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The effect of wilting and drying on intake rate and acceptability by sheep of the shrub legume *Cratylia argentea*

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Abstract

A series of feeding trials with sheep were carried out at the Centro Internacional de Agricultura Tropical in Colombia to assess the effect of wilting and drying on intake rate and acceptability of the shrub legume *Cratylia argentea* (Desvaux) O. Kuntze. In the first 2 experiments, intake rate was measured in periods of 20 minutes with sheep fed immature and mature legume either fresh, wilted or sun-dried. Relative acceptability of fresh and dried, immature and mature *C. argentea* was measured in 2 subsequent experiments with sheep of different age and previous experience with the legume. The test forages were offered separately in pairs for periods of 20 minutes and relative acceptability was defined as the short-term intake of fresh and dried forage corrected for metabolic weight of the animals. Intake rate of *C. argentea* was affected by post-harvest treatment when the legume was immature, but not when it was mature. With immature *C. argentea*, intake rate was higher when the forage was wilted and dried than when fed fresh. When sheep were given the choice of selecting fresh or dried *C. argentea*, they consumed more dried forage, regardless of maturity, age of the animals and previous experience with the forage. Factors responsible for low intake rate and acceptability of fresh, immature *C. argentea* could not be defined in this study.

Introduction

A number of leguminous shrubs and trees have been identified as suitable for feeding to ruminant animals in tropical areas (Blair 1990). However, some of the shrub legumes widely used or with potential for supplementing livestock (i.e. *Leucaena*, *Albizia*, *Erythrina*, *Calliandra*) are not well adapted to acid soils with high levels of exchangeable aluminium (Perdomo 1991; Shelton *et al.* 1991). Thus, the Tropical Forage Program (TFP) of the Centro Internacional de Agricultura Tropical (CIAT) undertook the task of selecting shrub legumes with adaptation to acid soils. Among the shrub legumes selected by the TFP was *Cratylia argentea* (Desvaux) O. Kuntze (Syn: *C. floribunda* Benth, *Dioclea argentea* Desv. and with no common name), due to quick establishment, vigorous regrowth after defoliation and drought tolerance (Xavier *et al.* 1990; Perdomo 1991). This is not surprising, since *C. argentea* is found in Brazil in native vegetation of the semi-arid north-east region (Silva and Lima 1980), and in acid soils of the cerrados (Costa *et al.* 1978). This legume is not presently utilised as a source of forage for ruminants, but there is anecdotal evidence indicating that, during the prolonged dry season in the cerrados of Brazil, cattle grazing savanna pastures browse native *C. argentea* and also consume fallen leaves (Marcelino Sobrinho, personal communication). The forage of *C. argentea* has an acceptable nutritional value, as measured by high leaf crude protein level (20-25%), intermediate digestibility (45-55%) and low levels of condensed tannins (0.2%) (Aroeira and Xavier 1991; Perdomo 1991). However, preliminary observations in the TFP suggested that *C. argentea* was rejected by grazing milking cows when offered in a protein bank, but was consumed when the forage was cut and wilted.

This paper reports the results of a series of trials designed to assess the effect of wilting and drying on intake rate and acceptability of *C. argentea* by sheep.

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Materials and methods

Four short-term feeding trials were carried out at CIAT's Quilichao substation in Cauca, Colombia. The first 2 experiments measured the effect of wilting and drying on intake rate of immature (Experiment 1) and mature (Experiment 2) *C. argentea* by sheep of different ages. The relative intake rate or acceptability of fresh and dried *C. argentea* was measured in Experiment 3 (immature forage) and Experiment 4 (mature forage) with sheep of 2 ages and with and without previous exposure to the legume. Potential intake rate and relative acceptability of the test forages were measured with a modified version of the method used by Kenney and Black (1984) to study factors involved in feed selectivity by sheep.

Experiments 1 and 2

In the first experiment, 8 African hair sheep were divided into 2 groups [4 young, 15 kg liveweight (LW) and 4 adult, 25 kg LW] and offered immature *C. argentea* (3 months regrowth) either fresh (25% DM), wilted for 24 h (40% DM), wilted for 48 h (65% DM), or sun-dried for 48 h (85% DM). Forage of *C. argentea* was harvested from a 5-year-old stand which had been cut 3 months before the initiation of the experiment. Harvested forage was chopped daily and either fed to the animals immediately, wilted in a shaded area or sun-dried for subsequent use.

