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MINERAL COMPOSITION OF ARBOREAL AND BUSH SPECIES OCCURRING IN PASTURES, IN PERNAMBUCO-BRAZIL

COMPOSIÇÃO MINERAL DE ESPÉCIES ARBÓREAS E ARBUSTIVAS EM PASTAGENS, PERNAMBUCO-BRASIL

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ADDITIONAL KEYWORDS

Native species. Cultivated species. Dry zone. Humid zone.

PALAVRAS CHAVE ADICIONAIS

Agreste. Espécies nativas. Espécies cultivadas. Sertão. Zona da Mata.

SUMMARY

The aim of the present study was to evaluate, during the dry and wet seasons the mineral composition of tree and bush species occurring in pasture areas near the cities of Itambé, Caruaru and Serra Talhada in the humid, intermediate, and dry climatic zones of the state of Pernambuco (Brazil). Leaves and branches up to 5.0 mm in diameter were collected for the determination of N, P, Mg and K concentrations. Five, 8, and 14 tree and bush species occurred in the pastures of Itambé, Caruaru and Serra Talhada respectively. In Itambé, N content was influenced by species, while P and K contents were affected by species and season. In Caruaru, N, P and K contents were not influenced by season and in Serra Talhada, only P and K contents were influenced by species and season. Chemical composition was generally more adequate in the rainy season.

RESUMO

O objetivo desse trabalho foi avaliar nos períodos seco e chuvoso de cada região a composição mineral de espécies arbóreas e arbustivas ocorrentes em áreas de pastagem dos Municípios de Itambé, Caruaru e Serra Talhada, nas zonas fisiográficas Mata, Agreste e Sertão de Pernambuco. Foram coletadas folhas e galhos com até 5,0 mm de diâmetro, para a determinação dos teores de N, P, Mg e K. Foram encontradas, respectivamente 5, 8 e 14 espécies arbustivas arbóreas nas pastagens estudadas de Itambé, Caruaru e Serra Talhada. Para Itambé, o teor de N variou conforme a espécie, enquanto que o P e K variaram conforme a espécie e época do ano. As espécies encontradas em Caruaru, não sofreram influência da época de coleta para N, P e Mg. Em Serra Talhada apenas P e K sofreram interação época do e ano e espécie. As espécies analisadas apresentaram em geral composições químicas mais satisfatórias no período chuvoso.

INTRODUCTION

Pasture livestock farming systems consist of a natural combination or a deliberate association of one or more ligneous (bush and arboreal) components within a pasture of native or cultivated grass and herbaceous leguminous species and their use with ruminants and herbivores (Ribaski and Montoya, 2001). The chemical

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composition of species with a ligneous component must be assessed in order to indicate such species as alternatives for pasture livestock farming systems, especially during the dry season, when there is less availability of the herbaceous components in the pasture (Reis *et al.*, 2006). According to Souza *et al.* (2006), scarce natural resources in semi-arid regions of Brazil, along with periodic droughts and the high demography of the region, force the northeastern region of the country to periodically turn to native and exotic plants that are able to contribute towards subsistence of livestock farming.

According to Carvalho *et al.* (2001) and Febles *et al.* (2001), the following are the main characteristics that indicate an arboreal/bush species as potential fodder for composing a pasture livestock farming system: high germination; ease in establishment; high capacity for re-budding; capability to provide nitrogen and other nutrients to the pasture; adaptation to the environment; tolerance to drought, frost or inundation of the soil; capability to provide palatable fodder; tolerance to pests and diseases; absence of toxic effects on animals; capability to provide shade and shelter; high fodder yield potential; deep roots; efficiency in the use of light; and compatibility with the herbaceous components of the system.

The qualitative assessment of the nutrients in the vegetal component of an agro-forestry system is fundamental to the selection of species with fodder potential that are able to provide a balanced diet rich in protein, energy and minerals. Qualitative assessments also help identify vegetal matter that is toxic to plant hat are toxic for the animals (Franke *et al.*, 2001). Imbalance in an animal diet, particularly minerals, may result in serious nutritional disorders, with a negative impact on the productive and reproductive performance of the animals (Leonel *et al.*, 2006).

