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Urea Supplementation Increases Nitrogen Retention in Sheep Fed with *Leucaenapallida* (Kx2) Foliage

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Abstract

Leucaena pallida (Kx2) is a good source of protein for sheep if its condensed tannin is only minimal. Alternative source of N could then- be given. This study determined the response of sheep to urea supplementation in terms of N balance, N digestibility and dry matter (DM) digestibility. Fifteen Merino wethers (ave. weight - 32.5 kg) were randomly distributed to 5 treatments. They were fed with *Leucaena pallida foliage* (750 g DM per day) and approximately 240 g of different urea concentrations in molasses as carrier (0, 6.1, 19.8, 28.0, and 45.9 g of urea/d). N and DM contents of L. pallida, urea in molasses mixture, urine, and feces were determined. Regression analysis was used to determine the relationship between N intake from urea in molasses, N digestibility, and DM digestibility. N retention and digestibility were improved and significantly related to N intake from urea with r^2 values equivalent to 0.816 and

Keywords: *Ovis bovidae*, condensed tannin, nitrogen balance, nitrogen digestibility, dry matter digestibility, sheep

Introduction

Leucaena is noted as a multi-purpose fodder tree legume. It is a good source of high-quality forage for animals and an excellent source of animal feed. It is used as fertilizer, protection for soil erosion, fuel wood, lumber and human food with wide environmental adaptability (Shelton and Jones, 1994).

One of the known species is Leucaena pallida. The advantages of Leucaena pallida are tolerance to psyllid (Shelton and Jones, 1994), tolerance to cool and frost temperatures (Hughes and Harris, 1994) and good growth potential in cool seasons (Castillo, 1993). In addition, it has better seedling vigor and has faster early growth compared to other legume trees (Sorensson, 1994).

It was found, however, that both pastures and browse species of tropical

legumes like Leucaena contain anti-nutritional factors or deleterious substances (Skerman et al., 1988). Leucaena pallida has higher condensed tannin compared to *Leucaena leucocephala*. It also has higher fiber levels as well as lower in vitro and in vivo digestibility (Castillo, 1993; Dalzell et al., 1998; McNie11 et al., 1998).

Tannins are water-soluble phenolic compounds of plants and are divided into two groups known as condensed tannin (CT) and hydrolysable tannin (HT). CT is a phenolic compound which binds with proteins to form insoluble complexes the kind of tannin that is found in Leucaena pallida. HT, on the other hand, are compounds found in plants that are readily hydrolyzed by acid, bases or by enzymes.

Since tannin binds with protein, digestive enzymes or rumen microbes therefore cannot act on protein. High tannin content in feeds reduces nitrogen utilization by binding with protein and larger protein molecules tend-to bind tannin more tightly (Kumar and D'Mello, 1995). This protein-tannin binding is known to have detrimental nutritional effects on animals. Effects may include lowering of feed intake and feed digestibility; the reduction of nitrogen and neutral detergent fiber (NDF) digestibility; decrease in Sulphur absorption; and increased fecal nitrogen which results in lower production of wool and a lower growth rate (Barry and Duncan, 1984; Pritchard et al, 1992). Hence under these circumstances dietary protein is protected from degradation of rumen microbes. Rumen microbes could be starved of nitrogen which then result in a reduced microbial protein supply and a lower growth rate.

Rumen microbes can use an alternative source of nitrogen. Non- protein nitrogen as found in urea can satisfy part of the protein requirement of the animal (Cheeke, 1991). It is a useful source of rumen digestible protein. Urea has a nitrogen content of 466 g/kg and is commercially produced as animal feed and plant fertilizer. Urea supplementation could be the cheapest way of improving the supply of nitrogen to rumen microbes, which in turn are utilized by the animal. Practical and beneficial levels of urea supplementation in animals fed with high quality legume should be determined (Tareque, 1996).

