RELATIVE PALATABILITY BY SHEEP AND GOATS OF OVEN-DRIED CALLIANDRA, ALBIZIA, GLIRICIDIA, AND LEUCAENA LEAVES

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SUMMARY

This experiment was conducted to assess the palatability of the lesser known fodder trees such as calliandra, and albizia which may have potential to be included in farming systems in the tropics the experiment. It was conducted in The University of Queensland, Gatton College in 1996 using six sheep and six goats in a Latin Square design involving pair-wise comparisons of four types of fodder trees, calliandra, albizia, gliricidia and leucaena. Variables measured were intake rates of each of fodder tree examined and differences between means were examined by the general linear model procedure of the Statistical Analysis System. The results showed that the overall intake rate of tree leaves examined was affected by animal species ($P<0.0017$) and tree types ($P< 0.001$). Rates of intake of gliricidia were consistently low and those of leucaena were consistently high, by both species of animals. Goats ate more quickly overall than sheep, but both species ate gliricidia much less rapidly than the others. Rates of intake of both calliandra and albizia were altered by the type of leaf fed as the pair. Intakes of calliandra were faster when paired with gliricidia than with albizia, and were reduced further when paired with leucaena. Rates of albizia intake were similarly influenced by the fodder which was paired with it. Fodder trees can be ranked with increasing order of palatability such as gliricidia, calliandra, albizia and leucaena. .

Keywords: relative palatability, leaves, sheep and goats

PALATABILITAS RELATIF OLEH DOMBA DAN KAMBING DARI DAUN KALIANDRA, ALBIZIA, GAMAL, DAN LAMTORO YANG DIKERINGOVENKAN

RINGKASAN

Penelitian ini bertujuan untuk mempelajari palatabilitas dari daun-daunan yang belum dikenal secara baik sebagai pakan seperti kaliandra dan albizia, tetapi mungkin memiliki arti penting bagi sistem pertanian di negara tropis. Karena itu, diadakan penelitian dengan menggunakan enam ekor domba dan enam ekor kambing yang melibatkan “pair-wise comparisons“ dari daun kaliandra, albizia, gamal, dan lamtoro dengan rancangan penelitian bujur sangkar latin. Penelitian dilaksanakan di Universitas Queensland, Gatton College pada tahun 1996.Variabel yang diamati dalam penelitian ini adalah laju konsumsi masing-masing daun-daunan dan rataan laju konsumsi tersebut dianalisis dengan menggunakan paket statistik, General Linear Model. Dari hasil penelitian ini

dapat disimpulkan bahwa laju konsumsi daun-daunan secara keseluruhan dipengaruhi oleh spesies ternak (P<0,001) dan jenis dari daun-daunan (P<0,001). Laju konsumsi gamal secara meyakinkan rendah dan sebaliknya laju konsumsi lamtoro tinggi baik oleh domba maupun kambing. Kambing mengkonsumsi daun-daunan lebih cepat jika dibandingkan dengan domba, tetapi kedua spesies ternak mengkonsumsi gamal lebih lambat jika dibandingkan dengan daun-daunan yang lain. Laju konsumsi kaliandra dan albizia dipengaruhi oleh jenis daun yang dipasangkan dengan daun kaliandra dan albizia. Konsumsi kaliandra lebih cepat bila diberikan bersamaan dengan gamal jika dibandingkan dengan bila dipasangkan dengan albizia, dan selanjutnya konsumsi kaliandra makin kecil bila dipasangkan dengan lamtoro. Demikian pula halnya, laju konsumsi albizia dipengaruhi oleh jenis daun yang diberikan bersamanya. Karena itu, daun-daunan dapat diranking menurut peningkatan palatabilitas sebagai berikut: gamal, kaliandra, albizia, dan lamtoro.

Kata kunci: palatabilitas relatif, daun-daunan, domba dan kambing

INTRODUCTION

Trees and shrubs have long been considered to be valuable feed resources for man's herbivorous animal since the time of domestication (Robinson, 1985). However, their feeding value, especially of the leguminous ones, varies from excellent (*Leucaena leucocephala*) to quite poor (most Australian acacia species as suggested by Gutteridge and Shelton, 1994). These authors further stated that the poor feeding value such as low palatability by animals of some tree foliage may be due to their contents of secondary compounds, particularly tannins which reduce the digestibility of both herbage dry matter and protein. Although leucaena ranks as excellent fodder tree, it is not without its limitations. Many authors reported that leucaena is poorly adapted to highly acid soils (Ruaysoongnern *et a*l., 1989), it is slow to establish (Lesleighter and Shelton, 1986) and its productivity has been severely reduced by the psyllid insect (*Heteropsylla cubana*) as suggested by Gutteridge (1998).

