

Contribution of woody species to the diet composition of goat and sheep in Caatinga vegetation

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Introduction

Woody vegetation covers extensive areas of the earth, specially in the tropical regions, where it serves many purposes, such as lumbering, firewood production, house and fence construction and forage. As components of range and pasture vegetation, the woody species have been regarded mostly as invaders or undesirable plants. And as such, they have been controlled to give place to grasses and other herbaceous forage plants.

However, in recent years, an increasing interest has been observed in the management of woody species as producers of goods and services, recognizing the very important role they play in the maintenance of the biodiversity and in the welfare of the land ecosystems.

Trees and shrubs are utilized by domestic and wild ruminant animals as important components of their diets. They produce leaves, flowers, fruits, and seeds that are readily edible and that, in many cases, are very significant strategic food resources at certain critical times of the year.

Within this context, small domestic ruminants, namely goats and sheep, classified as intermediate feeders (Demment and Longhurst, 1987), are good users of woody plants for browsing. This paper attempts to evaluate the importance of trees and shrubs in the botanical and chemical composition of the diets of small ruminants browsing the Caatinga vegetation of the semi-arid region of North-eastern Brazil.

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The Caatinga vegetation

Caatinga is the low thorn forest that covers the semi-arid region of North-eastern Brazil, which comprises an area of about one million square kilometers. Small trees and shrubs that lose their leaves in the dry period dominate the landscape, with a scattered herbaceous understory. The botanical composition of the vegetation reflects the variability of the soil, precipitation, and the history of over 3 centuries of exploitation by human colonizers. Extensive areas of the Caatinga may be entering a pre-desert stage as a result of man's activities. Slash and burn agriculture is one of the most important factors responsible for the degradation of the Caatinga woody vegetation. However, livestock raising was and still is the predominant use of the Caatinga region. An average ranch in the region raises cattle, sheep, and goats in several different combinations. Over 90% of the goat and 35% of the sheep production of Brazil takes place in this region.

The overall plant diversity in the Caatinga is high, including thousands of species of trees, shrubs, grasses and herbs. However, locally, the number of plant species is fairly low, presenting some 26 ligneous species and a little over 50 grass and herbaceous species (Kirmse et al., 1983). The woody species density varies from 400 up to 10,000 plants/ha and the woody vegetation cover ranges from 20% up to 100%. The above ground phytomass production reaches an average of 4 t/ha per year, and the proportion between woody and herbaceous forage availability varies according to the site, being 90:10 in high tree density and young successional areas (Araujo Filho et al., 1982).

Botanical composition by Caatinga woody species of the diets

Of the 21 tree and shrub species found in the Caatinga sites studied, 13 composed the sheep diet, and 15

participated in the goat diet (Table 1). This fact indicates a flora particularly rich in browse species with 61.9% of the tree and shrub species being consumed by sheep, and 71.4% composing goat diet.

However, even though the number of woody forage species is high, the amount of forage is low when the quality is good, and it is high when the quality is poor (Table 2). At the beginning of the rainy season, the total available phytomass averages 2.3 t/ha. However, 92.2% of this total is composed by litter, that is rapidly decomposing and not palatable to the animals. The woody species forage which is on the reach of the browsers is only 2.5%, that is, about 57.2 kg/ha. As the rainy progresses, the total available phytomass decreases to 1.2 t/ha, reached by the end of the period, when the decayed litter amounts to 28% and the woody species forage reaches 14%, or 171 kg/ha. With the onset of the dry season, the woody species foliage reaches nil, due to the falling of the leaves, and the litter, which will play important role on the animal feeding, on the first half of the period, starts increasing its percentual, reaching about 90% by the end of the season. It is important to observe on the Table 2 the sudden increase on the total available phytomass, on the middle of the dry season, due the massive falling of the leaves of the ligneous vegetation.

The average percentages of woody species forage in the diet of goats was 44% in the rainy season and

Table 1. **Number of wood species of Caatinga participating in goat and sheep diets.**

Authors	Number of species		
	Caatinga	Goat diet	Sheep diet
Kirmse (1984)	18	14	12
Nascimento (1988)	15	13	10
Souza (1991)	19	12	11
Peter (1992)	33	20	19
Mean	21	15	13
Percentage	—	71	62

Table 2. **Seasonal availability (kg/ha) and botanical composition (%) of Caatinga vegetation.**

Season/phytomass	Total (t/ha)	Herbaceous (%)	Woody (%)	Litter (%)
Starting of wet season	2.29	5.3	2.5	92.2
Middle of wet season	1.91	36.5	8.4	55.2
End of wet season	1.20	57.6	14.2	28.2
Middle of dry season	3.60	24.6	0	75.4
End of dry season	2.41	9.8	0	90.2

