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FORAGE INTAKE AND LIVE WEIGHT GAIN OF STEERS GRAZING THREE DIFFERENT *LEUCAENA* SPECIES MIXED SIGNAL GRASS SUPPLEMENTED WITH POLYETHYLENE GLYCOL

Rusdi[1] *and B.W. Norton*[2]

[1]Faculty of Agriculture, Tadulako University, Palu 9400, Indonesia, [2]School of Land and Food Sciences, The University of Queensland, St Lucia, Qld 4017, Australia

ABSTRACT

A research has been conducted to evaluate forage intake and live weight gain of steers grazed on three different *Leucaena* species mixed with signal grass supplemented with polyethylene glycol (PEG) in drinking water. Eighteen steers weighing 500±38 kg were randomly allocated as a factorial design (3X2) within 3 replicates. The first factor is 3 species of Leucaena (*Leucaena pallida*, KX2 and *Leucaena leucocephala*) and the second factor is either with or without PEG. Steers were continously grazed for three-month period. The results indicate that *Leucaena* species had no effect on dry matter intake and live weight gain. The dry matter intake and live weight gain were 13.2, 12.4 and 13.3 kg d^{-1}, and 0.64, 0.49 and 0.50 kg d^{-1} for *Leucaena pallida*, KX2 and *Leucaena leucocephala* respectively. Polyethylene glycol significantly improved dry matter intake but no effect on live weight gain. The proportion of legume in the diet was elevated by supplementation of PEG in drinking water. The proportion was 21.2% for group of steers with PEG compared to 10.6 % for group without PEG. It is concluded that Leucaena species stimulated intake and live weight gain equally. PEG however consistently improved the nutritive value of legume, by enhancing pasture intake, particularly legume.

Keywords: *Steers, Leucaena, Peg, Intake, Live Weight*

INTRODUCTION

Tropical legumes are commonly used as forages in the tropical animal production system. Some *Leucaena* spp., such as *Leucaena pallida*, *Leucaena leucocephala* cv. Tarramba and KX2 (hybrid of *Pallida* and *Leucocephala*), have shown potential for use with both grazing animals or in cut and carry feeding systems. Once established, such legumes are able to survive for long periods of time, withstanding periodical defoliation and harsh growing conditions. However the potential use of *Leucaena spp*, particularly *L. pallida,* is limited by its high level of condensed tannin (CT), which may vary from 49-171g kg^{-1} dry matter (Dalzell *et al.*, 1998). CT forms insoluble complexes with protein, leading to a reduction in N availability for ruminal microbes. There was evidence indicated that high CT legume tends reduce the performance of animals in general.

The effect of tannin can be eliminated by providing absorbent agent of PEG or by diluting of CT through supplementation with protein (Silanikove *et al.*, 1997), or by mixing diet with non-tannin source ingredients. The following experiment investigates the performances of steers grazing *Leucaena* species mixed with signal grass

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(*Brachiaria decumbens*) supplemented with PEG through drinking water by assessing the intake and live weight gain.

MATERIALS AND METHODS

Steers and grazing management. The area was established as a fully cultivated *Leucaena* forage occupying 6 ha, which was divided into 6 paddocks. Each of two paddocks was planted with one of the three *Leucaena* genotypes: *L. pallida* K748, *L. leucocephala* K636 cv Tarramba and KX2. Inter row spaces were planted with signal grass (*Brachiaria decumbens*) after the *Leucaena* species had been established. Eighteen Charbray and Herefords steers weighing 500± 38 kg were randomly allocated to one of 6 paddocks (3 steers ha^{-1}). The steers were continuously grazed for 12 weeks in their particular paddocks, which were electrically fenced.

Experimental design. The steers were randomly allocated as factorial design (3x2) within 3 replicates (animals), which were allocated to the six paddocks. The first factor was three leucaena species; *Leucaena pallida* (LP), KX2 and *Leucaena leucocephala* cv Tarramba (LL), and the second factor was the level of PEG (0 and 100 g $head^{-1}$ d^{-1}).

Measurements and sampling

Live weight gain. At the beginning of the experiment, all steers were weighed (initial weight) after overnight fasting, and then every three weeks thereafter. Daily liveweight gains of individual steers were calculated as the average gain over the whole 12 week experimental period.

