Impact of incorporating Moringa oleifera seed cake as protein source in growing lambs ration

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Abstract: Thirty growing Rahmani lambs (27.25±0.25 kg average body weight 6-7 months old) were used to evaluate the impact of incorporating Moringaoleifera seed cake as protein source in a total mixed ration (TMR) for 90 days feeding trial followed by 21 days digestion. Moringaoleifera seed cake (MSC) was used for partial substitution of soybean meal protein by (0%, 25% and 50%) in three experimental rations, control (R1), R2 and R3, respectively. Results indicated that the feeding lambs on R3 recorded a significant (P<0.05) increases in all of nutrients digestibility and nutritive value compared with R1 or R2. All of rumen parameters, pH, ammonia and total volatile fatty acids, were in normal ranges as an indication of healthy. Also, the highest average daily gain recorded with R3 (222.2 g) followed by R2 (208.3 g) and R1 (203 g). Thus, it could be concluded that MSC can use as protein source in a TMR for growing lambs rations up to 50%. And more studies were needed to evaluate different levels of replacement for MSM as protein source in the rations of ruminant.

Keywords: Moringa cake, lambs, digestibility, growth

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1 Introduction

There are many challenges faced livestock farmers and causing adverse effects on animal production. The main challenge is high cost of production due to high prices of feed ingredients especially protein and energy resources (Akinmutimi, 2004; Puran et al., 2014). These increases in conventional ingredients prices make many nutritionists searching about cheaper alternative energy and protein resources can be used in animal rations. But there are some conditions must be considered in these alternative resources that should not be in high demand by humans and should be cheap (Ahamefule, 2002). Moringa seed meal or cake, by-product of oil extraction from moringa seeds differ in the method of extraction, can be used as a protein source in ruminant rations as a result of highly protein content, about 25%-60% CP, (Fuglie, 2001). Rumen protein degradability for seed cakes was about 61% as mentioned by Krishnamoorthy et al. (1995). And proteins in the moringa seed meal have a high positive charge (Folkard et al., 2001) and an antibiotic effect (Makkar et al., 2007). moringa seed cake is free of most plant secondary metabolites such as tannins, saponins, alkaloids, inhibitors of trypsin and amylase, lectin and cyanogenicglucosides, but contains glucosinolates (Makkar and Becker, 1997)

So, the objective of this study was evaluating the impact of the partial incorporating of moringa seeds cake as a protein source in growing lambs ration on nutrients digestibility and growth performance.

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2 Materials and Methods

2.1 Preparation of experimental rations

Three total mixed rations, TMR, from concentrate feed mixture, CFM, and wheat straw were prepared to be

iso-calories and iso-nitrogen. Animals fed amount of ration to cover its requirements according to sheep NRC (1985). Control TMR, R1, consists of 25.3% corn grains, 11.1% wheat bran, 19.4% soybean meal, 40% wheat straw, 1.7% vit. and minerals premix. 1.7% lime stone and 0.8% salt. While. 25% and 50% from soybean meal protein were replaced by the same amount from moringa seed cake (oil is extracted by hydraulic press) in R2 and R3, respectively.

2.2 Growth trial

Thirty growing Rahmani male lambs (27.25±0.25 kg average live body weight and 6-7 months old) were kept at the experimental research station under veterinary medical care for a preliminary period of 15 days and received all vaccination. Then they were divided according to their live body weight into three feeding groups (10 each) in a growth trial for 90 days, and then every group was randomly assigned to fed one of the experimental ration. Amounts of TMR were adjusted biweekly according to live body change. Drinking water was available at all time. Feed intake was daily recorded; meanwhile, daily body weight gains and feed conversion (g feed g^{-1} gain) were calculated biweekly.

2.3 Digestibility trial and rumen parameters

At the end of the growth trial, five animals of each group were used in metabolism trials. Animals were dwelled in metabolic cages for seven days as a preliminary period, and then feces and urine were collected during the next seven days. Samples represented tenth of the voided feces and excreted urine were taken daily just after collection. Urine samples were stored in tight bottles containing sulfuric acid (1:1) and refrigerated at 4°C for nitrogen determination. Feces samples were weighted and dried at 60°C 12 hrs^{-1}. in a hot oven. Dried samples of feces and feeds were ground to pass through 1-mm sieve, and it was stored in emeried bottles for chemical analysis. Meanwhile, digestion coefficient and nutritive value of the experimental rations were calculated.

Ruminal fluid samples were collected at the end of the experiment via stomach tube before feeding then at 3 and 6 hrs. after feeding. Samples of rumen content, for each animal, were filtered through four layers of cheesecloth, and then ruminal pH was immediately recorded using digital pH meter then, samples were stored at –20°C for latter ammonia and volatile fatty acids analyses.

