

## Short communication. Goat preferences for native woody shrubs in the Chaco Árido region of Córdoba, Argentina

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### Abstract

The Chaco Árido region of Argentina has suffered strong desertification. Some 95% of the area is now covered by deciduous plant species that form dense, spiny shrubs, many of which are of little forage value. Lack of forage during winter leads to economic losses, contributing to the overall low profitability of the region's small goat-producers. The incorporation of appropriate shrub plants into the production system might help ensure and make more uniform the supply of feed to goats over the year. However, it is first vital to determine the preferences of these animals in order to prioritise such incorporations. The preferences of local goats for the native shrubs of the Chaco Árido region were therefore established over the different seasons of the year by means of a «cafeteria» experiment. Preferences were determined using the Di Rienzo, Guzmán and Casanoves means-comparison test. *Maytenus spinosa*, *Celtis pallida* and *Lippia turbinata* were frequently chosen in summer and autumn. The consumption of *Condalia microphylla* was low year-round while *Larrea divaricata* was consumed strongly throughout the year. The latter species and *Capparis atamisquea* were particular favourites during the winter reduction in forage availability. It is suggested that these species be incorporated into local goat production systems.

**Additional key words:** animal nutrition, arid regions, local goats.

### Resumen

#### Preferencia del ganado caprino por arbustivas leñosas nativas del Chaco Árido de Córdoba, Argentina

El Chaco Árido de Córdoba es una región de Argentina fuertemente desertificada. El 95% de su superficie está cubierta por especies caducifolias que forman densos arbustales espinosos caducifolios de escasa oferta forrajera. Esto provoca bache forrajero en época invernal, pérdidas económicas y baja rentabilidad para los pequeños productores de caprinos. La incorporación de arbustivas apropiadas a los sistemas de producción podrían asegurar y uniformar a lo largo del año el alimento para el ganado caprino. Por tal motivo es indispensable determinar las preferencias del ganado caprino por las arbustivas para poder priorizar en los sistemas silvopastoriles. Se estableció el orden de preferencia caprina por arbustivas nativas del Chaco Árido en cada una de las cuatro estaciones del año mediante un experimento de cafetería con caprinos locales. Se estimó la preferencia en base al Análisis de Prueba de Di Rienzo, Guzmán y Casanoves de ordenamiento de medias. *Maytenus spinosa*, *Celtis pallida* y *Lippia turbinata* fueron altamente consumidas en verano y otoño. *Condalia microphylla* presentó muy bajo consumo todo el año. Se concluye que la preferencia caprina varía según la época del año y se destaca la importancia de *Larrea divaricata*, muy consumida a lo largo del año, que junto a *Capparis atamisquea* presentó una mayor preferencia durante la época de bache forrajero. Se sugiere incorporar estas arbustivas en el diseño de predios con producción caprina.

**Palabras clave adicionales:** cabra criolla, nutrición animal, zonas áridas.

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The Chaco Arido is a region occupying some 1,500,000 ha in the west of the Province of Córdoba, Argentina. A victim of indiscriminate tree-felling and over-grazing, some 95% of its extent now suffers severe desertification and has become home to dense,

deciduous, spiny shrubs (a landscape known as the *fachinal*) of little forage value (Ayerza *et al.*, 1988; Karlin *et al.*, 1992). The introduction of appropriate native shrubs to the production system would help ensure (and make more uniform) the year-round supply of forage to goats. Normally, half of the diet of the goats raised in this region is composed of shrubs, but these plants can make up as much as 80% of the diet during

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some periods (Dalla Tea *et al.*, 1992; Petit, 1994). As a first step in the incorporation of appropriate shrub species into these browsing systems, the preferences of these animals for those available must be determined; only then can priorities be established.

Traditionally, the goats of this region are provided supplementary forage (cracked maize or balanced feed) in autumn and winter (May to September); during this time natural forage is in low supply and simply cannot sustain production (Martín *et al.*, 1993; Nai Bregaglio, 2001). This can occasion large costs for the region's livestock producers, whose economy is mainly one of subsistence (Maccagno *et al.*, 2000). Some 80% of the population in this region falls into this category — yet this majority possesses only 10-15% of the land. Most are involved in the (extensive) production of cattle and goats, with calves and kids representing the final products (Karlin *et al.*, 1992).

Woody shrubs can be an important source of forage in arid regions since they are well adapted to extreme conditions, and if evergreen they can maintain a browsing biomass of high nutritive value even during winter and times of drought (Dalla Tea *et al.*, 1992).

