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RESEARCH ARTICLE

Enhancing Maize Stover utilization by West African Dwarf Sheep using *Moringa Oleifera*

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ABSTRACT

Experiments were conducted to investigate the effect of *Moringa oleifera* supplementation of maize stove based diet on the feed intake and rumen degradation of maize stover by sheep. A feed intake study on four levels of *Moringa Oleifera* supplementation (0, 3, 6 and 9 g dry matter/kg live weight per day) in a 4 x 4 Latin square design was undertaken. Dry matter degradation of maize stover and rumen ammonia concentration were studied using two fistulated sheep fed the four diets. Total dry-matter intake of the supplemented diets was significantly ($P<0.05$) higher than that of the unsupplemented diet. Daily dry-matter intake of maize stover alone increased from 32.8 g/kg for the unsupplemented diet to 36.2 g/kg for the diet containing the lowest level of *Moringa Oleifera* supplementation. Higher levels of *Moringa Oleifera* supplementation led to a decrease in the amount of maize stover consumed. *Moringa oleifera* supplementaiton significantly ($P<0.05$) increased the rumen degradation of maize stover at 48 hours of incubation compared to unsupplemented maize stover.Ammonia concentration in the rumen increased significantly ($P<0.05$) with increase in the level of *Moringa oleifera* supplementation up to 6 g/kg per day. Higher levels of *Moringa Oleifera* in the diet did not result in further increase in rumen ammonia concentration. There was no significant difference ($P<0.05$) in the rumen pH for the different levels of *Moringa oleifera* supplementation. The results indicate that intake and rumen degradation of maize stover in live weight per day of *Moringa oleifera* hay. Higher levels of supplementation appear to lead to substitution effects.

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INTRODUCTION

Intake of straw and stover by ruminants usually reduce their body weight, trough texture, poor digestibility and nutrient deficiency (Ahaotu *et al.*, 2009). These roughages are low in energy, carbohydrates and nitrogen, which reduce the efficiency with which they are utilized by animals. Chemical treatment of straws using sodium hydroxide (Uno, 1977; Kategile, 1979) or urea (Kiangi, 1981; Raymond, 1989) can improve both their digestibility and intake, but is not always practical under farm conditions. Thus alternative strategies to improve straw utilization are being sought.

Leguminous forages such as *Moringa Oleifera* have been used to improve dry-matter intake and digestibility of pasture hay by sheep (Bamualim *et al.*, 1984). Due to the increased interest in the use of *Moringa oleifera* protein supplements for ruminants, the present study investigated the effect of various levels of *Moringa oleifera* supplementation on the intake and rumen degradation of maize stover by sheep.

MATERIALS AND METHODS

Six West African dwarf sheep were used in the experiment. Four sheep, weighing 28 kg, were used for intake studies in a 4x4 Latin square. The other two, weighing 33 and 41kg, were fistulated and used for degradation studies. Maize stover was obtained from harvested maize fields and chopped into 3-5 cm lengths. *Moringa oleifera* hay was obtained by cutting and wilting leafy branches of the plant and *Moringa oleifera* threshing the branches to separate the leaflets (the hay) from the twigs.

Intake Studies

For the intake studies, the animals were confined in individual metabolic cages and offered a known quantity of maize stover *ad libitum* twice a day at 0900 and 1600 h. Each animal also received 200 g of maize bran and vitamin/ mineral mixture, alone or together with one of three levels of hay supplement (3, 6 and 9 g dry matter/ kg live weight per day), at the morning feeding. Each diet combination was fed to each animal for 14 days, a seven-day preliminary period and a seven-day data collection period.

Degradability of maize stover

Degradation of maize stover was investigated for each diet combination using the nylon-bag technique (Orskov *et al*., 1980). Maize stover was grounded to pass through a 2.5 mm screen and 2.9 samples were weighed into 20 labeled nylon bags of known weight. For each ration, 10 bags were put into the rumen of each sheep and moved, two at a time, after 6, 12, 24, 48 and 72 h of incubation. The removed bags were washed under tap water until the water was clear and the residues were dried in an oven at 60 ^{o}C for 48 h, cooled in desiccators and weighed. Dry-matter degradability was calculated using the formula.

