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RESPONSE OF GROWING RABBITS TO VARIOUS LEVELS OF *Leucaena leucocephala* IN A WHEAT BRAN BASED DIET

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Abstract

Groups of 6 female and 6 male recently weened rabbits were fed *Leucaena leucocephala ad libitum* (LLal), *L. leucocephala* 24% of the diet DM basis (LL24) in hot and cool season feeding trials with wheat bran fed free-choice. In the cool season a *L. leucocephala* and *Pennesitum purpureum ad libitum* and in the hot season a *Clitoria ternatea* and *P. purpureum ad libitum* treatment were also included using wheat bran as a base for the diets. In the cool season, rabbits reached a marketable 2kg in 6 weeks and mean average daily gains were undifferentiated among treatments (17.1g/day/animal overall). Cool season dry matter feed conversion efficiency was best in the LL24 treatment at 6.9 (average overall for the season was 8.5). In the hot season, rabbits took 17 weeks to reach 1.75kg. Mean average daily gains were again undifferentiated among diets (9.2g/day/animal overall) indicating that unthriftiness was due to overall low quality of the diet rather than forage toxicity. Dry matter conversion efficiencies were also undifferentiated in the warmer season but were very similar (8.3 overall) to those computed for the cool season. Mimosine toxicities were not significant in the cool season but severe in the hot season, indicating length of exposure rather than amount of mimosine ingested may be the determining factor since animals in the LLal cool season treatment consumed 4.77 kg/head, superior to the 4.43kg/head consumed by rabbits in the same treatment during the hot season.

Introduction

Raising rabbits on fresh forages can be a viable endevour in climatic zones where the latter can be harvested all year. The quality, especially as reflected by weight gains or toxicity effects, of such forages fed in large amounts should be carefully studied, however, before being recommended to producers.

Leucaena leucocephala is a forage which can be grown all year in many tropical and sub-tropical areas. It is especially attractive, due to its capacity to resprout after cutting during dry months, in regions with yearly droughts (Isarasenee *et al.*, 1983; Muir, 1990). Rabbits readily accept *L. leucocephala* (Roharjo and Cheeke, 1985) and studies show that, although not comparable to pelleted feeds or temperate legumes such as *Medicago sativa* (Harris and Cheeke, 1981), digestibilities in wilted material range over 74% for both dry matter and crude protein (Raharjo *et al.*, 1985).

Studies also indicate, however, that *L. leucocephala* can be prejudicial to rabbit growth due to the presence of mimosine and its subsequent conversion to 3-hydroxy-4(IH)-pyridone (DHP) during digestion (Brewbaker *et al.*, 1985). Alopecia, hematuria and unthriftiness have been reported in rabbits fed 40% fresh or up to 60% dried *L. leucocephala* (Malini et al., 1989; Tangendjaja et al., 1990).

A recent feeding trial substituting 8%, 16% and 24% of a wheatbran diet with fresh wilted *Leucocephala*, however, resulted in better weight gains as the percentage of the legume increased

(Muir and Massaete, 1991; see Table 1). Only very slight clinical signs of mimosine toxicity were reported.

Table 1. Average daily gain for rabbits on a basal diet of wheat bran and three dietary percentages of fresh *L. leucocephala*.

Treatment	wk1	wk2	wk3	wk4	wk5	wk6	Mean
	g/day						
0% Leucaena	8.6b*	0.6b	7.7b	-0.6b	0.9b	-5.7c	1.9c
8% Leucaena	14.0ab	7.7a	20.2a	8.0a	6.3a	9.5b	11.0b
16% Leucaena	16.7a	10.4a	19.6a	9.2a	9.5a	13.4ab	13.1ab
24% Leucaena	19.6a	12.8a	21.1a	12.8a	10.7a	14.9a	15.3a

(Muir and Massaete, 1991)
*Means within the same column followed by different letters differ (0.05) according to Duncan's Multiple Range Test.