The aim of the present study was to assess the mineral composition of arboreal and bush shrubby species occurring in pastures located in Itambé, Caruaru and Serra Talhada in order to obtain information that may contribute toward the diagnosis and planning of pasture livestock farming systems in the state of Pernambuco (Brazil).

MATERIALS AND METHODS

The study was carried out in pasture native and cultivated areas of the experimental fields of the Pernambuco Livestock Research Institute (IPA, Instituto Agrônomico de Pernambuco) in the counties of Itambé, Caruaru and Serra Talhada in the state of Pernambuco (northeastern Brazil).

Itambé is located in the humid, coastal zone, 96 km fromRecife (state capital). The climate is warm, rainy and humid, with a dry summer, a mean annual temperature of 24ºC and mean annual rainfall of 1200 mm. The vegetation is classified as deciduous and sub-deciduous forest (IPA, 1994). The soil is typified as Red-Yellow Argisoil, Red-Yellow Latosoil and Vertsoil (Embrapa, 1999).

Caruaru is located in the intermediate climatic zone in the interior of the state, 135 km from Recife. The climate is semi-arid, with a mean annual temperature ranging from 16.7° to 33.5°C and mean annual precipitation rainfall of 600 mm. The predominant vegetation is Hypoxerophile caatinga (IPA, 1994). The soil is typified as Red-Yellow Latosoil, Red-Yellow Argisoil and Neosoil (Embrapa, 1999).

Serra Talhada is located in the semi-arid region of the deep interior of the state, 418 km from Recife. The climate is semi-arid, very warm, with a mean annual temperature of 25.9°C and mean annual precipitation rainfall of 887.9 mm. The predominant vegetation is Hypoxerophile Caatinga (IPA, 1994). The soil is typified as Red-Yellow Argisoil, Red-Yellow Latosoil, Luvisoil and Neosoil (Embrapa, 1999).

Samples for chemical analysis were collected during the dry and humid seasons. Leaves and branches up to 5.0 mm in diameter were collected, dried and ground together for the determination of N, P, Mg and K. Analyses were carried out at the vegetal chemistry Laboratory of the Universidade Federal Rural de Pernambuco (UFRPE) following the methodology described by Bezerra Neto and Barreto (2004). Simultaneously, botanical material was collected for the identification of the arboreal and bush shrubby species in the pasture areas. Specimens were stored at the Sergio Tavares Herbarium of the Forets Science Department (UFRPE). The Cronquist classification system (1981) was used for the separation of the species into families.

Table I. *Common and scientific names, family and main uses of evaluated species, according locations locale.* (Nome vulgar, científico, família e uso das espécies avaliadas, conforme o local).

