle) Schweick. (= <i>B. dictyoneira</i>) (UPCB 48061)	Aerial parts	Aerial parts	Dec/2001
<i>Brachiaria</i> sp.	Aerial parts	n.o.	Dec/2001
<i>Oryza latifolia</i> Desv. (UPCB 46145)	n.o.	Leaves	Jun/2002

n.o., not observed forage

From the twenty-one plant species, *Cecropia pachystachya* (Cecropiaceae), *Lippia alba* (Verbenaceae), *Ludwigia nervosa* (Onagraceae), *Melochia villosa* (Sterculiaceae), *Mimosa xanthocentra* (Mimosaceae) and *Brachiaria humidicola* (Poaceae) were shown to be foraged by both marsh and pampas deer. Pampas deer were observed eating *Andira cuyabensis* (Fabaceae), *Axonopus purpusii* (Poaceae), *Mimosa debilis* (Mimosaceae), *Phyllanthus amarus* (Euphorbiaceae), *Sebastiania corniculata* (Euphorbiaceae) and *Brachiaria* sp. (Poaceae). The following nine species *Desmodium distortum* (Fabaceae), *Discolobium*

pulchellum (Fabaceae), *Oryza latifolia* (Poaceae), *Pavonia angustifolia* (Malvaceae), *Polygonum acuminatum* (Polygonaceae), *Rynchanthera novemnervia* (Melastomataceae), *Sabicea aspera* (Rubiaceae), *Sida santaremensis* (Malvaceae) and *Vernonia scabra* (Asteraceae) had been seen being ingested only by marsh deer.

Eight plant species composing the diet of those deer are also used as traditional medicine (Fig. 1). Six other ones belong to genera from which numerous species are employed in the Brazilian popular medicine mainly against infectious and inflammatory symptoms (Almeida *et al.*,

Table 2: Ethnomedicinal properties of plants used in Brazilian folk medicine and consumed by marsh deer and pampas deer at the Private Natural Heritage Reserve SESC-Pantanal

Ethnomedicinal uses [#]	Plant species							
	<i>Andira cuyabensis</i>	<i>Cecropia pachystachya</i>	<i>Desmodium distortum</i>	<i>Lippia alba</i>	<i>Ludwigia nervosa</i>	<i>Phyllanthus amarus</i>	<i>Polygonum acuminatum</i>	<i>Vernonia scabra</i>
Central nervous system's troubles	-	-	-	e, g	-	-	f, h	d, g
Circulatory and heart disorders	-	g	-	g	-	-	-	-
Diabetes	-	g	-	-	-	b, d	-	-
Eye diseases	-	g	-	-	-	-	-	d, g
Fever/pain	-	-	-	f, g	-	d	h	-
Genital infections	-	g, I	-	-	-	d	f, h	-
Haemorrhoids	-	-	-	-	-	-	d, f, h	-
Hepatitis	-	-	-	-	-	b, d	-	-
Intestinal and gastric problems	g	g	-	a,d,e,f,g	-	b, d	d, f, h	-
Parasites/Worms	d, g	-	-	-	-	-	d, f, h	-
Respiratory diseases	-	g, I	-	e, g	-	-	-	g
Rheumatism/contusions	-	-	-	g	c	-	d, f, h	-
Skin diseases	-	g	-	-	-	d	f, h	-
Snake bites	-	-	g	-	-	-	-	-
Stimulant of the menstruation/abortive	-	-	-	g	-	j	-	-
Urinary troubles	-	g, I	-	-	-	b,d,g,j,k	-	-

[#]As reported by ^aBranch and Silva (1983), ^bCalixto *et al.* (1998), ^cCavalcante (1973), ^dCorrêa (1984), ^eMartins *et al.* (1995), ^fMors *et al.* (2000), ^gPott and Pott (1994), ^hPott and Pott (2000), ⁱRodrigues and Carvalho (2001), ^jSilva and Sales (2004) and ^kTorres *et al.* (2003)