This study measured the extent to which tannin in Leucaena pallida reduces the production of microbial protein in sheep. It also determined the degree to which this loss can be redressed by the additi0ii of urea in the diet. It is hypothesized that urea in molasses supplementation in sheep fed with Leucaena pallida can overcome the tannin problem by increasing the nitrogen retention through a •stimulation of microbial crude protein production. It specifically evaluated the response of sheep to urea supplementation in the molasses carrier in terms of N balance, N digestibility, and dry matter digestibility.

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Materials and Methods

Date and location of the project. The study was conducted at Animal House, University of Queensland Research Farm, Mt. Cotton, Queensland,

Australia. Pre-experimental exposure started from the 7th up to 17th of July 1998. The pre-experimental period was a minimum period of 14 days (Hogan, 1996) to permit adaptation of rumen microbes to the new diet. Data were collected from the 18th up to 24th of July 1998.

Source of Leucaena pallida. An established area of Leucaena pallida (Kx2) at the University of Queensland research farm was the source of the foliage. Fresh foliage was hand-harvested (Plate 1) every morning and fed fresh to sheep. Collected leaves were placed into the bin and weighed. Sufficient amount of foliage was harvested for the day and placed in the cold storage to avoid moisture loss and wilting.

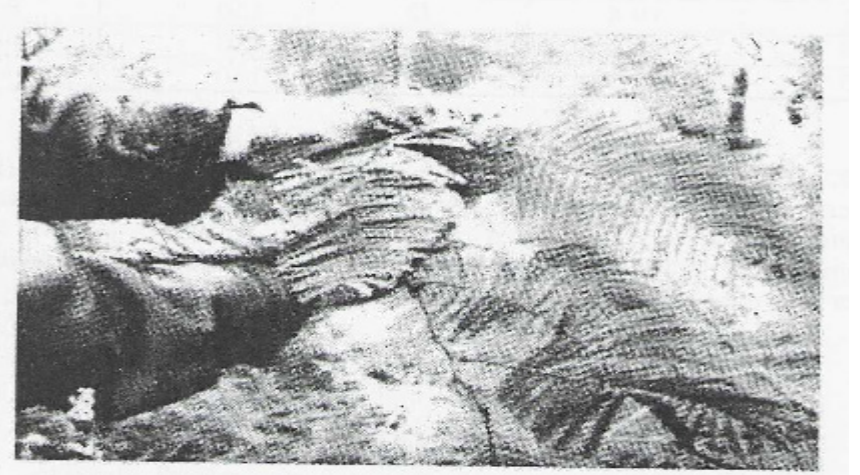

Plate 1. *Leucaena pallida* foliage

Experimental animal and design. Fifteen (15) Merino wethers with similar weights (32.5 kg) were used. The wethers were divided into 5 groups, with 3 animals per group. They were distributed using a Randomized Complete Block Design. Regression analysis was used to evaluate the relationships between nitrogen intake from urea in molasses, total N intake, nitrogen retention, nitrogen digestibility, dry matter intake and dry matter digestibility.

Preparation of urea in molasses mixture. All sheep were given the same amount of L. pallida per day with a variation in the amount of urea (Table 1). Urea was added to warm water then mixed in a plastic container. Molasses was then added to the urea solution.

Table 1. The composition of the different urea supplements fed to the sheep

Treatment No.	Urea (g)	Water (g)	Molasses (g)	% N (DM basis)
1	0	90	150	0.70
2	6.1	84	150	2.94
3	19.8	72	150	8.06
4	28.0	66	150	10.70
5	45.9	60	150	16.25

Experimental pen. The animals were placed in a group pen during the pre-experimental period (14 days) prior to their transfer to the metabolism crates at the animal house. The crates were cleaned and were used to facilitate collection of individual feces, urine and refusals as well as for feeding. A separator was used to separate feces and urine (Plate 2).