The objective of the feeding trials reported here was to determine the effects of increased amounts of *L. leucocephala* fed fresh with a basal diet of wheat bran to growing rabbits. The experiment was undertaken in both the hot and cool season to study the effect of season. Wheat bran, although a poor substitute for complete pelleted feed, was used due to its abundance in local urban markets and its common usage by rabbit producers in these areas of Southern Mozambique.

Materials and Methods

Experiment 1. Groups of 6 female and 6 male 6-week old rabbits of mixed-races were assigned to three diets consisting of:

1. *L. leucocephala* & *Pennesitum purpureum* & wheat bran
2. *L. leucocephala* & wheat bran
3. *L. leucecephala*-24% & wheat bran

All components were fed free-choice except in diet 3 where *.L. leucocephala* was limited to 24% of the diet. Forage material was wilted over-night. Forage consumed and wasted below the cages was measured on a dry matter basis. Crude protein of all dietary components were determined (Table 2).

Table 2. Crude protein content of dietary components used in Experiments 1 and 2.

Diet component	Crude Protein %
Wheat bran	16.9
L. leucocephala	25.6
P. purpureum	8.4
C. ternatea	16.6

Animals were individually weighed every week for 8 weeks (the time necessary to reach a marketable 2kg weight) following an initial 7 day period of adaptation to the diet. Carcass percent of liveweight as well as examinations for unusual lesions and hematuria in the bladder urine at time of death were carried out at the end of the experimental period. This experiment took place during the cool dry season (July and August) when mean daily temperature was 18.8^{o}C.

Experiment 2. This second experiment followed the same methodology as the first with the following dietary treatments:

1. *L. leucocephala* & wheat bran
2. *L. leucecephala*-24% & wheat bran
3. *Clitorea ternatea* & *P. purpureum* & wheat bran

This experiment took place during the warm rainy season (November through January) when the mean daily temperature was 25.8ºC. Weights were taken for 17 weeks, the time it took the animals to reach a 2kg marketable weight. Mimosine averaged 0.5%, 3.4DHP averaged 0.9% and 2.3DHP was not detectable in *L. leucocephala* dry matter samples batched from the two experiments.

Results and Discussion

Experiment 1. Mean average daily gains (Table 3) in the dry, cool season showed no difference (P=0.51) among the three treatments. In weeks 1, 4, 7 and 8 there were differences (P<0.05) in gains with a tendency towards higher gains in the LL *ad libitum* in the early weeks but lower gains in the same diet during the last two weeks. Although all average daily gains were low in week 8, LL *ad libitum* was -2g/day, indicating perhaps that a threshold in tolerance to a dietary component had been reached. Only 8 weeks were necessary to reach the 2kg market minimum; further decline in daily weight gains may have been registered had more weight been required.

Table 3. Average daily gain for rabbits on a basal diet of wheat bran supplemented with differing amounts of *L. leucecephala* and *P. purpureum* during the cool season.

Treatment	wk1	wk2	wk3	wk4	wk5	wk6	wk7	wk8	Mean
	g/day								
LL-24%*	20c**	23	16	17b	14	24	15a	9a	17.2
LL & N al	31a	20	18	18b	14	25	12ab	4ab	17.8
LL al	25b	22	18	24a	13	24	6b	-2b	16.3

*LL=leucaena, N=napier; al=*ad libitum*
*Means within the same column followed by different letters differ (0.05) according to Duncan's Multiple Range Test.

Feed conversions on a dry matter basis (Table 4), showed the best results in the LL-24% treatment with 6.9g of feed DM needed for every liveweight g gained. Due, perhaps to the limited quantities of forage available, the amount of bran consumed in this treatment was higher than in the other two, resulting in a higher wheat bran consumed:weight gain ratio.

Table 4. Average daily dry matter offered (+), waisted (-), ingested (I) and conversion effeciencies in diets containing *L. leuceocephala*, *P. purpureum* in a wheat bran basal diet fed to growing rabbits during the cool season.