Local common name	Scientific name	Family	Other uses
Itambé			
Bordão-de-velho	*Chomelia* sp	Rubiaceae	
Caubin	*Casearia sylvestris* Sw.	Flacourtiaceae	F
Espinho-de-judeu	*Machaerium cultratum* Pittier	Fabaceae	
Sabiá	*Mimosa caesalpiniiaefolia* Benth	Mimosaceae	F,CC
Leucena	*Leucaena leucocephala* (Lam.) de Wit	Mimosaceae	F
Caruaru			
Algaroba	*Prosopis juliflora* (Sw.) DC	Mimosaceae	F
Canafístuola	*Senna spectabilis* (DC.) H.S. Irwin e Barneby	Fabaceae	MI
Catingueira	*Caesalpinia pyramidalis* Tul.	Caesalpinaceae	F,CC
Chumbinho	*Oxalis insipida* St. Hil.	Oxalidaceae	
Jurema branca	*Piptadenia stipulacea* (Benth.) Ducke	Mimosaceae	F,CC
Jurema preta	*Mimosa arenosa* Willd	Mimosacea	F,CC
Marmeleiro	*Croton rhamnifolius* Humb. Bonpl. E. Kunth.	Euphorbiaceae	F,CC
Pitombeira	*Platymiscium floribundum* Vogel	Fabaceae	
Serra Talhada			
Angico-de-caroço	*Anadenanthera colubrina* (Vell.) Brenan var. cebil	Mimosaceae	F,CC
Aroeira	*Myracrodruon urundeuva* Allemão	Anacardiaceae	CC,MI
Baraúna	*Schinopsis brasiliensis* Engl.	Anacardiaceae	F,CC
Catingueira	*Caesalpinia cf. bracteosa* Tul	Caesalpiniaceae	
Imburana	*Amburana cearensis* (Allemão) A.C.Smith	Anacardiaceae	CC
Joazeiro	*Ziziphus joazeiro* Mart.	Rhamaceae	
Jurema-preta	*Mimosa tenuiflora* (Willd.) Poir.	Mimosaceae	
Marmeleiro	*Croton* sp	Euphorbiaceae	
Mororó	*Bauhnia cf. subclavata* Benth	Fabaceae	CC
Moleque-duro	*Cordia leucocephala* Moric	Boraginaceae	CC
Pau-de-leite	*Euphorbia* sp	Euphorbiaceae	
Pereiro	*Aspidosperma pyrifolium* Mart.	Apocynaceae	
Quixabeira	*Sideroxylum obtusifolium* (Roem. e Schult) T.D.Penn	Sapotaceae	MI
Umbuzeiro	*Spondias tuberosa* Arr. Cam.	Anacardiaceae	MI

F: For firewood and coal; CC: For civil construction (rafters, stakes, stanchions, boards and rods); MI: For medicinal and industrial uses (use of tannin for production of leather, resins and adhesives).

Table II. *N, P, Mg abd K contents mean ± SD by species, according to season of the year, Itambé-PE.* (Teores media ± DP de N, P, Mg e K por espécie, conforme a época, Itambé-PE).

Species	Nitrogen (%)		Phosphorus (%)	
	Dry season	Rainy season	Dry season	Rainy season
Bordão-de-velho	1.38^{aC}±0.07	1.7^{aD}±0.16	0.92^{aA}±0.13	0.84^{aC}±0.23
Caubin	2.44^{aB}±0.11	2.25^{aC}±0.15	0.94^{aA}±0.15	1.04^{aC}±0.19
Espinho-de-judeu	2.7^{aB}±0.04	2.61^{aB}±0.09	1.16^{aA}±0.27	0.72^{aC}±0.19
Sabiá	2.80^{aB}±0.12	2.13^{bC}±0.18	1.02^{bA}±0.32	1.83^{aB}±0.28
Leucena	4.14^{aA}±0.10	4.15^{aA}±0.20	1.34^{bA}±0.40	2.51^{aA}±0.20
Mean	2.60±0.13	2.48±0.12	1.06±0.11	1.25±0.13
Species	Magnesium (%)		Potassium (%)	
	Dry season	Rainy season	Dry season	Rainy season
Bordão-de-velho	0.12±0.01	0.09±0.03	0.94^{aB}±0.11	0.42^{bB}±0.03
Caubin	0.08±0.02	0.06±0.01	1.16^{aA}±0.08	0.55^{bB}±0.15
Espinho-de-judeu	0.09±0.02	0.06±0.01	0.82^{B}±0.07	0.70^{aA}±0.12
Sabiá	0.09±0.02	0.09±0.01	0.97^{B}±0.11	0.42^{B}±0.13
Leucena	0.08±0.02	0.08±0.03	0.92B±0.09	0.46^{B}±0.20
Mean	0.09±0.01	0.07±0.01	0.98±0.04	0.52±0.06

Means followed by the different small letter in the same species differ according to F test ($p<0.05$); Means followed by the different capital letter in the same period differ according to Scott-Knott test ($p<0.05$).