Therefore, it is necessary to look to alternatives genera which are being currently evaluated by many institutions world-wide. For example, gliricidia and calliandra (Oxford Forestry Institute), *Sesbania sesban* (The International Livestock Centre for Africa) as suggested by Gutteridge (1998). Moreover, differences in animal species may bring about differences in tolerating these secondary compounds, and hence their palatability as suggested by Begovic et al.(1978).

In this trial, the palatability of the lesser known tree species such as calliandra (*Calliandra calothyrsus*) and albizia (*Albizia chinensis*) were compared with gliricidia (*Gliricidia sepium*) and leucaena (*Leucaena leucocephala* cv. Tarramba) in pair-wise comparisons using sheep and goats.

MATERIALS AND METHODS

Animals and dietary treatments.

Six sheep weighing 35 ± 2.3 kg and six goats 36 ± 2.9 kg (mean ± SD) were penned individually to compare six combinations of leaves of tree legumes *Gliricidia sepium* (local cultivar), *Albizia chinensis, Calliandra calothyrsus*, and *Leucaena leucocephala* cv. Tarramba in a latin square design: albizia-gliricidia, albizia-calliandra, albizia-leucaena, calliandra-gliricidia, calliandra-leucaena and gliricidia-leucaena. The tree legumes *G. sepium, C. calothyrsus* and *A. chenensis* were grown at the University of Queensland, Mount Cotton Research Farm (27^0 53' S and 153^0E). The soil type is an infertile gleyed podzolic (ultisol) with a pH of 5.2 (Gutteridge, 1988). *Leucaena leucocephala* cv. Tarramba was grown at Beaudesert (west of Brisbane, 28^0 01' S and 153^0 02' E) on a deep alluvial soil

(Gutteridge, *pers. comm*). Leaves including rachis from these trees were harvested by hand in late autum of 1995 and oven-dried at 50 ^{0}C for 48h before use.

Feeding routines and measurements.

This trial was conducted in 1996 for six days. Before commencement of the trial, the animals were familiarized with the leaf over an eight day period in which all animals were offered each fodder tree on 2 occasions. Feed troughs were divided into 2 compartments. Amounts (200g, oven-dried) of the leaf under test were placed separately in each compartment. Leaf was offered at 0700 h for 15 minutes, and 3 consecutive 5 minutes intake measurements were made.

The amount of the test forage consumed in each period was calculated by difference and expressed as dry matter intake per minute. Two goats consumed all the leucaena provided during the first 10 minutes, and an additional 100g leucaena leaf was offered to these goats in the final 5 minutes. At 0900 h all sheep were given 800g Rhodes grass hay (*Chloris gayana* cv. Callide). The hay residues were removed at 1700 h to allow overnight fasting. Fresh water and multimineral blocks were also available *ad lib*. Overall mean intakes were calculated by averaging the intakes over all the pair-wise comparisons, while the relative preference or avoidance of each type of leaf was calculated as a percentage of total intake over all the pair-wise comparisons as suggested by Walker *et al.* (1994).

Chemical analysis

Leaves from each fodder tree were analyzed for dry matter (100 ^{0}C for 24 h) and for organic matter (450 ^{0}C for 4h). Leaf N content was determined by the Dumas method using a FP-2000 nitrogen analyzer (Leco, USA). Neutral detergent fibre, acid detergent fibre and acid detergent lignin contents were analyzed using the Fibertec system (Tecator, Sweden) based on the methods of Goering and van Soest (1970). Condensed tannin contents were determined by a modification of the butanol-HCL technique of Perez-Maldonado 1994).

Statistical analysis

Differences between means were examined by the general linear model procedure of the Statistical Analysis System (SAS), Insitute Inc., 1988). Significant differences between the treatment groups were determined by least significant difference (LSD) and were declared at $P<0.05$. Because of excessive variability, actual mean intakes were expressed as least square means.

RESULTS.

The N contents of the four fodder trees examined were in the range of 2.8 to 3.7% of DM. Gliricidia and leucaena contained similar amounts of N with the lowest in leucaena and highest in albizia. The NDF content of albizia was more than double that of leucaena, while calliandra contained more NDF than gliricidia or leucaena. Tannins were detected in all tree leaves tested. The lowest and highest total condensed tannin concentrations were in albizia and gliricidia, respectively, while calliandra and leucaena contained similar amounts of total

condensed tannins. The chemical composition of the fodder trees is presented in Table 1.

The overall intake rate of fodder trees was affected by animal species ($P< 0.0017$) and tree types ($P<0.0001$, Table 2).

Table 1 Nitrogen (N), organic matter (OM), neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) and condensed tannin of fodder trees.