Diet	LL*			N			B	Total	DM/Gain	B/Gain
	+	-	I	+	-	I				
	g/day									
LL-24%	32.5	2.4	30.1				88.4	118.5	6.9a**	5.1
LL & N al	85.8	20.2	65.6	16.7	3.5	13.2	77.4	156.2	8.8b	4.3
LL al	93.2	8.2	85.1				75.3	160.4	9.8b	4.6

*LL=leucaena; N=napier; al=*ad libitum*; B=wheat bran
**Means within the same column followed by different letters differ (0.05) according to Duncan's Multiple Range Test.

Experiment 2. In this hot-season trial, mean average daily gains (Table 5) were much lower than during the cool-season Experiment 1: 9.2g gained/day versus 17.1g gained/day. The animals took more than twice as long (over 17 weeks versus 6 weeks) to reach a marketable liveweight of 2kg (Figure 1). Although animals in both experiments were the same age, initial weights in Experiment 1 were higher (1.13kg versus 0.66kg), indicating a possible seasonal effect on weight at weening since pre-weening diets were similar.

As in Experiment 1, there were no differences (P=0.57) among the mean average daily gains. Individual weekly differences (P<0.05) did exist and, as in Experiment 1, where there were differences between the 24% and the *ad libitum* treatments, the latter gave higher gains early in the trial while the 24% was superior in the later weeks. The fact that the treatment without *L. leucocephala* gave very similar results to the treatments containing this forage indicates that season and low quality of the base diet, wheat bran, rather than anti-quality factors in the leucaena, induced unthriftiness in the rabbits.

Table 5. Average daily gain for rabbits on a basal diet of wheat bran supplemented with differing dietary proportions of *L. leucocephala*, *C. ternatea* and *P. purpureum* during the warm season.

Treatment	wk1	wk2	wk3	wk4	wk5	wk6	wk7	wk8	wk9	wk10
	g/day									
C* & N al	8.3	8.7	9.1b**	13.1	15.6	13.6a	11.6	6.5	9.8	4.4
LL al	10.6	11.9	12.4a	11.7	12.1	9.6b	7.9	5.4	8.5	6.8
LL 24%	10.8	9.9	8.7b	9.7	11.7	9.8b	8.6	5.9	10.6	4.9

*LL=leucaena, N=napier, al=*ad libitum*, C=*Clitoria ternatea*
**Means within the same column followed by different letters differ (0.05) according to Duncan's Multiple Range Test.

Table 5 continued.

Treatment	wk11	wk12	wk13	wk14	wk15	wk16	wk17	Mean
	g/day							
C & P	6.0	8.7	9.1	6.5	7.7	10.9a	12.7	9.5
LL ad lib	7.8	7.9	5.7	9.2	7.6	6.0b	8.8	8.8
LL 24%	7.6	11.0	6.5	11.1	9.3	10.8a	13.5	9.4

Average daily dry matter ingested in Experiment 2 (Table 6), was lower than in Experiment 2, averaging 76.8 g/day/animal as opposed to 145 g/day/animal. Since the intakes were similar among treatments, high rainy season temperatures, rather than dietary components, were likely responsible for low intakes. Average conversion efficiencies in the rainy season (8.3) did not differ, however, much from that of the cool dry season (8.5). Conversion efficiency differences among treatments in this trial were not apparent. Lower dry matter intake, therefore, is responsible for the lower average daily gains during the hotter months. In this experiment, the forage *ad libitum* diets resulted in noticeably lower bran consumed/weight gained ratios.

Table 6. Average daily dry matter offered (+), waisted (-), ingested (I) and conversion effeciencies in diets containing *L. leuceocephala*, *P. purpureum*, *C. ternatea* in a wheat bran basal diet fed to growing rabbits during the cool season.