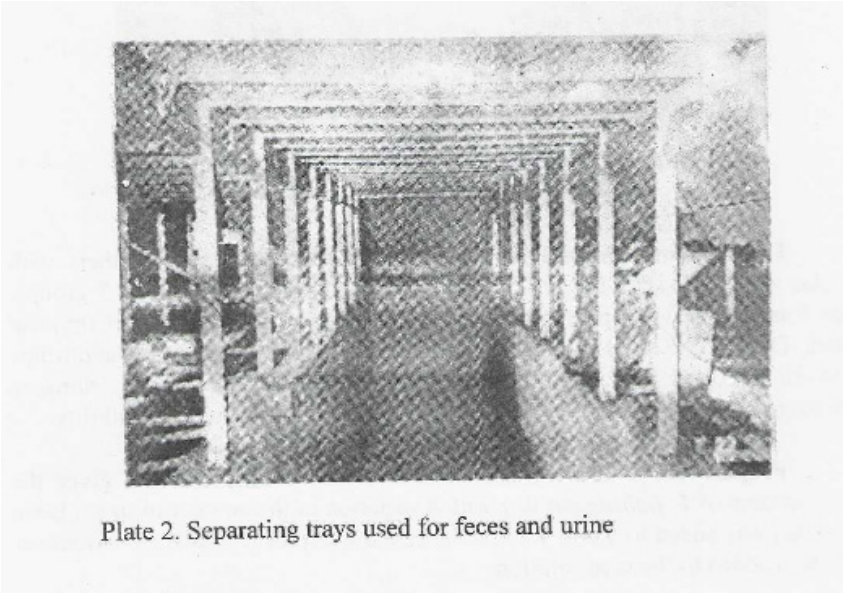

Plate 2. Separating trays used for feces and urine

Pre-experimental exposure. During this period, the sheep were fed with hay then gradually changed to L. pallida. with 25% increase per day. The animals were also introduced to molasses-urea feeding.

Drenching of sheep. To facilitate rapid adoption of rumen microbes to L. pallida, the sheep were drenched with rumen fluid taken from fistulated cattle that

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had grazed on L, pallida (Kx2). Each sheep was given 100 ml of the rumen fluid. In addition, the wethers were drenched with 8 ml/animal of Cydectin to avoid nutrient competition.

Feeding of *L.pullida* and of urea in molasses. The sheep were fed with 2.5 kg of pallida or 750 g dry matter per day- Feeding of the foliage was done three times a day with equal amounts at 8: 00 AM, 12:00. Noon and 6:00 PM. The molasses-urea mixture (Plate 3) was given according to the treatments (Table l). the mixture was given to the animal at approximately 240 g per day to avoid urea toxicity, the molasses-urea mixture was given to the animals in equal amounts, three times a day (i.e., 8:00AM, 12: 00 Noon and 6:00PM).

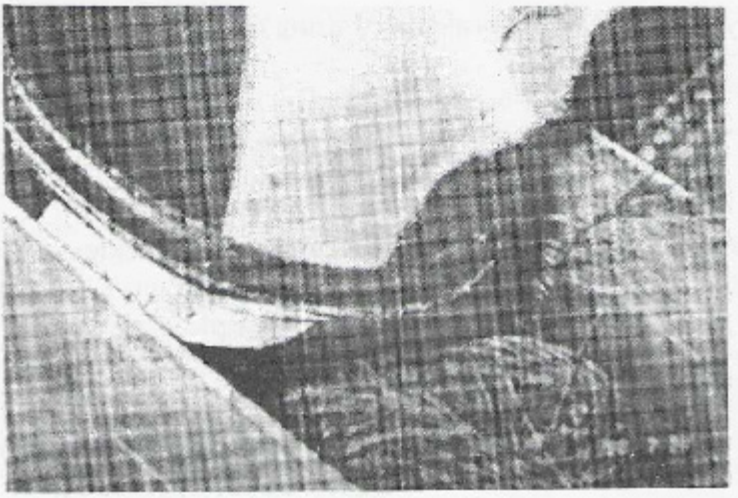

Plate 3. Molasses-urea mixture as supplement to sheep fed with *L. pallida* foliage

Refuse collection. The daily refuse of I. pallida and the molasses-urea mixture were collected and weighed separately. Ten percent (10%) of each weight were taken as a sample for laboratory analysis and stored in the freezer until use.