%DMD = Weight of DM incubated – weight of dry residue x 100/Weight of DM incubated

Rumen ammonia and pH

For rumen ammonia and pH determination, rumen liquor was obtained from the fistulated animals during the data collection period for each level of *Moringa oleifera* supplementation. The liquor was collected at 0600, 1000, 1400 and 1800 h, strained through cheese-cloth and centrifuged at 300 rpm for 15 min, and 20-ml samples were taken for immediate pH determination.

For ammonia determination, 25-ml samples of the centrifuged rumen liquor were treated with two drops of concentrated sulphuric acid and frozen to await analysis. For the analysis, 5 ml of rumen liquor were mixed with 10 ml of 5% sodium tetraborate solution. Two drops of mixed indicator were added and the mixture was distilled using the kjeltec system. The distillate was collected in a flask containing 25 ml of 20% boric acid, and titrated with 0.1213N HCI. Ammonia concentration was calculated by:

% Ammonia – N = 14.01 x (titre-blank) x norm of HCL/mls of sample x 10

% Ammonia = Ammonia – N x 1.21

% Ammonia was then converted into mg ammonia/litre.

Statistical analysis

Two-way analysis of variance was used for intake studies data, and one-way analysis of variance was used for other parameters, according to Gordon and Gordon (2004). The significance of the results was tested using F test and LSD.

RESULTS

Dry-matter intakes (DMI) of the total ration roughage (maize stover plus *Moringa oleifera*) and of maize stover alone are shown in Table 1.

Total DMI was significantly (P<0.05) increased by *Moringa oleifera* supplementation. Total DMI of ration B was significantly lower (P<0.0) than that of ration D, but there was no significant difference between the DMI of rations B and C or rations C and D.

Table 1: Dry-matter intake of total roughage (maize stover and *Moringa oleifera*) supplementation stover alone for the four rations

	Daily intake (g DM/kg liveweight)			
	Total roughage		Maize stover	
Ration	Mean	SE	Mean	SE
A	32.8	1.9	32.8	1.29
B	39.2	1.29	36.2	0.29
C	41.4	0.67	35.7	0.83
D	42.8	1.29	33.8	1.29

Ration A = unsupplemented; Ration B = supplemented with 3 g *Moringa oleifera* DM/kg liveweight per day; Ration C = supplemented with 6 g *Moringa oleifera* DM/kg liveweight per day; Ration D = supplemented with 9 g *Moringa oleifera* DM/kg liveweight per day

Table 2: Dry-matter and Organic-matter degradability of maize stover at different incubation times

Degradability (%) at various incubation times							
					48 hours		
Ration	0hrs	6hrs	12hrs	24hrs	mean	SE	7hrs
Dry-matter degradability							
A	7.25	7.73	9.65	12.99	14.84	0.01	29.94
B	7.25	11.05	15.95	23.68	33.79	1.46	44.44
C	7.25	13.38	19.11	28.62	35.02	0.48	52.59
D	7.25	8.13	16.63	27.20	37.60	0.30	51.59

Table 3: Organic-matter degradability

A	3.96	4.42	6.40	10.65	12.12	0.89	29.38
B	3.56	7.48	12.59	20.75	31.74	1.26	41.60
C	3.96	9.90	15.73	25.55	32.71	0.37	51.19
D	3.96	6.61	13.10	24.15	35.76	0.40	49.58

Ration A = unsupplemented; Ration B = supplemented with 3 g *Moringa oleifera* DM/kg liveweight per day; Ration; B = supplemented with 6 kg *Moringa oleifera* DM/kg liveweight per day; Ration D = supplemented with 9 kg *Moringa oleifera* DM/kg liveweight per day