Attributes	Gliricidia (local)	Calliandra	Albizia	Leucaena
Dry matter (%)**	92.8	88.6	90.5	90.1
Constituents (% DM)				
N	2.9	3.3	3.7	2.8
OM	94.0	94.8	95.1	86.4
NDF	40.4	50.8	62.8	31.3
ADF	23.2	27.0	35.7	17.5
ADL	12.3	17.5	22.4	8.9
Total condensed tannins (CT)*	7.8	5.2	3.3	5.0

* CT in gliricidia, calliandra and albizia are expressed as leucaena CT equivalent.** air-dry basis.

Table 2 Mean overall intake rates (least square means) of albizia, calliandra, gliricidia and leucaena leaf in pair-wise comparisons when fed to sheep and goats.

Intake rate (g DM per minute)	Sheep	Goats
Albizia	6.60^{bc}	7.78^{c}
Calliandra	5.11^{b}	7.41^{bc}
Gliricidia[1]	-0.18^{a}	1.21^{a}
Leucaena	11.64^{d}	13.37^{d}
SE	0.84	
Significance (P<0.05)		
Animal	0.00017	
Tree	0.0001	
animal x tree	0.9254	

SE = Standard error of least square means. ^{abcd}, least square means with dissimilar notations are significantly different.[1] negative value is due to its expression as least square mean.

Rates of intake of gliricidia were consistently low and those of leucaena were consistently high, by both species of animals. Goats ate more quickly overall than sheep, but both species ate gliricidia much less rapidly than the others fodder trees. Rates of intake of both calliandra and albizia were altered by the type of leaf

fed as the pair. Intakes of calliandra were faster when paired with gliricidia than with albizia, and were reduced further when paired with leucaena. Rates of albizia intake were similarly influenced by the fodder which was paired with it (Table 3)

Table 3 Rates of intake of tree leaves as influenced by others in a pair test with sheep and goats.

Sheep					Goats				
	Pair					Pair			
Intake rate (g DM/ minute)	Gli	Cal	Alb	Leu	Intake rate (g DM/minute)	Gli	Cal	Alb	Leu
Gliricidia	-	0.16[a]	0.04[a]	0.04[a]	Gliricidia	-	3.63[a]	1.71[a]	1.85[a]
Calliandra	7.23[b]	-	4.33[a]	2.95[a]	Calliandra	9.60[b]	-	6.54[a]	6.10[a]
Albizia	9.22[b]	5.78[a]	-	3.71[a]	Albizia	9.80[b]	6.97[a]	-	5.89[a]
Leucaena	10.64[a]	11.27[a]	11.13[a]	-	Leucaena	13.04[a]	11.44[a]	13.03[a]	-

[ab] Within rows, least square means with dissimilar notations are different ($P<0.05$).Gli, gliricidia; Cal, calliandra; Alb, albizia; Leu, leucaena.

DISCUSSION.

The local gliricidia cultivar used in this trial was not well accepted by either sheep or goats compared to the other fodder tree leaves. This was in agreement with Faint *et al*. (1997) who reported that for naive cattle the leucaena genotypes were more readily accepted than *Gliricidia sepium* cv. Retalhuleu, *Calliandra calothyrsus* and *Sesbania sesban*.

However, goats had less aversion to consuming gliricidia leaf than sheep, possibly owing to their higher tolerance of forages containing tannins. Begovic *et al*. (1978) have suggested that goats have active tannases in their rumen fluid. Condensed tannins may have influenced the acceptability of the test fodder tree leaves to both sheep and goats. Intake of gliricidia appears to have been adversely influenced by its CT content.

The importance of tannin in limiting intake of *Acacia saligna* and *A. salicina* was noted by Degen *et al*. (1997). Intake of immature forages from these

two acacias was lower than of the mature forages by both sheep and goats. This difference was associated with the higher content of tannin in the immature rather

than the mature forages (15.6 v. 8.8% and 19.6 v. 9.8% DM for *A.saligna* and *A. salicina*, respectively). From a cafeteria trial using sheep, it was noted by Kaitho (1997) that NDF, ADF and lignin contents of fodder trees and shrubs were negatively correlated with palatability and dry matter intake.

Therefore, the slower rate of intakes of calliandra and albizia than leucaena may be related to the higher contents of NDF and ADF in these two forages compared to NDF and ADF in leucaena leaves, although tannins in calliandra are similar to and lower in albizia than leucaena. The four fodder trees examined can be ranked in an ascending order of palatability: gliricidia, calliandra, albizia and leucaena.

CONCLUSIONS

The overall intake rate of fodder trees was affected by animal species and tree types. Rates of intake of gliricidia were consistenly low and those of leucaena were consistenly high, by both species of animals. Goats ate more quickly overall than sheep, both species ate gliricidia much less rapidly than the others. The four fodder trees examined can be ranked in an ascending order of palatability: gliricidia, calliandra, albizia and leucaena.

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