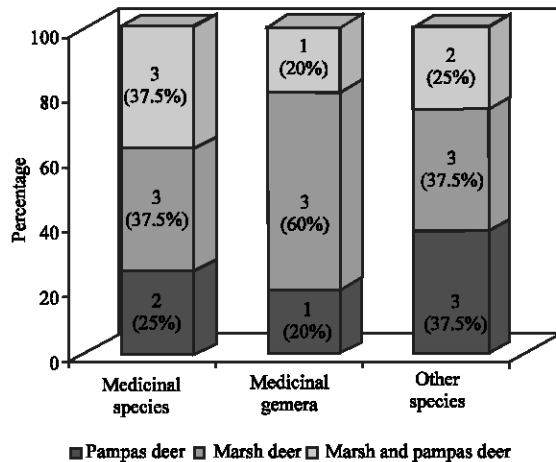


Fig. 1: Distribution and characteristics of the twenty-one plant species foraged by marsh and pampas deer at the Private Natural Heritage Reserve SESC-Pantanal

1998; Berg, 1993; Branch and Silva, 1983; Calixto *et al.*, 1998; Cavalcante, 1973; Corrêa, 1984; Martins *et al.*, 1995; Mors *et al.*, 2000; Pott and Pott, 1994; Pott and Pott, 2000; Rodrigues and Carvalho, 2001; Schwenk and Silva, 1998; Silva and Sales, 2004; Torres *et al.*, 2003).

Different ethnomedicinal uses are associated with *Andira cuyabensis*, *Cecropia pachystachya*, *Desmodium distortum*, *Lippia alba*, *Ludwigia nervosa*, *Phyllanthus amarus*, *Polygonum acuminatum* and *Vernonia scabra*, based on the above authors (Table 2). In quantitative terms, the most frequently reported medicinal uses of these plants are related to gastrointestinal, central

nervous system's, genital, respiratory and skin troubles, rheumatism/contusions and fever/pain. Second line ethnomedicinal uses deal with circulatory, urinary, eye and menstruation disorders. The highest number of ethnomedicinal uses/citations was observed for *Cecropia pachystachya*, *Phyllanthus amarus*, *Polygonum acuminatum* and *Lippia alba*.

Three of these medicinal species, *Cecropia pachystachya*, *Lippia alba* and *Ludwigia nervosa*, are foraged by both marsh and pampas deer. *Andira cuyabensis* and *Phyllanthus amarus* were consumed by pampas deer while *Desmodium distortum*, *Polygonum acuminatum* and *Vernonia scabra* had been seen being consumed only by marsh deer.

The other medicinal genera composing the deer's diet are *Mimosa*, *Sebastiania* and *Sida* (Corrêa, 1984; Mors *et al.*, 2000), *Pavonia* (Rodrigues and Carvalho, 2001) and *Sabicea* (Branch and Silva, 1983; Rodrigues and Carvalho, 2001).

Plants belonging to *Brachiaria*, *Discolobium*, *Melochia* and *Oryza* genera seem to be used mainly for cattle forage (Allem and Valls, 1987). No medicinal uses were found for these genera in the literature used.

The only reported data on the plant components of the marsh deer (*Blastocerus dichotomus*) diet were available from studies through microscopic analysis of fecal samples from remnant of plant species. Most of the forty-one plant species detected are aquatic or tolerant to seasonal flooding (Tomas and Salis, 2000). According to their data, marsh deer were defined as a grazer-browser strategist as they feed on shoots of shrubs and leaves of macrophytes (Tomas and Salis, 2000). The same method early applied by Jackson and Giulietti (1988) to the study

of food habits of pampas deer (*Ozotoceros bezoarticus*) in Argentinian grasslands revealed the selective grazer behavior of this deer in those habitats.