In Itambé, the dry season samplings were carried out in December 2002, November and December 2003, whereas the rainy season collections were carried out in February, July and September 2003. In Caruaru, the dry season samplings were carried out in December 2002, January, November and December 2003, with precipitation rainfall of 2.7 mm, 8.3 mm, 5.5 mm and 8.3 mm, respectively; the rainy season collections samplings were carried out in March, April and July 2003, with precipitation rainfall of 62.2 mm, 47.1 mm and 45.1 mm, respectively. In Serra Talhada, the dry season collections were carried out in August and October 2003, with precipitation rainfall of 0.3 mm and 2.0 mm, respectively; the rainy season samplings were carried out in February and March 2003, with precipitation rainfall of 122.7 mm and 119.4 mm, respectively (Agritempo, 2007).

The species collected in each location were those most frequent in the area. For analysis of variance, an entirely randomized experimental design in a factorial arrangement was employed, with four replicates. The experimental treatments were the combination of species and seasons (dry and rainy). The means of the variables analyzed were compared using the F test in the comparison between seasons and the Scott-Knott test in the comparison between species. The level of significance was set at 5%. Statistical analyses were performed on the SAEG Statistical and Genetic Analysis System (SAEG, 2000).

RESULTS AND DISCUSSION

Table I displays a list of the species collected for chemical evaluation; among the study areas, the city of Serra Talhada had the greatest number of species (14), followed by Caruaru, (8) and Itambé (only 5 species recorded). Among the species

collected, there was a predominance of native species and legume families.

Carvalho *et al.* (2001), Gonçalves and Lelis (2001) and Queiroz *et al.* (2002) discuss the multiple uses of the different species evaluated in the 4 locations. Besides their importance as fodder, there are other uses that these species may have **(table I)**.

Among the species collected in the Itambé region, leucena (white leadtree) had the greatest **(table II)** and *bordão-de-velho* had the lowest N content, regardless of season. The sampling period influenced the N concentration in the species sabiá, which was higher in the dry season. The N content for sabiá is similar to that described by Vieira *et al.* (2005) and Moura *et al.* (2006) in the same area. The N concentration in leucena is similar to that described by Oliveira (2000) in Petrolina (PE, Brazil). For espinheiro (*Machaerium aculeatum*), which was also found in the Itambé pastures, Ferreira *et al.* (2007) and Silva *et al.* (2007) respectively estimated 2.15 and 2.45% N for the average of the seasons (dry and rainy), which are similar to the reported in the present study.

A significant interaction ($p<0.05$) occurred between species and seasons, with regard to P concentration in Itambé **(table II)**. The mean average P concentration in the species was higher in the rainy

***Table III**. N, P, Mg and K contents mean ± SD by species, according to season of the year, Caruaru-PE.* (Teores media ± DP N, P, Mg e K por espécie, conforme a época, Caruaru-PE).

Species	Nitrogen(%)		Phosphorus(%)	
	Dry season	Rainy season	Dry season	Rainy season
Algaroba	2.73±0.17	2.33±0.07	0.87±0.26	0.52±0.11
Canafístula	2.81±0.14	2.95±0.12	0.96±0.18	0.81±0.16
Catingueira	1.91±0.09	1.99±0.07	0.93±0.21	0.64±0.12
Chumbinho	1.49±0.07	1.95±0.08	0.57±0.27	0.48±0.15
Jurema-branca	2.34±0.14	2.26±0.09	0.52±0.14	0.68±0.14
Jurema-preta	2.37±0.16	2.31±0.22	0.90±0.23	0.79±0.23
Marmeleiro	1.76±0.08	1.92±0.08	1.05±0.23	0.76±0.19
Pitombeira	2.28±0.13	2.13±0.09	0.89±0.26	0.55±0.12
Mean	2.28±0.07	2.23±0.05	0.86±0.08	0.65±0.05
Species	Magnesium(%)		Potassium(%)	
	Dry season	Rainy season	Dry season	Rainy season
Algaroba	0.13^{ab}±0.03	0.15^{ab}±0.03	2.38±0.84	1.25±0.39
Canafístula	0.16^{a}±0.02	0.17^{a}±0.03	2.60±0.59	1.46±0.46
Catingueira	0.11^{b}±0.02	0.14^{ab}±0.03	3.29±0.57	1.87±0.53
Chumbinho	0.05^{c}±0.03	0.05^{c}±0.02	1.65±0.86	0.49±0.32
Jurema-branca	0.12^{ab}±0.03	0.15^{a}±0.03	1.72±0.57	1.84±0.50
Jurema-preta	0.12^{ab}±0.03	0.12^{ab}±0.04	2.68±0.70	1.73±0.65
Marmeleiro	0.09^{bc}±0.02	0.11^{b}±0.02	2.33±0.70	1.58±0.47
Pitombeira	0.12^{ab}±0.02	0.08^{bc}±0.02	1.34±0.56	1.21±0.40
Mean	0.12±0.01	0.12±0.01	2.34^{a}±0.23	1.42^{b}±0.16

