'THE CONTRIBUTIONS OF LEUCAENA LEUCOCEPHALA TO POST RUMINAL DIGESTIBLE PROTEIN FOR SHEEP FED TROPICAL PASTURE HAY SUPPLEMENTED WITH UREA AND MINERALS

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SUMMARY

Protein digested post-ruminally was measured with sheep fed spear grass and urea and minerals as basal diet (SG) supplemented either with Leucaena leucocephala in the diet (SG+L) or with casein infused into the abomasum (SG+C). Intake of organic matter (OM) increased by 43% with leucaena supplementation which included an 11% increase in intake of SG, compared with a 51% increase of SG intake with casein infusion. The supplements improved the balance between amino acids and energy expressed as intestinally digested crude protein/100 g digestible organic matter (DCPi/DOM). Leucaena supplementation increased DCPi/DOM from 10.6 to 17.1, compared with an increase from 12.3 to 21.0 following casein infusion. It is suggested that the enhanced feed intake was caused by the improved supply of amino acids to the tissues.

INTRODUCTION

Apart from its mimosine toxicity, Leucaena leucocephala is a useful protein supplement for ruminants, producing good liveweight gains with cattle (Jones 1977; Wahyuni et al. 1982) similar to those observed with meat meal (Siebert et al. 1976). Bamualim et al. (1984) also showed that leucaena supplementation increased the OM intake of low quality spear grass (Heteropogon contortus) hay by goats. The present study tested the hypothesis that leucaena supplementation when rumen ammonia supply was adequate improved the intake of poor quality roughages through an increased supply of amino acids post ruminally.

MATERIALS AND METHODS

Eight Corriedale wethers fitted with rumen and abomasal fistulae were placed in metabolism cages in a controlled temperature room (27°C). The experiment consisted of two periods. In period I, all sheep were offered spear grass and ureaandminerals (SG) (Siebert and Kennedy 1972). In period II, the animals were divided into two comparable groups on the basis of voluntary feed intake in period I, and fed the basal diet (SG) either supplemented daily with 150 g dry leucaena supplying 4.4 g N (SG+L) or infused abomasally with the same amount of nitrogen in casein (SG+C). Each period comprised 2 weeks of ad libitum feed intake studies in which the basal diet was offered at 120% expected consumption, followed by 2 weeks of digestion studies when the basal diet was offered at 95% ad libitum intake in equal portions at 3 hour intervals. The basal diet contained on a dry matter basis 90.4% organic matter (OM), 78.2% cell wall constituents (CWC) and 0.82% nitrogen (N) including urea, while the dry matter of leucaena consisted of 90.7% OM, 24.4% CWC and 3.2% N.

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Flow of digesta fluid, digesta solid and microbial-protein along the digestive tract was measured using ^{51}Cr-EDTA, ^{103}Ru-P and $Na_2{}^{35}SO_4$ respectively (Hogan 1981). Feed offered and refused, abomasal digesta and faeces were analysed for OM and total N, while ammonia-N was determined in rumen liquid and abomasal digesta.

The results were analysed statistically by paired-comparison (Sokal and Rohlf 1981).

RESULTS

The mean ad libitum OM intake for group 1 was 435 g SG/day (30 g/kg $BW^{0.75}$) but increased to 614 g/d (39 g/kg $BW^{0.75}$) for SG+L. This included 126 g leucaena. For group 2, the ad libitum SG intake was 425 g/day (28 g/kg $BW^{0.75}$) increasing to 645 g/day (40 g/kg $BW^{0.75}$) for SG+C.

TABLE 1 Intake and digestibility of organic matter (OM) and values relating to N intake and digestion by sheep fed either basal diet (SG) and SG+L (leucaena 126 g OM; 4.4 g N/day) in group 1, or SG and SG+C (casein infusion into abomasum; 4.4 g N/day) in group 2

	Group 1		Group 2	
	SG	SG+L	SG	SG+C
OM intake, g/day	397	568***[a]	390	600***
OM digestibility, %	50.5	49.3	47.9	53.0*
N intake, g/day	3.7	8.0***	3.6	9.7***
Rumen ammonia, mg-N/l	149	134	110	137***
Rumen liquid MRT, h	21.9	14.3***	19.9	nm
N flow from the stomach, g/day				
Non ammonia N (NAN)	5.5	11.1***	5.9	13.4[b]
Microbial N	4.1	6.3***	4.0	6.2[b]
NAN app. digested in intestines g/100 g NAN leaving stomach	61.8	68.1**	61.1	76.3[b]
g DCPi/100 g DOM intake[c]	10.6	17.1	12.3	21.0

a OM intake of SG+L = 442 g SG + 126 g leucaena/day.
b Estimated assuming flow of digesta and microbial-N measured pro rata with SG -intake in period I.
C DCPi = digestible crude protein in intestines; DOM = digestible OM.
nm = not measured.
* = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$ (comparison within group only).

Supplementation with leucaena had no significant effect on OM digestibility or on rumen ammonia-N levels but greatly reduced mean retention time (MRT) of the soluble marker (Table 1). Casein infusion per abomasum increased the OM digestibility and rumen ammonia-N but MRT was not determined. It was calculated that both supplements increased both flow of protein from the abomasum and the ratio of DCPi/DOM in the intestines.

DISCUSSION

The basal diet presumably met the ammonia requirements of the rumen microbes as the levels of rumen ammonia measured were more than twice the 50g N/l suggested by Satter and Slyter (1974) to be adequate. It may therefore be argued that the increased OM intakes on supplementation reflected an enhanced supply of amino acids to the tissues following intestinal digestion. Weston (1971) has suggested that a deficiency of amino acids at the tissue level can restrict the intake of low quality roughage. For sheep in groups 1 and 2 respectively, the basal diet provided 10.6 and 12.3 g crude protein digested in intestines (DCPi)/100 g digestible organic matter (DOM) intake. The OM intake was found to increase by 43% when the level of DCPi/DOM was increased to 17.1 g by the inclusion of leucaena in the diet. These compare with the 51% improvement measured when the DCPi/DOM was increased to 21 g through infusion of casein into the abomasum. The responses observed were similar to those reported by Egan (1965) but higher than those of Weston (1971) who fed a better quality roughage. Nevertheless, these studies indicated that intakes of diets which provide a low level of DCPi can be improved by the supply of protein that escapes rumen degradation.

The total OM intakes recorded in the casein infusion treatment tended to be slightly better than the leucaena treatment. This could be due to both the increased amounts of amino acids reaching the small intestines of the casein-infused sheep and the higher digestibility of these proteins in the hind gut. However, another contributing factor may be the presence within the rumen of 3-hydroxy-4(IH)-pyridone (DHP) a breakdown product from fermentation of mimosine, an amino acid in leucaena. A reduction of voluntary intake by sheep fed lucerne hay has been found following intraruminal infusion of DHP (A. Bamualim and C.S. McSweeney unpublished data).

Assuming that proportion of non-microbial N leaving the stomach with the basal SG diet was not altered by the presence of leucaena, it may be calculated that approximately 60% of leucaena-protein escaped degradation (Zinn et al. 1981). This value was higher than the 34% reported by Bamualim et al. (1984) with fresh leucaena, and may reflect protection of protein during drying or the fact that MRT was lower in the present than in their experiment (14 vs 22 h).

Probably the most important finding of this work was that leucaena provided at a level 20% of the diet did not act entirely as a substitute feed but to some extent increased the intake of basal diet itself. This would indicate that not only does relatively poor degradability of leucaena protein in the rumen make it a valuable source of by-pass protein for supplementation of low quality roughage, but also that supplementation would improve the supply of energy to the animals.

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