Pasture intake. Pasture intake of the steers was estimated using the n-alkane method. All steers were orally dosed with a controlled release capsule (CRC) of alkane for 300-650 kg cattle (Captec Pty Ltd. New Zealand) 3 weeks after grazing commenced. Further procedures and method involved are explained in Rusdi (2003).

Chemical and statistical analysis. *Leucaena*, grass and faecal samples were analyzed for DM, OM and N, CT concentration and alkane content by the methods as described in Rusdi (2003). The ratio natural isotopes of ^{12}C and ^{13}C ($\delta^{13}C$) in the plant and faecal samples was done by Davies Laboratory of CSIRO, Aitkenvale, Queensland, Australia. Data were subjected to the analysis of variance using the GLM model of SAS (1998). Analysis of covariance was used to adjust dry matter intakes and liveweight gains for differences in initial liveweight. Any significant differences between treatments were detected using the least significant difference (LSD) test at the $P<0.05$.

RESULTS

Chemical composition and pasture yields of the leucaena and signal grass

The chemical composition of the different *Leucaena* species and signal grass is given in Table 1. All *Leucaena* species contained tannin, of which 91.4 to 95.5% was as free tannin. No tannins were detected in the signal grass samples. The edible DM yield of the *Leucaena* species and signal grass at the end of the experiment was higher than that at beginning of the experiment.

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Effect of Leucaena species on forage intakes and live weight gains.
The effects of the different *Leucaena* species on the DM intakes of forage, dry matter and live weight gains of steers are shown in Table 2. *Leucaena* species had no significant (P>0.05) effect on the dry matter intake (DMI) and live weight gain (LWG). Steers in LP consumed less legumes when compared with steers in KX2 or LL (P<0.01), but steers in LL consumed less free tannins than steers in LP or LL (P<0.01).

Table 1. Dry matter (DM) content (g kg^{-1} fresh material) and chemical composition (g/kg^{-1} DM) of the three leucaena species and signal grass (Brachiaria decumbens).

Pasture component	*L. pallida*	KX2	*L. leucocephala*	Signal grass
DM	330	304	274	257
OM	950	947	948	909
N	30	36	44	11
NDF	244	279	173	587
$\delta^{13}C$#	-27.7	-27.7	-27.7	-12.5
Alkane[1] (mg kg^{-1}DM):#				
C31	164	117	10	140
C32	8	7	7	8
C33	14	24	8	234
C35	-	-	-	78
CT:				
Free	234	180	74	ND[2]
Fibre bound	4	3	2	ND
Protein bound	7	8	5	ND
Total	245	191	81	ND

[1]Samples were taken at the period of faecal sampling for alkane concentration estimation.

[2]ND not detected.

Effect of PEG on forage intakes and live weight gains.
Inclusion of PEG in drinking water significantly (P<0.05) enhanced dry matter intake (DMI). A similar trend was recorded for legume intake (LI) (P<0.01) and free tannin intake (FTI) (P<0.01). In contrast, PEG did not have a significant (P>0.95) effect on live weight gain (LWG).

Interaction between Legume species and PEG.
PEG supplementation improved DMI of steers consuming LL (P<0.05). The proportion of legumes in the diet was increased in steers consuming LP (P<0.05) and steer consuming LL (P<0.01) and therefore significantly enhanced the free tannin intake (FTI) of steers consuming such legumes. There was no interaction recorded on live weight gain. The values are shown in Table 2.

DISCUSSION

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The mean DMI of steers in the present experiment (2.4% LW or 13 kg DM d^{-1}) was higher than that found for steers grazing *Leucaena* pastures (1.9-2.3% LW) in north-west Western Australia (Petty *et al.*, 1998). Steers on LP pasture consumed less legumes (10.4% total DMI) when compared with steers on KX2 or LL pasture (18.8 and 18.4 % for KX2 and LL respectively; Table 2).