Our inventory of plant diet of marsh and pampas deer was based on the visual observation of their foraging habits during two surveys at RPPN SESC Pantanal, comprising dry and wet seasons. Marsh and pampas deer seem to behave as grazer and browser into the delimited area chosen for our study, feeding on grasses, herbs and shoots, leaves and flowers of several shrubs and trees. Some of these plants such as *Cecropia pachystachya*, *Desmodium distortum*, *Lippia alba*, *Ludwigia nervosa*, *Melochia villosa*, *Mimosa debilis*, *Mimosa xanthocentra* and *Sebastiania corniculata* were seen to be eaten many times by pampas and/or marsh deer. It was observed an overlapping of 6 plant items (Table 1 and Fig. 1) in the foraging habits of both deer (*Brachiaria humidicola*, *Cecropia pachystachya*, *Lippia alba*, *Ludwigia nervosa*, *Melochia villosa* and *Mimosa xanthocentra*), among the 21 plant species inventoried. Nine items were foraged only by marsh deer, while six other were seen to be consumed by pampas deer (Table 1 and Fig. 1).

It was observed that eight plant species composing the marsh and pampas deer's diet are reputed medicinal and that other five plant species belong to genera used in Brazilian popular medicine to alleviate illness symptoms, mainly inflammatory and infectious processes. It can be affirmed that marsh and pampas deer feed on some medicinal plant species in the habitat shared by both deer during dry and wet seasons.

The plant species *Andira cuyabensis*, *Cecropia pachystachya*, *Desmodium distortum*, *Lippia alba*, *Ludwigia nervosa*, *Phyllanthus amarus*, *Polygonum acuminatum* and *Vernonia scabra* belong to botanic genera possessing several medicinal species in Brazil (data not shown). Some of these medicinal plants have been deserved the attention of chemists and biologists in the search of bioactive compounds. Among the most investigated ones, *Phyllanthus amarus* stands out from the other diet's items by its wide biological activity spectrum that comprises anti-inflammatory (Kassuya *et al.*, 2003, 2005; Raphael and Kuttan, 2003); antibacterial (Kloucek *et al.*, 2005), contraceptive (Rao and Alice, 2001) and mainly antiviral (Notka *et al.*, 2004) activity.

Several reports on the *Lippia alba* and its chemical components have emphasized their medicinal properties such as analgesic (Costa *et al.*, 1989); antiviral (Ruffa *et al.*, 2004) and antibacterial (Caeres *et al.*, 1991). A significant anti-inflammatory activity was demonstrated for *Cecropia pachystachya* (Hikawczuk *et al.*, 1998), which can be seen as a benefit effect in the consuming of this plant popularly used against infectious troubles.

Many of the edible plants that are consumed in the human's diet have both therapeutic and dietary functions, exhibiting health protecting properties such as vermifuge (Tandon *et al.*, 2003), antimicrobial (Lai and Roy, 2004; Schmourlo *et al.*, 2005) or cardiovascular and anticancer activities (Kris-Etherton *et al.*, 2002). However, very little is known about the health benefits of regular consumption of small quantities of medicinal foods (Ogle *et al.*, 2003).

Studies of animal self-medication, until now almost exclusively limited to gorillas and chimpanzees (Cousins and Huffman, 2002; Huffman, 2003), could be advantageously extended to other animal orders such as ungulates like pampas and marsh deer under investigation here. It has also become increasingly apparent that other animals, outside non-human primates, share strong similarities with humans in their use of plants. Clearly the hypothetical link between the pharmacological profiles of the identified plants and their true benefits for deer health remain to be established. It is important to note that, for the present preliminary study, the criteria that determine the plant selection behavior of the deer has not been taken in consideration, a crucial point that will receive a special attention in the next future.

ACKNOWLEDGMENTS

We are indebted to Dr Leopoldo G. Brandão (SESC, Rio de Janeiro, Brazil) for the research grant, means and facilities put at our disposal at RPPN-SESC Pantanal. We are grateful to the RPPN-SESC Pantanal guardians for technical assistance. D.B. De Oliveira thanks CAPES (Brazil) for fellowship. Thanks to Dr J.P. Férézou (CNRS-France) for fruitful discussions and criticisms.