61% in the dry season, while those in the sheep diet were 32% and 49%, respectively (Table 3). The strong variation in the data reflects site variability. Nascimento (1988) worked with a savanna type Caatinga, comprising a productive herbaceous layer and scattered trees. Thus, the contribution of the browse to the diet was low in the rainy season (11% for goats and 7% for sheep), but about the average in the dry season (52% for goats and 39% for sheep), due to the leaf fall. Peter (1992) worked on a dense and low tree stand, where most of the woody plant foliage was within reach of animals. Consequently, more ligneous species were present in the diets of goats (88% and 85% in wet and in dry season, respectively) and of sheep (71% and 85%).

Table 4 summarizes the contribution to the diet of some of the most important trees and shrubs of the Caatinga sites studied. There are some marked differences as to the ruminant species, and as to the season. In the rainy season, the species most selected by goats were *Sida* sp. (18%), *Bauhinia cheillantha* (8%), *Auxemma oncocalyx* (5%), and *Caesalpinia bracteosa*

Table 3. **Participation of woody species (%) in the botanical composition of goat and sheep diets in Caatinga.**

Authors/season	Wet season		Dry season	
	Goat	Sheep	Goat	Sheep
Kirmse (1984)	27.0	24.0	38.0	13.2
Nascimento (1988)	11.1	6.9	51.7	38.7
Souza (1991)	49.5	27.8	70.4	57.5
Peter (1992)	88.4	70.7	85.1	84.8
Mean	44.0	32.3	61.3	48.5

Table 4. **Participation (%) of the most important woody species in the botanical composition of goat and sheep diets in Caatinga.**

Species/season	Wet season		Dry season	
	Goat	Sheep	Goat	Sheep
<i>Aspidosperma pirifolium</i>	1.5	0.9	7.2	3.1
<i>Myracodruon urundeuva</i>	2.2	3.0	8.4	2.1
<i>Auxemma oncocalyx</i>	4.5	4.2	2.5	2.1
<i>Bauhinia cheillantha</i>	8.3	4.5	8.7	4.6
<i>Caesalpinia bracteosa</i>	3.1	1.5	16.3	13.2
<i>Caesalpinia ferrea</i>	0.2	0.1	0.6	1.9
<i>Combretum leprosum</i>	1.3	0.6	3.6	1.8
<i>Croton sonderianus</i>	1.3	0.6	2.4	3.7
<i>Mimosa caesalpiniiifolia</i>	1.6	5.6	2.0	1.5
<i>Sida</i> sp.	18.2	11.7	6.1	8.2
<i>Zizyphus joazeiro</i>	2.3	2.3	5.0	6.7
Total	44.5	35.0	62.9	48.9

(3%). In the dry season, goats selected *Caesalpinia bracteosa* (16%), *Bauhinia cheilantha* (9%), *Myracodruon urundeuva* (8%), *Croton sonderianus* (7%), *Sida* sp. (6%), and *Zizyphus joazeiro* (5%). On the other hand, during the wet season, sheep preferred *Sida* sp. (17%), *Mimosa caesalpinifolia* (6%), *Bauhinia cheilantha* (5%), *Auxemma oncocalyx* (4%), and *Myracodruon urundeuva* (3%); and in the dry season *Caesalpinia bracteosa* (13%), *Sida* sp. (8%), *Zizyphus joazeiro* (7%), *Bauhinia cheilantha* (5%), and *Croton sonderianus* (3%).

In the rainy season, green leaves of the woody species composed the bulk of the diets of the small ruminants, while in the dry season, fallen dry leaves and fruits made up the highest percentage of their diets.

Chemical composition of goat and sheep diets

Crude protein (CP) and neutral detergent fiber (NDF) were analyzed in the extrusa samples of goats and sheep browsing Caatinga vegetation. The results are summarized in Tables 5 and 6.

The CP content of the goat diet averaged 17% in the rainy season, and 12% in the dry period, while in the sheep diet CP percentages were 17 and 11 in the wet and in the dry season, respectively (Table 5). The results suggest that the small ruminants could select in each season a diet with a CP content above the

Table 5. Crude protein content (%) of goat and sheep diets in Caatinga vegetation.