Diet	LL*			N&C			Bran	Total	DM/Gain	B/Gain
	+	-	I	+	-	I				
	g DM/day									
LL-24% & B	18.0	2.0	16.0				58.4	74.4	7.9	6.2
LL al & B	42.0	4.8	37.2				43.6	80.8	9.2	4.9
C & N al & B				49.6	14.3	35.3	40.0	75.3	7.9	4.2

*LL=leucaena; N=napier; al=*ad libitum*; C=*Clitoria ternatea*; B=bran

Although mild alopecia was apparent in 17% of the fryers fed leucaena *ad libitum* in Experiment 1 (Table 7), the large dietary percentages of this forage (53% of the diet, DM basis) did not appear to affect animal performance. In the hot-season Experiment 2, however, the leucaena *ad libitum* animals (leucaena comprised 46% of the diet, DM basis) suffered a 50% mortality rate over the 17 weeks. Half of these deaths were due to extreme cases of pododermatitis which necessitated eliminating animals. These cases of "sore hocks" affected 66.6% of the fryers in this treatment and can be directly attributed to hair loss on the hocks from excessive mimosine ingestion since the treatment containing no leucaena did not register a single case of pododermititis and the 24% treatment registered only one case.

These differing results between seasons would indicate that, due to loss of performance during the heat, rabbits which take longer to gain marketable weights were more susceptible to the cummulative effects of mimosine toxicity. The actual average quantities of leucaena (and therefore mimosine) consumed by each animal in the *ad libitum* cool season treatment was very similar (4.77kg) to that consumed by animals in the same treatment during the hot season (4.43kg). This would indicate that time exposed to the mimosine, rather than total mimosine ingested, produced physical effects of toxicity.

Table 7. Mortalities, diseases and toxicities in Experiments 1 and 2.

Causes	Experiment 1			Experiment 2		
	LL-24%*	LL&N-al	LL-al	LL-24%	LL-al	C&N-al
Diarhea (lethal)				2	2	-
Pododermatitis						
lethal	-	-	-	-	3	-
non-lethal	-	-	-	1	5	-
Pneumonia (lethal)				2	1	2
Alopecia	-	2	-	3	9	-
% Mortality	0	16.7	0	33.3	50	16.7

*LL=leucaena, N=napier, al=*ad libitum*, C=*Clitoria ternatea*

Carcass percentages of liveweight did not differ between treatments, seasons or sexes, averaging 51.5% overall. Histological examinantions of the main organs showed no signs of damage in any diet of the two experiments. Hematuria was not apparent in any treatment following bladder sampling at time of slaughter. These results correspond to those found by Muir and Massaete (1991).

Conclusions

Average daily gains in both experiments are low. These results may be due, however, more to the nature of the wheat bran than the effect of *L. leucocephala*. Results from Experiment 2 support this conclusion since the diet containing forages other than leucaena did not give greater mean average daily gains.

Experiment 2 mortality figures indicated a negative effect of leucaena since 25% of the animals in the *ad libitum* treatment were lost due to severe pododermatitis. This would support the conclusion that, where fed low quality dry feeds such as wheat bran and where fed in hot climates conducive to unthriftiness in rabbits, leucaena should be offered to fryers in controled amounts. The 24% leucaena treatment mortality data indicated that, should hair quality (skin quality was unaffected) or live animal aesthetics not be of commercial value (as is the case in Mozambique), this forage may be included in at least these amounts without affecting marketable results.

The most pertinent conclusion to be extracted from this experiment is that time exposed to mimosine, rather than quantity of mimosine ingested, is the most important factor in inducing toxicity symptoms. The quantity of leucaena ingested by the *ad libitum* animals in both trials was very similar although the amount per day was half in hot season animals. Alopecia and consequent pododermatitis, however, were severe only in the hot season animals. The difference was that animals in the cool season ingested mimosine for 8 weeks (final 2.09kg liveweight average) before slaughter while those in the hot season consumed leucaena for 17 weeks (final 1.75kg liveweight average).