REFERENCES

- Allem, A.C. and J.F.M. Valls, 1987. Recursos forrageiros nativos do Pantanal Matogrossense. Embrapa Cenargen, Brasília.
- Almeida, S.P., C.E.B. Proença, S.M. Sano and J.F. Ribeiro, 1998. Cerrado: Espécies vegetais úteis. Embrapa - CPAC, Planaltina, DF.
- Andriolo, A., U. Piovezan, M.J.R. Paranhos da Costa and J.M.B. Duarte, 2001. Line-transect sampling method used to evaluate the impact of a flooding dam on marsh deer (*Blastocerus dichotomus*) population in the Paraná River, Brazil. Deer Specialist Group News (Newsletters), 16: 1-2.
- Athanasiadou, S. and I. Kyriazakis, 2004. Plant secondary metabolites: Antiparasitic effects and their role in ruminant production systems. Proc. Nutr. Soc., 63: 631-639.

- Berg, M.E. van den, 1993. Plantas medicinais na Amazônia: Contribuição ao seu conhecimento sistemático. Museu Paraense Emílio Goeldi, Belém.
- Branch, L.C. and M.F. Silva, 1983. Folk medicine of Alter do Chão, Pará, Brazil. *Acta Amaz.*, 13: 737-797.
- Caceres, A., A.V. Alvarez, A.E. Ovando and B.E. Samayoa, 1991. Plants used in Guatemala for the treatment of respiratory diseases. 1. Screening of 68 plants against gram-positive bacteria. *J. Ethnopharmacol.*, 31: 193-208.
- Calixto, J.B., A.R.S. Santos, V. Cechinel Filho and R.A. Yunes, 1998. A review of the plants of the genus *Phyllanthus*: Their chemistry, pharmacology and therapeutic potential. *Med. Res. Rev.*, 18: 225-258.
- Cavalcante, P.B., 1973. A farmacopéia Tiriyo: Estudo etnobotânico. Museu Paraense Emílio Goeldi. Publicações Avulsas, 24: 145.
- Cooper, R., D.J. Morré and D.M. Morré, 2005. Medicinal benefits of green tea: Part I. Review of noncancer health benefits. *J. Altern. Complement. Med.*, 11: 521-528.
- Corrêa, M.P., 1984. Dicionário das plantas úteis do Brasil e das exóticas cultivadas. Ministério da Agricultura, Instituto Brasileiro de Desenvolvimento Florestal, Imprensa Nacional, Rio de Janeiro.
- Costa, M., L.C. Di Stasi, M. Kirizawa, S.L.J. Mendaçolli, C. Gomes and G. Trolin, 1989. Screening in mice of some medicinal plants used for analgesic purposes in the State of Sao Paulo. Part II. *J. Ethnopharmacol.*, 27: 25-33.
- Cousins, D. and M.A. Huffman, 2002. Medicinal properties in the diet of gorillas: An ethnopharmacological evaluation. *Afr. Stud. Monogr.*, 23: 65-89.
- Dearing, M.D., W.J. Foley and S. McLean, 2005. The influence of plant secondary metabolites on the nutritional ecology of herbivorous terrestrial vertebrates. *Ann. Rev. Ecol. Evol. Syst.*, 36: 169-189.
- Etkin, N.L. and P.J. Ross, 1982. Food as medicine and medicine as food. An adaptive framework for the interpretation of plant utilization among the Hausa of Northern Nigeria. *Soc. Sci. Med.*, 16: 1559-1573.
- Greathead, H., 2003. Plants and plant extracts for improving animal productivity. *Proc. Nutr. Soc.*, 62: 279-290.