Collection of feces and urine. Fecal weights were recorded daily. Ten percent (10%) of total fecal weight was collected as a sample for laboratory analysis and frozen until use.

Urine volume was collected and measured daily. Using a pH meter, pH was monitored and 10% sulfuric acid (H_2SO_4) was used to acidify the urine up to pH 3.0. This was to prevent bacterial destruction of purine derivatives (Chen and Gomes, 1995)

Determination of dry matter. Dry matter contents of L pallida, urea in molasses, and feces, were determined by oven-drying at 800C until constant weights were obtained. Materials were then ground and allowed 10 pass a I mm sieve prior to N content determination.

Dry matter (DM) was calculated using the formula:

$$DM\ (\%) = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100$$

Nitrogen analysis and data calculations. Samples were analyzed for nitrogen Content using a Maxima™ 820 machine at 1 g/sample with two replicates per sample. N content of each sample was used to determine N retention, N digestibility and dry matter digestibility (DMD) which were calculated as follows:

N reten11011 (g) Total N intake (g) - Total N output (g)

$$N\ \text{digestibility}\ (\%) = \frac{\text{Total N intake} - \text{Total N excretion}}{\text{Total N intake}} \times 100$$

$$DM\ (\%) = \frac{\text{Total DM intake} - \text{DM output in feces}}{\text{Total DM intake}} \times 100$$

Results and Discussion

Results show that N retention was positively and linearly related to the voluntary intake of urea ($P=0.001$, $r^2=0.816$, Figure l). The N intake from L. pallida, as expected, was not affected by urea supplementation in sheep. This implies that there are similar N intakes from L. pallida are similar across treatments while N intake from urea varied (Table 2).

It can be noted however that at high levels of urea concentration (28 g urea/d or 3 % of total DM offered an&45.9 g/d or 6 % of total DM offered) the N intake tended to decline relative to the N intake at 19.8 g urea/d. This decline could be due to reduced palatability of the urea in molasses mixture.

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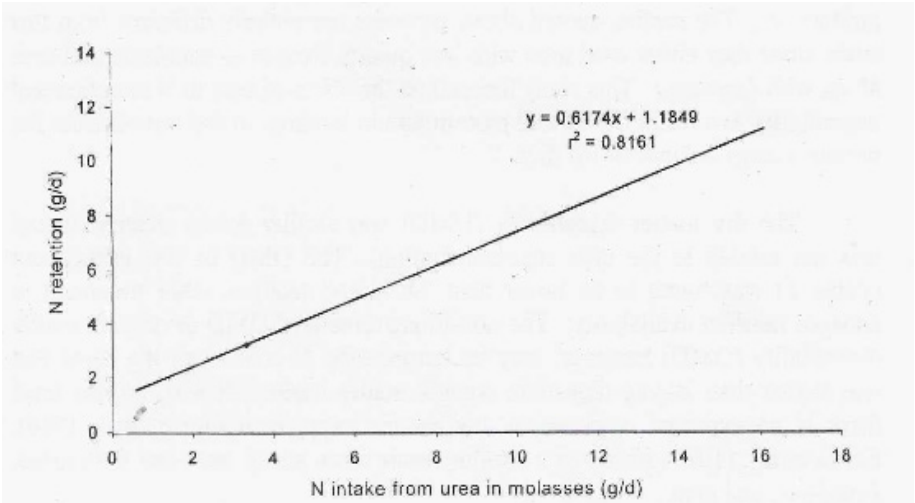

Figure 1. The relationship of N intake from urea in molasses and N retention of sheep