Table 4: Rumen Ammonia Concentration and Rumen pH for the four rations

	Rumen ammonia concentration (mg/litre)		Rumen pH	
Ration	Mean	SE	Mean	SE
A	32.0	4.83	6.83	0.07
B	4.8	6.21	7.10	0.65
C	91.3	6.71	6.61	0.03
D	90.1	6.16	6.9	0.07

Ration A = unsupplemented; Ration B = supplemented with 3 g *Moringa oleifera* DM/kg liveweight per day; Ration C = supplemented with 6 g *Moringa oleifera* DM/kg liveweight per day; Ration D = supplemented with 9 g *Moringa oleifera* DM/kg liveweight per day.

Dry-matter intake of maize stover alone increased when the diet was supplemented with 3 g *Moringa oleifera* DM/kg live weight per day, but further increase in the level *Moringa oleifera* supplementation led to a decline in the amount of maize stover consumed.

Dry-matter (DM) and organic-matter (OM) degradability of maize stover in the rumen of sheep fed the different rations are shown in Table 2. *Moringa oleifera* supplementation increased DM and OM degradability of maize stover at all incubation times. The greatest increase was observed at the supplementation level of 3 *Moringa oleifera* DM/ kg live weight per day.

OM degradability at 48 h of incubation revealed that ration A had significantly (P<0.05) lower DM and OM degradability than the supplemented rations. Ration B had lower (P<0.0) DM and OM degradability than ration D, but the differences between rations B and C or rations C and D were not significant (P>0.05).

Rumen ammonia concentrations in sheep fed the four rations are shown in Table 3. Inclusion of *Moringa oleifera* in the maize stover based diet significantly (P<0.05) increased the rumen ammonia concentration. The concentration in sheep fed ration B was significantly (P0.05) lower than those in sheep fed rations C and D, which were not different (P>0.05) from each other.

Rumen pH was not affected (P>0.05) by ration (Table 4).

DISCUSSION

The high dry-matter intake of rations supplemented with *Moringa oleifera* indicates that *Moringa oleifera* is a good supplement than low quality roughages such as maize stover. This improvement in intake with *Moringa oleifera* supplement is in agreement with results reported by Ahaotu *et al.* (2013). These authors further reported that an increase in total dry-matter intake could be due to consumption of the supplement rather than the roughage.

The fact that the highest dry-matter intake of maize stover was obtained at a supplementation level of 3 g *Moringa oleifera* DM kg live-weight per day may indicate that it is this optimum level of supplementation for poor quality roughages. Further increase in the level of *Moringa oleifera* supplementation led to a substitution effect whereby the intake of maize stover was reduced. Increase in the intake of maize stover with *Moringa oleifera* supplementation could be due to the increase in the concentration of rumen ammonia and dry-matter degradability of maize stover.

The improvement in the rumen degradation of maize stover dry matter and organic matter with *Moringa oleifera* supplementation indicates a possible improvement in microbial growth. This is supported by the observed increase in rumen ammonia concentration.

Concentration increased from 32 mg/litre for the unsupplemented diet to about 90 mg/ litre for higher levels of *Moringa oleifera* supplementation. FAO (1986) reported that, for efficient rumen function, concentration in the rumen should between 50 and 90 mg/ litre. With the unsupplemented maize stover diet, the rumen ammonia concentration was below the critical level, and this corresponds with the low dry-matter intake and dry-matter and organic-matter degradabilities for that ration.

Conclusions

Dry-matter intake, rumen degradation and rumen ammonia concentration all showed improvement when the maize stover diet was supplemented with *Moringa oleifera*. This means that efficiency of utilization of maize stover is improved by *Moringa oleifera* inclusion. However, the improvement declined at higher levels of supplementation. It is therefore recommended to supplement maize stover with *Moringa oleifera* at a level not exceeding 6g DM/kg liveweight per day.

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