- González, S., J.E. Maldonado, J.A. Leonard, C. Vilà, J.M.B. Duarte, M. Merino, N. Brum-Zorrilla and R.K. Wayne, 1998. Conservation genetics of endangered Pampas deer (*Ozotoceros bezoarticus*). *Mol. Ecol.*, 7: 47-56.
- Hikawczuk, V.J., J.R. Saad, T. Guardia, A.O. Juarez and O.S. Giordano, 1998. Anti-inflammatory activity of compounds isolated from *Cecropia pachystachya*. *An. Asoc. Quim. Arg.*, 86: 167-170.
- Huffman, M.A., 2003. Animal self-medication and ethno-medicine: Exploration and exploitation of the medicinal properties of plants. *Proc. Nutr. Soc.*, 62: 371-381.
- Iason, G., 2005. The role of plant secondary metabolites in mammalian herbivory: ecological perspectives. *Proc. Nutr. Soc.*, 64: 123-131.
- Jackson, J.E. and J.D. Giulietti, 1988. The flood habits of pampas deer *Ozotoceros bezoarticus celer* in relation to its conservation in a relict natural grassland in Argentina. *Biol. Conserv.*, 45: 1-10.
- Kassuya, C.A.L., A.A. Silvestre, V.L.G. Rehder and J.B. Calixto, 2003. Anti-allodynic and anti-oedematogenic properties of the extract and lignans from *Phyllanthus amarus* in models of persistent inflammatory and neuropathic pain. *Eur. J. Pharmacol.*, 478: 145-153.
- Kassuya, C.A.L., D.F.P. Leite, L.V. de Melo, V.L.G. Rehder and J.B. Calixto, 2005. Anti-inflammatory properties of extracts, fractions and lignans isolated from *Phyllanthus amarus*. *Planta Med.*, 71: 721-726.
- Kloucek, P., Z. Polesny, B. Svobodova, E. Vlkova and L. Kokoska, 2005. Antibacterial screening of some Peruvian medicinal plants used in Calleria District. *J. Ethnopharmacol.*, 99: 309-312.
- Krief, S., C.M. Hladik and C. Haxaire, 2005. Ethnomedicinal and bioactive properties of plants ingested by wild chimpanzees in Uganda. *J. Ethnopharmacol.*, 101: 1-15.
- Kris-Etherton, P.M., K.D. Hecker, A. Bonanome, S.M. Coval, A.E. Binkoski, K.F. Hilpert, A.E. Griel and T.D. Etherton, 2002. Bioactive compounds in foods: their role in the prevention of cardiovascular disease and cancer. *Am. J. Med.*, 113: 71-88.
- Lai, P.K. and J. Roy, 2004. Antimicrobial and chemopreventive properties of herbs and spices. *Curr. Med. Chem.*, 11: 1451-1460.
- Lawler, I.R., W.J. Foley, B.M. Eschler, D.M. Pass and K. Handasyde, 1998. Intraspecific variation in *Eucalyptus* secondary metabolites determines food intake by folivorous marsupials. *Oecologia*, 116: 160-169.
- Martins, E.R., D.M. Castro, D.C. Castellani and J.E. Dias, 1995. Plantas Medicinais. Universidade Federal de Viçosa, Brazil.
- Moerman, D.E., 1996. An analysis of the food plants and drug plants of native North America. *J. Ethnopharmacol.*, 52: 1-22.
- Mors, W.B., C.T. Rizzini and N.A. Pereira, 2000. Medicinal Plants of Brazil. Algonac, Michigan.
- Notka, F., G. Meier and R. Wagner, 2004. Concerted inhibitory activities of *Phyllanthus amarus* on HIV replication *in vitro* and *ex vivo*. *Antiviral Res.*, 64: 93-102.