Animals were housed in metabolism crates and adjusted to the cages and test forages over 7 days. During this period, animals were offered *ad libitum* a mixture of *Brachiaria decumbens*-*Centrosema macrocarpum*. In addition, they were offered a different test forage each day according to the following procedure. Animals were fasted for 4 h (1000-1400 h), and then offered the different test forages for 20 minutes in the following order:

- Day 1: fresh forage
- Day 2: wilted (24 h) forage
- Day 3: wilted (48 h) forage
- Day 4: sun-dried (48 h) forage
- Day 5: fresh forage
- Day 6: wilted (24 h) forage
- Day 7: sun-dried (48 h) forage

Treatments during the measurement phase were arranged in a 4 × 4 Latin Square reversible

design. In each period of 1 day, the forage was offered for 20 minutes, after a 4-hour fast. Before and after feeding the test forages, animals were offered the *B. decumbens*-*C. macrocarpum* mixture. The test forages were offered in excess to maximise animal selectivity. The amount of forage consumed was calculated by difference, and results expressed as dry matter intake per hour. Results were subject to analysis of variance with group, animal within group, period within group, treatment and group × treatment as sources of variation.

A second trial involved 6 African hair sheep divided into 2 groups (3 young and 3 adult), which were offered mature forage of *C. argentea* either fresh (40% DM), wilted for 24 h (55% DM), or sun-dried for 24 h (65% DM). Mature forage of *C. argentea* was harvested from a plot used for seed multiplication, which had not been cut for at least 2 years. As for Experiment 1, animals were offered a basal diet of *B. decumbens*-*C. macrocarpum* for 7 days in the cages and offered the test forages for 20 minutes after a 4-hour fast in the following order:

- Day 1: fresh forage
- Day 2: wilted forage
- Day 3: sun-dried forage
- Day 4: fresh forage
- Day 5: wilted forage
- Day 6: sun-dried forage
- Day 7: fresh forage

Treatments in Experiment 2 were arranged in a 3 × 3 Latin Square reversible design. In each measurement period of 1 day, animals previously fasted for 4 h in the morning were offered the test forages for 20 minutes each day. Measurements, calculations and statistical analysis were performed as in Experiment 1.

Experiments 3 and 4

Two separate trials were conducted to determine the effect of previous experience and age of sheep on relative acceptability of immature (Experiment 3) and mature (Experiment 4) *C. argentea*. Each experiment involved 12 animals, grouped as follows:

- Group 1: previous experience (3 young, 17 kg LW)
- Group 2: previous experience (3 adult, 26 kg LW)

Group 3: no previous experience (3 young, 17 kg LW)

Group 4: no previous experience (3 adult, 26 kg LW)

Animals with previous experience had been exposed to *C. argentea* for short periods of time during one month prior to the initiation of Experiment 3, whereas animals with no previous experience had been grazing *Brachiaria* spp. pastures from the time they were weaned.

Forage offered in Experiments 3 and 4 consisted of a basal diet of *B. decumbens*-*C. macrocarpum* and the test forage of *C. argentea* either fed fresh (25% DM immature, 40% DM mature) or oven-dried for 8 h at 60°C (90% DM immature and mature). In both experiments, measurements were carried out for 3 consecutive days, after allowing a 4-day adjustment period. To determine relative acceptability, animals were offered fresh and dried *C. argentea* simultaneously during a 20-minute period in feed troughs divided by a board. The amount of fresh and dried forage consumed was calculated by difference and results expressed as short-term DM intake per hour corrected for metabolic weight of the animals.

Treatments in Experiments 3 and 4 were arranged in a factorial randomised block design with 3 replications, and results were subjected to analysis of variance, with sheep age, previous experience, post-harvest treatment and corresponding interactions as sources of variation.

Results

Experiments 1 and 2

Results on intake rate of immature and mature *C. argentea* subjected to different post-harvest treatments are presented in Table 1. Intake rate

(i.e. forage consumed in 1 h) was affected by post-harvest treatment when the forage offered was immature, but not when it was mature. Intake rate of immature *C. argentea* was doubled ($P < 0.05$) when the forage offered to sheep was wilted or sun-dried as compared to when it was offered fresh, regardless of the age of the animals used. Intake rate of *C. argentea* was 2-3 times higher with mature than with immature forage, regardless of post-harvest treatment.

Experiments 3 and 4

Results with immature *C. argentea* (Table 2) showed that, when animals were given a choice of immature fresh and dried *C. argentea*, they consumed more of the dried forage, regardless of age and previous experience of the animals. It was also evident that preference for dried, immature *C. argentea* was greater ($P < 0.05$) with the group of sheep that had previous experience (85%) than in those with no experience (67%). When sheep were given a choice of selecting fresh-mature and dried-mature *C. argentea*, they selected more ($P < 0.05$) dried forage (Table 2). Results also indicate that young sheep discriminated more between dried and fresh mature forage than adult sheep, and that sheep with previous experience consumed more ($P < 0.05$) dried mature *C. argentea* than sheep with no previous experience.