Authors/season	Wet season		Dry season	
	Goat	Sheep	Goat	Sheep
Kirmse (1984)	15.6	14.4	12.4	8.7
Pfister (1982)	19.2	18.6	13.2	12.4
Souza (1991)	14.7	15.0	9.1	8.8
Peter (1992)	18.6	18.2	12.2	12.5
Mean	17.0	16.6	11.7	10.6

Table 6. Neutral detergent fiber (NDF) content (%) of goat and sheep diets in Caatinga.

Authors/season	Wet season		Dry season	
	Goat	Sheep	Goat	Sheep
Kirmse (1984)	42.2	43.7	54.2	52.6
Pfister (1982)	37.3	36.8	47.2	46.5
Souza (1991)	57.4	55.5	50.3	52.3
Mean	45.6	45.3	50.7	50.5

recommended minimum of 9%. Nevertheless, there were variations, due, probably, to site and year differences. Pfister (1983) found the highest values in both seasons for sheep and goats, while Souza (1991) found the lowest. In Pfister's study site, the Caatinga vegetation was largely dominated by woody species, many of them protein rich legumes. On the contrary, Souza's study area was a savanna type Caatinga, dominated by an annual herbaceous cover. It should be pointed out that during the dry period the CP content of the herbaceous layer may be as low as 3% (Araújo Filho et al., 1982). Therefore, the high levels of CP in the diets are related to the selectivity of the small ruminants and to availability of leaves of trees and shrubs of the Caatinga vegetation.

The NDF contents of the diets were similar between the ruminant species, but lower in the rainy season and higher in the dry period (Table 6). The mean values were 46% and 51% for goat diets in the wet and in the dry season, respectively, and 45% and 51% for sheep diets in the same order of seasons. Preliminary data indicate that the NDF percentages of the phytomass available for browsing the Caatinga averaged 60% in the rainy season and 85% in the drought (Araújo Filho, unpublished data). The small ruminants were able to improve the quality of their diets by lowering the fiber content, due to their ability to select.

Goat and sheep production

Table 7 was adapted from the research report of the Universidade Federal do Ceará (UFC, 1985), and presents the performance of goat and sheep browsing on Caatinga vegetation. The average yearly liveweight gain was 10.4 kg/head for goats and 8.1 kg/head for sheep. There were strong variations related to year as a result of the rainfall variability (UFC, 1985). In 1983, the driest of the period of study, the liveweight gain of both ruminant species reached the lowest values (3.9 kg/head). However, as the rainy seasons returned to normal in 1984 and 1985, the goats recuperated

Table 7. Goat and sheep production in Caatinga vegetation in Tauá, Ceará, Brazil, in the period of 1980/85.

Authors/season	Goat		Sheep	
	(kg/head)	(kg/ha)	(kg/head)	(kg/ha)
1980/81	12.0	15.0	11.1	13.9
1981/82	8.5	10.6	8.2	10.2
1982/83	3.9	4.9	3.9	4.9
1983/84	9.7	12.1	6.5	8.1
1984/85	17.9	22.4	11.0	13.8
Mean	10.4	13.0	8.1	10.2

faster than the sheep, the former reaching a gain of 17.9 kg/head and the latter 11 kg/head (Table 7). In terms of production per area, goats averaged 13 kg/ha per year, and sheep produced 10.2 kg/ha per year, being the trends along the study period very similar for both ruminant species. Again, goats performed better than sheep, the former producing 22.4 kg/ha and the latter 11 kg/ha by the end of the period.

Conclusions

The results suggest that the Caatinga vegetation has a good potential for browsing, due to the presence of many tree and shrub species readily acceptable by small ruminants.

Goats and sheep do not have similar botanical diet composition in Caatinga vegetation, differing in the species selection and percentage composition. Goats performed better than sheep, since they are probably more nutritionally adapted to the dominant vegetation.

The total production and seasonal distribution of forage availability in Caatinga may be improved by the manipulation of the woody species, including coppicing and enrichment of the botanical composition.

Resumen

En este trabajo se revisa y resume la importancia de los árboles y arbustos de la vegetación de Caatinga, típica de la parte semi-árida de la región Nordeste del Brasil, en la composición de la dieta de ovinos y caprinos en pastoreo libre. Las investigaciones se realizaron en zonas representativas de esta región bajo condiciones de vegetación nativa. Los animales utilizados fueron ovinos del tipo criollo y caprinos sin raza definida. Se utilizaron animales con fístula esofágica para recolectar las extrusas utilizadas en las determinaciones de la dieta, de acuerdo con el método de Harker et al. (1964). Los resultados indicaron que las especies leñosas constituyeron más del 70% de la dieta de los caprinos y aproximadamente el 62% de la dieta de los ovinos. Ambos tipos de animales seleccionaron más forraje de árboles y arbustos en la época seca que en la lluviosa. En las dos épocas, la composición porcentual de forraje de las especies leñosas fue más alta en los caprinos. También se encontraron diferencias entre ambos tipos de animales en la selección, tanto en especies botánicas como en el porcentaje consumido de cada una. Los caprinos tuvieron un mejor desempeño que los ovinos, en aumento de peso vivo y en la producción por área. Se concluye que la vegetación de la región de Caatinga tiene un gran potencial para la producción animal, ofreciendo a los animales la oportunidad para seleccionar una dieta nutricional adecuada en cualquier