- Ogle, B.M., H.T. Tuyet, H.N. Duyet, D. Xuan and N. Nguyen, 2003. Food, feed or medicine: The multiple functions of edible wild plants in Vietnam. *Econ. Bot.*, 57: 103-117.
- Pott, A. and V.J. Pott, 1994. Plantas do Pantanal. Empresa Brasileira de Pesquisa Agropecuária, CPAP, Distrito Federal.
- Pott, V.J. and A. Pott, 2000. Plantas aquáticas do Pantanal. Empresa Brasileira de Pesquisa Agropecuária, CPAP, Distrito Federal.
- Ramsar, 2005. The Ramsar convention on wetlands. Available at <http://www.ramsar.org/>. Accessed on February 28, 006.
- Rao, M.V. and K.M. Alice, 2001. Contraceptive effects of *Phyllanthus amarus* in female mice. *Phytother. Res.*, 15: 265-167.
- Raphael, K.R. and R. Kuttan, 2003. Inhibition of experimental gastric lesion and inflammation by *Phyllanthus amarus* extract. *J. Ethnopharmacol.*, 87: 193-197.
- Rivera, D., C. Inocencio, C. Obón and F. Alcaraz, 2003. Review of food and medicinal uses of *Capparis* L. Subgenus *Capparis* (Capparidaceae). *Econ. Bot.*, 57: 515-534.
- Rodrigues, V.E.G. and D.A. Carvalho, 2001. Levantamento etnobotânico de plantas medicinais no domínio do cerrado na região do Alto Rio Grande-Minas Gerais. *Ciênc. Agrotec.*, 25: 102-123.
- Ruffa, M.J., M.L. Wagner, M. Suriano, C. Vicente, J. Nadinic, S. Pampuro, H. Salomón, R.H. Campos and L. Cavallaro, 2004. Inhibitory effect of medicinal herbs against RNA and DNA viruses. *Antivir. Chem. Chemother.*, 15: 153-159.
- Schmourlo, G., R.R. Mendonça-Filho, C.S. Alviano and S.S. Costa, 2005. Screening of antifungal agents using ethanol precipitation and bioautography of medicinal and food plants. *J. Ethnopharmacol.*, 96: 563-568.
- Schwenk, L.M. and C.J. Silva, 1998. A etnobotânica da Morraria Mimoso no Pantanal de Mato Grosso. In: III Simpósio sobre Recursos Naturais e Sócio-econômicos do Pantanal. Os Desafios do Novo Milênio. Corumbá (MS), 27-30 Nov 2000, pp: 1-27. Available in: <http://www.cpap.embrapa.br/agencia/congresso/Bioticos/SCHWENK-046.pdf>
- Silva, J.S.V. and M.M. Abdon, 1998. Delimitação do Pantanal brasileiro e suas sub-regiões. *Pesquisa Agropecuária Brasileira*, 33: 1703-1711.
- Silva, M.J. and M.F. Sales, 2004. O gênero *Phyllanthus* L. (Phyllanthaceae-Euphorbiaceae Juss.) no bioma Caatinga do estado de Pernambuco - Brasil. *Rodriguésia*, 55: 101-126.
- Singh, B., T.K. Bhat and B. Singh, 2003. Potential therapeutic applications of some antinutritional plant secondary metabolites. *J. Agric. Food Chem.*, 51: 5579-5597.
- Singh, R.B., G. Dubnov, M.A. Niaz, S. Ghosh, R. Singh, S.S. Rastogi, O. Manor, D. Pella and E.M. Berry, 2002. Effect of an Indo-Mediterranean diet on progression of coronary artery disease in high risk patients (Indo-Mediterranean Diet Heart Study): A randomized single-blind trial. *Lancet*, 360: 1455-1461.
- Sovak, M., 2001. Grape extract, resveratrol and its analogs: A review. *J. Med. Food*, 4: 93-105.
- Tandon, V., B. Das and N. Saha, 2003. Anthelmintic efficacy of *Flemingia vestita* (Fabaceae): Effect of genistein on glycogen metabolism in the cestode, *Raillietina echinobothrida*. *Parasitol. Intl.*, 52: 179-183.
- Tomas, W.M. and S.M. Salis, 2000. Diet of marsh deer (*Blastocerus dichotomus*) in the Pantanal wetland, Brazil. *Stud. Neotrop. Fauna Environ.*, 35: 165-172.
- Tomas, W.M., S.M. Salis, M.P. Silva and G.M. Mourão, 2001. Marsh deer (*Blastocerus dichotomus*) distribution as a function of floods in the Pantanal wetland, Brazil. *Stud. Neotrop. Fauna Environ.*, 36: 9-13.
- Torres, D.S.C., I. Cordeiro and A.M. Giulletti, 2003. O gênero *Phyllanthus* L. (Euphorbiaceae) na Chapada Diamantina, Bahia, Brasil. *Acta Bot. Bras.*, 17: 265-278.