The consumption of plants by goats is influenced by several factors such as organoleptic quality, content in anti-nutritional, repulsive or toxic compounds (Bryant *et al.*, 1992), and the physical defences of the plant itself. Woody shrubs often defend themselves with thorns or spines, which reduces the rate of ingestion and the amount of forage that can be taken per bite (Laca *et al.*, 2001). Further, the food preferences of goats change with the availability of different plants, their physiological dynamics and phenological stage (Moore and Jung, 2001).

Thus, differences in goat food preferences should be expected over the year. The aim of the present work was to establish the preferences of local goats for the native shrubs of the Chaco Árido region in the different seasons of the year.

The study was undertaken in Pedanía Chancaní (Departamento de Pocho), in the west of the Province of Córdoba, Argentina (31°25'22" South, 65°27'09" West). This area belongs to the Chaco Árido region and falls within the Chaqueña phytogeographic province (western district). The area experiences wide daily temperature fluctuations, both in summer and winter (Karlin *et al.*, 1992). The mean maximum for summer (December, January and February) is 33.5°C, while in winter (July, August and September) the mean minimum is 6°C. The area has a mean of 16 days with frost, all

in the winter months. The annual mean rainfall for the period 1982-1997 was 425.5 mm (Nai Bregaglio, 2001); some 70% of this falling in summer (Karlin *et al.*, 1992). The high temperatures lead to high annual water deficits; the water index is -20, and the evapotranspiration potential is 1,000-1,200 mm per year (Karlin *et al.*, 1992).

The original vegetation of the area is low, sparse xerophytic woodland, mainly containing *Aspidosperma quebracho blanco* Schltdl. and *Prosopis flexuosa* DC., with a continuous herbaceous layer mainly composed of C4 grasses, the majority of which are perennial. The main species are *Trichloris* sp., *Setaria* sp. and *Digitaria* sp. (Karlin *et al.*, 1992). The shrub layer contains a great abundance of species, but especially *Larrea divaricata* Cav., *Condalia microphylla* Cav., *Capparis atamisquea* O. K., *Lippia turbinata* Griseb., *Celtis pallida* Torrey., *Geoffroea decorticans* (Gill. ex Hook. et Arn.) Burkart, *Acacia aroma* Gill. ex Hook. et Arn., *Maytenus spinosa* (Griseb.) Lourt. et O'Don, *Acacia praecox* Griseb., *Acacia furcatispina* Burk. and *Mimozyanthus carinatus* (Gris.) Burk. This original vegetation, however, is now deteriorated. A dense deciduous shrub layer now dominates with the herbaceous layer currently represented mainly by annual grasses (Karlin *et al.*, 1992).

A «cafeteria» experiment, analogous to that performed by Vargas and Elvira (1987), was designed in order to determine the preference of goats for six shrubs native (Martín *et al.*, 1993): *Condalia microphylla* (Rhamnaceae), *Capparis atamisquea* (Capparaceae), *Lippia turbinata* (Verbenaceae), *Celtis pallida* (Ulmaceae), *Larrea divaricata* (Zygophyllaceae) and *Maytenus spinosa* (Celastraceae).

Eight adult goats of the same hierarchy, family, and age were selected from a flock in the region. These were placed in pairs in four different pens and offered browsing material from each of the above species (in quantities covering needs during the enclosure time) for 2 h or until one of the offered species was completely consumed (Deza, personal communication). This was performed in the morning every day for five days and repeated in all four seasons of the year. This green browsing material was collected and provided daily. The material was hung (with a random distribution) from the roof of the pen, imitating its presentation to animals under natural conditions. The amount of each species consumed was determined from the difference between the initial weight and that at the end of the enclosure period (Table 1). On the floor, a 1 m<sup>2</sup> square

**Table 1.** Consumption [g of woody shrub per pen (1-4)] in each season

	Spring				Summer				Autumn				Winter			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<i>Larrea divaricata</i>	463	344	250	333	372	156	90	95	139	122	117	64	568	676	478	441
<i>Capparis atamisquea</i>	197	292	183	234	82	105	21	39	24	19	113	44	632	769	553	642
<i>Celtis pallida</i>	69	196	167	110	88	249	116	114	249	74	94	41	—	—	—	—
<i>Maytenus spinosa</i>	82	113	144	263	135	164	134	131	75	36	108	79	100	425	125	154
<i>Condalia microphylla</i>	44	47	94	49	49	75	51	47	63	46	21	21	118	131	140	180
<i>Lippia turbinata</i>	224	238	211	106	96	152	67	63	132	98	105	120	—	—	—	—

—: Not determined.

of cloth was spread out under each bundle of plant material in order to recover any that fell during browsing.

No period of adjustment was necessary since the animals were quite used to the pens where the experiment was performed (they were normally enclosed there every night) and the plant material provided is readily available in the surrounding area.