Means followed by the different small letter in the same species differ according to F test ($p<0.05$); Means followed by the different capital letter in the same period differ according to Scott-Knott test ($p<0.05$).

season and leucena (white leadtree) had the highest P content in this season.

A significant interaction ($p<0.05$) was found for K content with higher values in the dry season **(table II)**. Caubin had the highest K content in the dry season, whereas *espinho-de-judeu* had the highest K content in the rainy season. Mg variations were non-significant **(table II)**.

N and P concentrations did not differ significantly ($p>0.05$) between species or seasons in Caruaru **(table III)**. The species

Table IV. *N, P, Mg and K contents mean ± SD by species, according to season of the year, Serra Talhada-PE.* (Teores media ± DP de N, P, Mg e K por espécie, conforme a época, Serra Talhada-PE).

Species	Nitrogen(%)		Phosphorus(%)	
	Dry season	Rainy season	Dry season	Rainy season
Angico-de-caroço	1.70^{bA}±0.05	2.51^{aA}±0.12	2.65±0.99	0.58±0.01
Aroeira	1.08^{bC}±0.18	1.57^{aC}±0.15	0.24±0.00	0.60±0.03
Baraúna	1.49^{aB}±0.11	1.83^{aB}±0.17	1.07±0.37	0.60±0.01
Catingueira	1.16^{bC}±0.08	2.23^{aA}±0.10	1.41±0.36	0.59±0.01
Imburana	1.44^{aB}±0.25	1.52^{aC}±0.09	0.86±0.86	0.62±0.01
Joazeiro	1.82^{aA}±0.06	2.02^{aB}±0.09	1.40±0.36	0.65±0.04
Jurema-preta	1.61^{bB}±0.09	2.08^{aB}±0.06	1.45±0.40	0.58±0.01
Marmeleiro	1.19^{bC}±0.10	1.92^{aB}±0.12	1.02±0.53	0.48±0.10
Moleque-duro	1.81^{aA}±0.08	1.86^{aB}±0.20	0.60±0.60	0.60±0.02
Mororó	1.15^{bC}±0.06	1.94^{aB}±0.15	1.24±1.24	0.61±0.01
Pau- de-leite	1.00^{bC}±0.07	1.55^{aC}±0.06	1.73±0.33	0.60±0.01
Pereiro	1.22^{aC}±0.04	1.38^{aC}±0.04	1.32±0.54	0.58±0.01
Quixabeira	1.81^{aA}±0.10	1.93^{aB}±0.24	1.04±0.40	0.62±0.01
Umbuzeiro	0.96^{bC}±0.03	1.65^{aC}±0.07	0.72±0.46	0.64±0.00
Mean	1.39±0.05	1.86±0.05	1.29^{a}±0.16	0.59^{b}±0.01
Species	Magnesium(%)		Potassium(%)	
	Dry season	Rainy season	Dry season	Rainy season
Angico-de-caroço	0.02±0.01	0.07±0.02	1.10±0.54	0.63±0.12
Aroeira	0.05±0.02	0.09±0.01	0.63±0.02	0.56±0.07
Baraúna	0.04±0.02	0.26±0.07	1.40±0.74	0.84±0.21
Catingueira	0.05±0.02	0.11±0.05	1.97±0.83	0.71±0.25
Imburana	0.02±0.01	0.10±0.00	0.38±0.33	0.85±0.25
Joazeiro	0.08±0.02	0.23±0.06	2.63±0.61	0.84±0.07
Jurema-preta	0.06±0.02	0.16±0.02	1.03±0.42	0.77±0.10
Marmeleiro	0.01±0.01	0.07±0.03	0.23±0.15	0.79±0.11
Moleque-duro	0.07±0.07	0.07±0.04	0.11± 0.11	0.72±0.19
Mororó	0.07±0.07	0.10±0.06	1.10±0.96	0.58±0.09
Pau-de-leite	0.09±0.02	0.13±0.04	1.46±0.55	0.74±0.13
Pereiro	0.06±0.03	0.12±0.04	1.20±0.73	0.87±0.10
Quixabeira	0.09±0.03	0.21±0.12	2.16±0.70	0.83±0.12
Umbuzeiro	0.05±0.02	0.13±0.02	2.42±1.00	1.00±0.16
Mean	0.05^{b}±0.01	0.13^{a}±0.01	1.29^{a}±0.17	0.76^{b}±0.04