The data shows a strong linear relationship between N intake from urea in molasses and N retention. This suggests that urea may have influenced the N retention of the animal through the microbes -that may have utilized the nonprotein nitrogen from urea. Higher N retention suggests faster growth in animals. It is interesting to note however, that molasses supplementation alone gave an N retention of 0.7 Wd. Urea supplementation and its advantageous effect of urea to ruminant animals are supported by the claims of Tessema and Emojong (1984) and Wongskriskeao and Wanapat (1984). Likewise, the results of Hossain et al., (1995) suggested that urea supplementation to sheep results in much faster meat production. In addition, Karda et al., (1998) repotted that urea supplementation with Leucaena improved N digestibility. reports also show that there was an increase in N digestibility through microbial crude protein production. The studies quoted above however are entirely different from this study since they cither used urea with low quality forages or supplemented urea along with Leucaena. This study focused on the effect of urea in N retention and digestibility as a result of reduced protein-tannin binding. It did not consider the protein-energy balance of the diet.

The dry matter digestibility (DMD) was similar across treatments and was not related 10 the urea supplementation. The DMD in This experiment (Table 2) was found to be lower than 54 % and requires other treatment to enhance nutrient availability. The non-improvement of DMD or organic matter digestibility (OMD) however, may be because. the N content of the basal diet was higher than 20g/kg digestible organic matter intake (DOMI). At this level there is no expected response

to any protein supplementation (Egan, 1984). Karda et. al., (1998) observed a similar result when sheep were fed with grass, Leucaena, and urea.

We are in the process of confirming the observed improvements in N retention translate into commercially acceptable levels of live weight, wool, Or milk production in sheep. To minimize the risk of urea toxicity whilst maximizing the response we recommend feeding at maximum level of 19.8 g urea/d mixed with molasses and water, offered ad libitum.

Table 2. Nitrogen balance, retention, digestibility; and dry matter digestibility in sheep fed *L. pallida* and supplemented with urea in molasses. Each value is the mean for three animals.

PARAMETER	UREA OFFERED (g/d)					r^2	REGRESSION COEFFICIENT (b)	CI	
	0	6.1	19.8	28.0	45.9			Lower 95%	Upper 95%
N intake from urea in molasses (g/d))	0.7	3.2	9.9	9.3	15.6	0.770**			
N intake from L.pallida (g/d)	18.9	21.7	23.4	20.0	21.5	0.097ns	0.163	-0.136	0.463
Total N intake (g/d)	19.6	24.9	33.3	29.3	37.1	0.844**	1.163	0.864	1.463
N excreted in feces (g/d)	15.2	18.4	19.1	16.6	19.6	0.232ns	0.266	-0.024	0.556
N excreted in urine (g/d)	3.7	2.8	6.1	5.8	7.2	0.449**	0.280	0.112	0.448
Total N excreted (g/d)	18.9	21.2	25.2	22.4	26.8	0.559**	0.546	0.255	0.837
N retention (g/d)	0.7	3.7	8.1	6.9	10.3	0.816**	0.617	0.442	0.793
N digestibility (%)	3.6	14.9	24.3	23.6	27.8	0.685**	1.449	0.860	21.040
DM intake from L.pallida (g/d)	717.6	836.7	923.6	787.2	838.7	0.140ns	0.620	0.440	0.790
DM intake from urea in molasses (g/d)	96.7	109.7	122.9	86.8	96.1	0.010ns	0.230	-1.640	2.100
Total DM intake (g/d)	814.3	946.4	1046.5	874.0	934.8	0.130ns	8.210	-4.780	21.200
DMD (%)	52.8	49.0	52.8	53.8	46.5	0.090ns	-0.290	-0.850	0.260

** = highly significant (0.01); ns= not significant
CI = Confidence Interval

Conclusion

Urea supplementation improved N retention in sheep fed on Leucaena pallida-based diet. As the amount of urea in molasses increased from 6.1 to 45.9 g/d, total N intake, N excreted and N digestibility varied. A strong relationship was shown by urea supplementation and the total N intake, N retention and N digestibility with r2 at 0.844, 0.816, and 0.685, respectively.

Total DM intake and DMD did not vary significantly as urea in molasses increased.

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