Discussion

Results from this study showed that intake rate and relative acceptability of *C. argentea* were particularly low when animals were fed immature forage, but not when the forage was mature. However, wilting or drying immature forage helped to increase its acceptability. Anecdotal

Table 1. Short-term intake of immature and mature *Cratylia argentea* fed either fresh, wilted or sun-dried to sheep (Experiments 1 and 2).

Forage type	Treatments				s.e.m.
	Fresh	Wilted (24 h)	Wilted (48 h)	Sun-dried	
	(g DM/h)				
Immature (Experiment 1)	84b ¹	157a	183a	160a	18
Mature (Experiment 2)	291	376	—	359	27

¹Means in the same row followed by different letters are significantly different ($P < 0.05$).

Table 2. Effect of age and previous experience of animals on relative short-term intake of immature and mature *Cratylia argentea* fed either fresh or dried to sheep (Experiments 3 and 4).

Forage type	Forage treatment	Sheep age		Sig. ¹	Previous experience		Sig. ²
		Young	Adult		Without	With	
		(g DM/kg LW ^{0.75} /h)			(g DM/kg LW ^{0.75} /h)		
Immature (Experiment 3)	Fresh	11b ³	14b	NS	17c	8a	0.0001
	Dried	41a	38a		34b	45a	
	s.e.m. 1.7						
Mature (Experiment 4)	Fresh	15c	19c	0.004	21c	12d	0.0001
	Dried	50a	44b		37b	57a	
	s.e.m. 1.7						

¹Interaction of forage treatment × sheep age.²Interaction of forage treatment × previous experience of sheep.³Within experiments, means followed by different letters are different ($P < 0.05$) within categories of age and previous experience.

evidence indicates that wilting increases the intake of other tropical shrub legumes, such as *Gliricidia sepium*. However, the positive effect of wilting or drying on acceptability of woody legumes cannot be generalised. For example, intake of *Calliandra calothyrsus* was higher when the forage was fed fresh as opposed to wilted or dried, presumably due to changes in tannin activity (Palmer and Schlink 1992).

It is acknowledged that animal and plant factors can influence the acceptability of forages (Arnold 1966a; 1966b). Inexperienced animals may completely reject or consume low quantities of novel feeds for long periods, compared with animals exposed to the feed early in life (Provenza and Balph 1987). In our study, discrimination between fresh and dry forage was greater when sheep had been previously exposed to *C. argentea*. Thus, it seems that a learning process accentuated the preference of sheep for dried *C. argentea*. In a conventional feeding trial with sheep, dry matter intake of immature fresh *C. argentea* fed alone was low (45 g DM/kg LW^{0.75}/d) even after a 14-day adjustment period (Aroeira and Xavier 1991).

Results from other studies have shown that DM intake rate of forages with no known deleterious factors can change with moisture content of the forage offered. For example, Kenney *et al.* (1984) found that DM intake rate of kikuyu grass increased by 55% as the DM in the forage was raised from 15% to 40%, but remained constant thereafter. Thus, it could be argued that the higher intake rate of immature dried or mature fresh *C. argentea* could simply be due to moisture reduction. Alternatively, the low

intake rate and acceptability of fresh immature *C. argentea* could be associated with one or several deterrent compounds present in the edible forage. If this was the case, the compound(s) present in *C. argentea* would seem to be partially lost when the forage is wilted or dried or when the forage is mature. Samples of leaves of immature and mature *C. argentea* were analysed in CIAT for the presence of known anti-quality factors. Results indicated that *C. argentea* contained only traces of condensed tannins, alkaloids, cyanogens and coumarin. However, other results indicated the presence of hydroxycoumarins and terpenes, particularly in young leaves. Whether these compounds are responsible for low intake and acceptability of immature *C. argentea* could not be determined at this stage. Future research should be aimed at determining if an adverse plant chemical constituent is in fact responsible for low acceptability of young regrowth of fresh *C. argentea*.

Low acceptability of immature *C. argentea* forage could be viewed as an advantage in the establishment and management of the legume in pasture systems. Utilisation by livestock of *C. argentea* sown in protein banks could be deferred for the dry season, when the plant is mature, but with adequate levels of crude protein to supplement low quality grasses. Alternatively, forage of *C. argentea* could be used in a cut-and-carry system where immature forage could be easily wilted or dried before being fed to livestock. Ongoing work by the TFP of CIAT indicates that milking cows readily consume wilted forage of *C. argentea*, without the need for an adjustment period.

Conclusion

The shrub legume *Cratylia argentea* has great potential as a source of fodder for livestock in tropical areas with infertile acid soils and prolonged dry season stress. The low acceptability of immature *C. argentea* rather than being a problem, could provide opportunities for managing the plant as a feed resource that would not be possible with highly palatable legume species.

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