Means followed by the different small letter in the same species differ according to F test ($p<0.05$); Means followed by the different capital letter in the same period differ according to Scott-Knott test ($p<0.05$).

algaroba (mesquite), *cana-fístula*, *catingueira*, *jurema-branca* and *jurema-preta* had higher Mg values ($p<0.05$) than the *chumbinho* **(table III)** and they were not influenced by season. Average K content was higher in the dry season ($p<0.05$).

Regarding the data obtained in Serra Talhada, the species *angico-de-caroço*, *joazeiro*, *moleque-duro* and *quixabeira* had a higher N content concentration than other species ($p<0.05$) in the dry season, whereas only *angico-de-caroço* and *catingueira* do it in the rainy season **(table III)**, thereby showing an interaction between species and season. The P and K concentrations were higher ($p<0.05$) in the dry season **(table III)** and K content concentration was higher in the rainy season.

The mineral content in plants is influenced by characteristics that are inherent to the species and environment. According to Larcher (2000), the proportion of various bioelements may be strongly determined by plant species and family, by organ or by stage of development. In general, N, P and K content varied in accordance with the species, season and locations, which may be associated to the high mobility of these minerals (Malavolta *et al.*, 1989) as well as the immobility of magnesium in the plant (Epstein, 1974).

Phosphorus is one of the most important elements for cattle, especially cattle kept in pastures. Extensive areas of pastures with phosphorus deficiency occur throughout the world and there is no doubt that this is the most common mineral deficiency among cattle (Tokarnia *et al.*, 2000). According to Moraes (2001), 0.12% P in the dry matter of tropical fodder is closer to the needs of cattle than levels established by the American National Research Council (overestimated at 30% for the conditions of the country). Thus, the content in most of the species evaluated in the three locations achieved this value.

Knowledge on the mineral composition of fodder in different locations and seasons provides information for the assessment of mineral and nutritional supplements for animal feeding. Furthermore, information on the degree of mineral extraction from different plants is important to the assessment of fertilizer possibilities. The species *bordão-de-velho* collected in Itambé, *marmeleiro* and *chumbinho* collected in Caruaru and *aroeira*, *baraúna*, *catingueira*, *imburana*, *jurema preta*, *mameleiro*, *moleque-duro*, *mororó*, *pau-de-leite*, *pereiro*, *quixabeira* and *umbuzeiro* collected in Serra Talhada **(tabla IV)** exhibited N content concentration below 1.92%, which Araújo *et al.* (2001) consider the minimum satisfactory value of crude protein N. It should be stressed that, besides the chemical components of the species occurring in pastures, aspects such as ease of propagation, adaptation to climatic conditions, type of animal and objectives of the animal production system should be considered in the choice of species for use in pasture animal husbandry systems.

Regardless of the locations, the species analyzed exhibited different content concentration of N, P, Mg and K as a result of variations seasonal. It is noteworthy that the legume species may have an influence on N concentration. Chemical compositions was generally more satisfactory in the rainy season.

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