época del año. Los caprinos aprovecharon mejor la vegetación de Caatinga, por lo que mostraron un mejor desempeño.

Resumo

Em este trabalho se revisa e sumaria a importância das árvores e arbustos da Caatinga na composição das dietas de ovinos e caprinos em pastoreio livre. As pesquisas foram conduzidas em sítios representativos da região semi-árida do Nordeste Brasileiro, sob condições de vegetação nativa. Os animais eram ovinos da raça Criola e caprinos sem raça definida. Animais com fístulas esofágicas foram utilizados para coleta de extrusa para determinações das dietas, segundo o método descrito por Harker et al. (1964). Os resultados indicaram que acima de 70% das espécies lenhosas participaram da dieta dos caprinos, enquanto que cerca de 62% compuseram a dieta de ovinos. Ambos tipos animais selecionaram mais forragem de árvores e arbustos na estação seca do que no período úmido. A composição percentual de forragem das espécies lenhosas foi mais elevada para caprinos em ambas as estações. Também, houve diferenças em termos de seleção, tanto das espécies botânicas como do percentual consumido de cada forrageira, quando se compara caprinos versus ovinos. Os caprinos apresentaram melhor desempenho do que os ovinos, não só no ganho de peso, como na produção por área. Concluiu-se que a vegetação da Caatinga tem um bom potencial para ramoneio, oferecendo aos animais oportunidades de selecionar uma dieta nutricionalmente adequada em qualquer estação do ano. Os caprinos fazem melhor uso da vegetação lenhosa da Caatinga, apresentando melhor desempenho.

References

- Araújo Filho, J. A. de; Torres, S. M. de S.; Gadelha, J. A.; Maciel, D. F.; and Catunda, D. A. 1982. Estudos de pastagem nativa do Ceará. En: BNB. Estudos econômicos e sociais. Fortaleza-CE, Brazil. 73 p.
- Demment, M. W. and Longhurst, W. M. 1987. Browsers and grazers: Constraints on the feeding ecology imposed by gut morphology and body size. En: 4th International Conference on Goats. Proceedings. Brasília. Documento no. 14. Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA). p. 989-1004.
- Harker, K. M.; Torrel, D. T.; and Dyne, G. M. van. 1964. Botanical examination of forage from esophages fistula in cattle. J. Anim. Sci. 23(2):465-469.
- Kirmse, R. D. 1984. Effects of clearcutting on forage production, quality and decomposition in the Caatinga woodland of Northeast Brazil: Implications to goat and sheep nutrition. Ph.D. Thesis. Utah State University. 140 p.

_____; Pfister, J. A.; Vale, L. V.; and Queiroz, J. S. 1983. Woody plants of Northern Ceará Caatinga. SR-CRSP, Utah State University. 49 p.

Nascimento, A. E. 1988. Influência da raça na seleção da dieta por caprinos e ovinos em Caatinga nativa e raleada no Sertão Central cearense. Tese Mestrado. Universidade Federal do Ceará, Fortaleza, Brazil. 69 p.

Peter, A. M. 1992. Composição botânica e química da dieta de bovinos, caprinos e ovinos em pastejo associativo na Caatinga nativa do semi-árido de Pernambuco. Recife-PE. Tese Mestrado. Universidade Federal Rural de Pernambuco, Brazil. 86 p.

Pfister, J. A. 1983. Nutrition and feeding behaviour of goat and sheep grazing deciduous shrub wodland in Northeastern Brazil. Ph.D. Thesis. Utah State University. 130 p.

Souza, P. Z. 1991. Flutuações estacionais da dieta de caprinos e ovinos em pastoreio combinado na região dos Inhamuns, Ceará. Tese Mestrado, Universidade Federal do Ceará, Fortaleza-CE, Brazil. 98 p.

UFC (Universidade Federal do Ceará). 1985. Pastoreio combinado bovino, ovino e caprino. En: UFC. Relatório técnico anual das atividades do convênio BNB/FCPF. Fortaleza-CE, Brazil. 43 p.