The contribution of each species (percentage) to the total weight of material consumed in each pen was calculated (Table 2). The results for the different seasons of the year were compared by the Di Rienzo, Guzmán and Casanoves (DGC) means-comparison test (Infostat, 2002). This uses multivariate analysis of conglomerates to produce a binary tree that shows the hierarchical sequence of conglomerate formations. This allowed the shrubs to be grouped according to descending levels of preference (A, B or C) and with a degree of significance of  $P=0.05$  (Table 2).

Table 2 shows that *Condalia microphylla* was the least consumed year-round. This shrub has many branches with a lot of spines that make it difficult for the animals to gain access to its rather small leaves (Abiusso, 1962). As indicated by Laca *et al.* (2001), this reduces the rate of ingestion and the amount of material

that can be taken in any single bite. In addition, many species of the family Rhamnaceae have high contents of saponins and tannins (Abiusso, 1962; Mediondo, 2000). These not only discourage animals browsing on them but actually reduce their capacity to digest food by inhibiting cellulolytic enzymes in their rumens (Rhoades, 1977).

*Celtis pallida* and *Lippia turbinata* fell into group A during summer and autumn (when they were the most consumed species) and into group B during the spring (when they were the second most consumed). However, these deciduous species offer no browsing material in winter, which clearly reduces their importance as forage species during this time of scarcity.

*Celtis pallida* is of high nutritional value (Cora, 2002), which might explain its popularity. *Lippia turbinata* is an aromatic species that, according to Martínez-Crovetto (1981), has a high content in essential oils. This is especially true just before flowering, the content then falling towards the autumn. This might explain the relative increase in the intake of this species in the latter season; these oils are anti-nutritional and can even cause miscarriages in some mammals (Martinez-Crovetto, 1981).

**Table 2.** Percentage consumption and preferences for woody shrub species in each season

	Spring		Summer		Autumn		Winter	
	%	Pref. level	%	Pref. level	%	Pref. level	%	Pref. level
<i>L. divaricata</i>	31.22	A	26.47	A	22.09	A	35.27	A
<i>C. pallida</i>	12.17	B	21.08	A	22.90	A	—	—
<i>L. turbinata</i>	17.49	B	14.05	A	22.71	A	—	—
<i>M. spinosa</i>	13.52	B	20.97	A	14.86	A	13.11	B
<i>C. atamisquea</i>	20.35	B	9.18	B	9.95	B	42.34	A
<i>C. microphylla</i>	5.25	C	8.25	B	7.49	B	9.28	B

A, B and C indicate preference [greater to lesser ( $P < 0.05$ )].

*Maytenus spinosa* fell into group A both in summer and autumn. However, during the winter it belonged to group B, when a strong reduction in its intake was observed. This might be due to the fact that, during winter, many of its soft shoots become lignified and form thorns. In addition, the concentration of tannins and other anti-herbivore compounds in the lignified cell walls increase during this period (Rhoades, 1977).

*Capparis atamisquea* fell into group B in spring, summer and autumn and into group A in winter. This suggests it could play an important role during this season of low forage supply. However, little information is available on this species, and it should be remembered that the genus *Capparis* has many members that contain flavonoids (Mediondo, 2000). These could reduce the palatability of both meat and milk via their physiological effects in these animals (Pfister *et al.*, 2001).

Throughout the year, *Larrea divaricata* was one of the most preferred species and fell into group A during winter (Table 2). This plant produces a resin (composed of phenolic aglycones) on its leaves and terminal shoots (Abiusso, 1962; Mizrahi, 1967), and some herbivores show a marked preference for older rather than younger leaves since the resin concentration is lower in the former. According to Rhoades (1977), removing this resin makes the different-aged leaves equally palatable. Some authors (Abiusso, 1962; Mizrahi, 1967; Rhoades, 1977) indicate that this resin has to be removed if livestock are to consume this forage. However, the present results show that this species was among the most preferred throughout the year. The removal of this resin does not, therefore, appear to be necessary. However, just how much of what is consumed is actually of use to these animals remains unknown. *In vitro*, this resin, which contains a phenol oxidase system, shows anti-herbivore properties, and forms complexes with leaf starch and proteins; this reduces protein digestion (Rhoades, 1977). However, Bryant *et al.* (1992) report no effect on protein digestion *in vivo*. The species can therefore be regarded as a very good forage plant that requires no treatment prior to its consumption. In addition, *L. divaricata* has no physical defences, which allows large mouthfuls to be taken quickly and easily (Laca *et al.*, 2001).

In conclusion, *L. divaricata* and *C. atamisquea* are important forage species since they are those most preferred by the goats during the winter fall in forage supply. Goat-raisers may do well to incorporate these species into their management practices.

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