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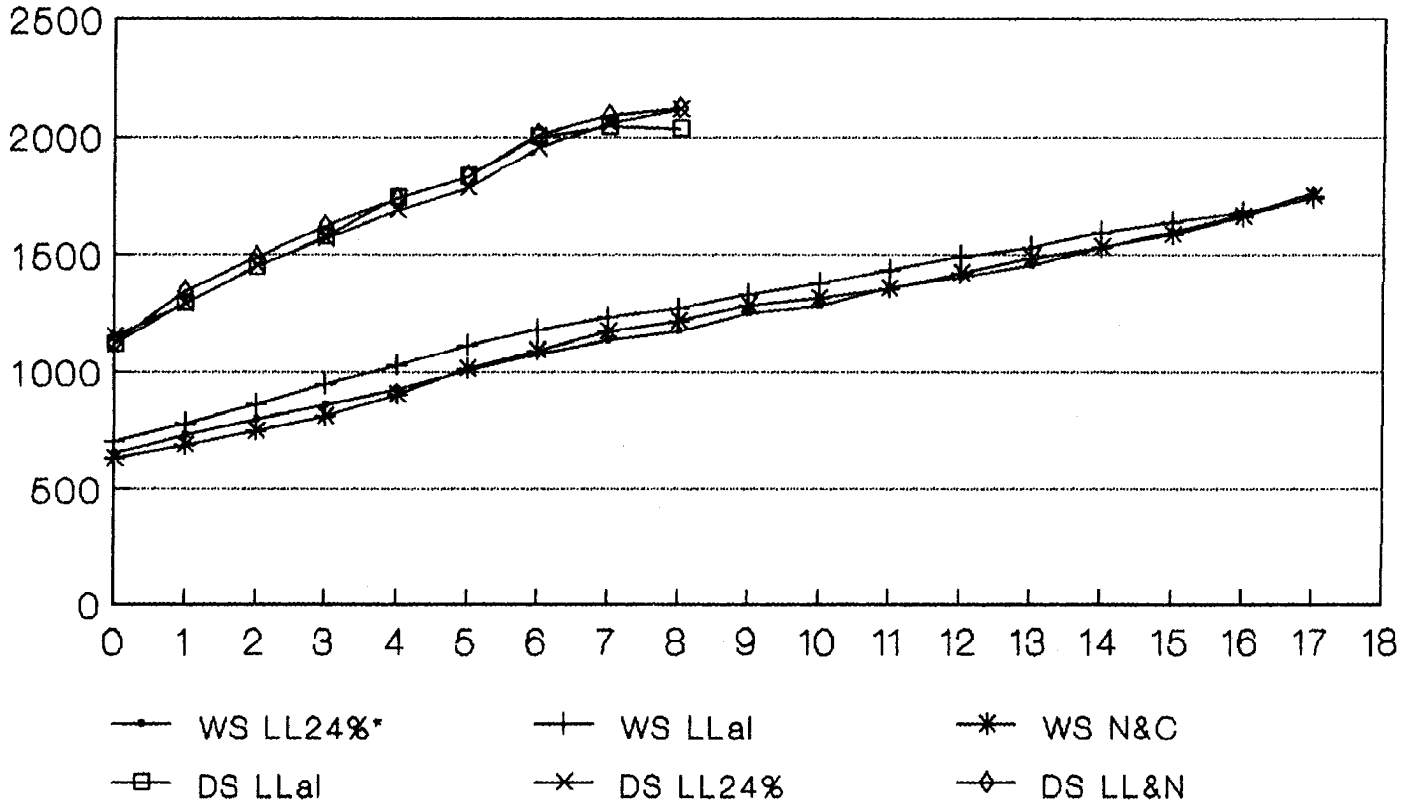

Figure 1. Fryer gains during dry season (DS) and wet season (WS) fed leucaena (LL), napier (N) and clitoria (C).