Table 2. Mean values (adjusted by covariance analysis for difference in initial live weight) for dry matter intake (DMI), legume intake (LI), free tannin intake (FTI) and live weight gain (LWG) of steers graze on a mixture pasture of Leucaena and signal grass supplemented either with or without PEG

	LP		KX2		LL			Significance[1]		
Treatments	+PEG	-PEG	+PEG	-PEG	+PEG	-PEG	SEM	L	P	LXP
DMI, kg DM d^{-1}	13.7	12.7	12.7	12.1	14.7	11.9	0.86	ns	*	*
DMI, % LW	2.8	2.4	2.4	2.1	2.5	2.2	0.15	ns	*	ns
LI, % total DMI	14.1	6.7	21.3	16.4	28.4	8.5	1.98	**	**	**
FTI, kg d^{-1}	0.448	0.202	0.492	0.357	0.307	0.077	0.05	**	**	**
LWG, kg d^{-1}	0.749	0.534	0.426	0.550	0.473	0.535	0.15	ns	ns	ns

[1]Significance of difference between mean: *P<0.05, **P<0.01, ns not significant, L legume species, P PEG and LXP interaction.

The lower intakes of legumes in LP suggest that the palatability of *L. pallida* was lower than that of the other *Leucaena* species, and is similar to the results obtained in previous studies with *L. pallida* (Galgal, 2002). These low intakes are possibly related to the high tannin content of LP (23.4% of free tannin), this value being three times higher than that for *L. leucocephala*. However, the present results do not support the findings of Faint *et al.* (1998) who reported that CT content does not affect the palatability of different *Leucaena* species. It is likely that the level of *L. pallida* intake is regulated by astringency and the post ingestive effect. While LP intakes were reduced, total DM intakes were similar to those found in steers grazing the other species, suggesting that these steers increased their intakes of grass to compensate for the decreased intake of LP. A lower intake of LP may also be related to lower protein concentrations in LP compared with KX2 or LL (Table 1), since the protein can also neutralize the effects of tannin (Silanikove *et al.*, 1997). Titus *et al.* (2000) have also shown that some animals will actually select high protein diets as a means of overcoming the detrimental effects of high tannin diets. However, a marked finding in the present study is that PEG consistently improved dry matter intake and shifted composition of the diet to more legume proportion in the diet through enhancement of legume intake. This phenomenon agrees with Provenza *et al.* (2000), who found improvement intake of tannin-containing forage, when PEG was included in the diet. There was evidence that PEG have improved legume intake for steers consuming LP and LL, but not for steer consuming KX2. This evidence indicated that there was no consistent effect of PEG to the level of tannin in the diet of the current study.

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Legume species did not have any significant effect on live weight gain. A similar trend was recorded on the effect of PEG supplementation on live weight gain. The mean live weight of all steers increased over the 12 week of grazing period and similar observations have been made for cattle grazing such pastures in the long term (Galgal, 2002). The liveweight gains made were 0.641, 0.484 and 0.504 kg d^{-1} for LP, KX2 and LL respectively, but, were higher than those found by Galgal (2002) who reported values of 0.08, 0.33 and 0.23 kg d^{-1} for LP, KX2 and LL respectively over a 15 week grazing period. These differences between the present study and that of Galgal may be partly explained by the different weights of steers used, for instance, Galgal's steers weighing only 240 kg liveweight compared with steers in the present experiment, which weighed over 500 kg. Alternatively, the current results were additional effect of PEG, as Galga's study did not use PEG supplementation.

Free tannin intakes were estimated to be 0.325 kg $head^{-1}d^{-1}$ (2.5% in diet), 0.424 kg/head/d (3.4%) and 0.192 kg $head^{-1}$ d^{-1} (1.5%) for LP, KX2 and LL respectively, which might be categorized as a moderate level and can be predicted to have a beneficial effect on animal performance (Wang *et al.*, 1996). The present results do not support this recommendation, and would support the alternative view that these levels have no significant effects on animal performance (Komolong *et al.*, 2001). This has been supported by the fact that legume species did not have effect on dry matter digestibility (Rusdi, 2003). The lack of difference is possibly due to the level of legumes in the diet may not high enough to produce a significant effect on intake. PEG however consistently elevated the tannin intake (0,212 kg d^{-1} vs. 0,415 kg d^{-1}; Table 2) as a result of increment of legume intake.

It is concluded that a mixed pasture of legumes and signal grass potentially induces live weight gain of steers equally. There was no consistent effect of tannin content in the diet to the steer's performance in general. In contrast, PEG supplementation through drinking water consistently improved nutritive values of legumes, particularly high tannin-containing legumes. Therefore, PEG could be used as absorbent agent to improve intake and live weight gain of steers consuming tannin-containing diets.

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