2.4 Statistical analysis

Data of nutrients digestibility and growth was subjected to one-way analysis of variance (ANOVA) procedure of SAS (2000). While, data of the rumen parameter was subjected to two-way analysis by the same previous procedure. Significant means were ranked using the Duncan's multiple range test option of the same software package.

3 Results and Discussion

Data of chemical composition of ingredients and experimental rations are summarized in Table 1 showed that all of the experimental rations were almost similar in NDF, crude protein and energy contents and suitable for sheep requirements as recommended by NRC (1985).

Table 1 Chemical composition of Moringa oleifera seed cake and the experimental rations (as DM basis)

Chemical composition, %	Moringa seed cake (MSC)	Experimental rations		
		R1	R2	R3
Organic matter (OM)	94.8	96.0	96.7	96.3
Crude protein (CP)	25.0	13.46	13.46	13.23
Ether extract (EE)	11.9	3.3	3.4	4.21
Crude fiber (CF)	28.36	20.42	20.42	21.54
Nitrogen free extract (NFE)	29.54	58.82	59.42	57.32
Ash	5.2	4.0	3.3	3.7
Neutral detergent fiber (NDF)	44.4	40.3	40.2	41.4
Acid detergent fiber (ADF)	27.1	25.3	25.0	25.6

Note: R1: Total mixed ration (TMR) contained soybean meal as a protein source, R2: TMR contained MSC provide 25% from soybean meal protein, R3: TMR contained MSC provide 50% from soybean meal protein.

3.1 Nutrients digestibility and nutritive value

Data in Table 2 showed that there were significant (P<0.05) increases in the digestibility of all nutrients of R3 compared with R1 by 12.6%, 11.3%, 6.0%, 16.5%, 22.7% and 4.2%, respectively for DM, OM, CP, EE, CF and NFE. While, there were insignificant (P<0.05) increases in all of nutrients digestibility of R2, being 76.47%, 79.36%, 78.46%, 73.04%, 64.80% and 84.81%, respectively for DM, OM, CP, EE, CF and NFE compared to 74.06%, 78.59%, 78.17%, 72.96%, 63.94% and 83.14% in the same order for R1. This improvement effect for MSM on nutrients digestibility may be due to the antibiotic effect for its proteins meanwhile modify rumen fermentation leading to decrease protein

degradation in the rumen and increasing proteins flow to post rumen digestion (Hoffmann et al., 2003; Makkar *et al*., 2007).

Table 2 Nutrients digestibility, nutritive value and nitrogen balance of growing lambs fed the experimental rations

Item	Experimental rations			±SE
	R1	R2	R3	
Nutrients digestibility, %				
Dry matter digestibility (DMD)	74.06[b]	76.47[b]	83.37[a]	1.56
Organic matter digestibility (OMD)	78.59[b]	79.36[b]	87.44[a]	0.58
Crude proteindigestibility (CPD)	78.17[b]	78.46[b]	82.85[a]	0.65
Ether extractdigestibility (EED)	72.96[b]	73.04[b]	84.98[a]	1.62
Crude fiberdigestibility (CFD)	63.94[b]	64.80[b]	78.46[a]	1.22
Nitrogen free extractdigestibility (NFED)	83.14[b]	84.81[b]	86.60[a]	0.91
Nutritive value, %				
Total digestible nutrients (TDN)	77.9[b]	79.8[b]	82.23[a]	0.54
Digestible crude protein (DCP)	10.52[b]	10.56[b]	10.96[a]	0.21
Nitrogen balance				
Nitrogen intake, g hd^{-1}.	13.96	14.26	17.96	
Fecal nitrogen, g hd^{-1}.	2.84	3.91	4.1	
Urine nitrogen, g hd^{-1}.	5.67	4.72	5.52	
Nitrogen balance, g.	5.45[b]	5.63[b]	8.34[a]	0.95

Note: [a,b,c] Means in the same row with different superscripts are significantly different (P<0.05). R1: Total mixed ration (TMR) contained soybean meal as a protein source, R2: TMR contained MSC provide 25% from soybean meal protein, R3: TMR contained MSC provide 50% from soybean meal protein.

Data in the same table showed that the nutritive value as TDN and DCP had the same trend of nutrients digestibility that R3 recorded a significant (P<0.05) increase comparedwithR1 which was insignificantly (P<0.05) differ with R2, being (82.41% and 10.96%), (79.09% and 10.52%) and (80.48% and 10.56%), respectively. These results are a reflection for nutrients digestibility which were greater in R3. Also, nitrogen balance was positive with all rations and had the same trend and was 5.45, 5.63 and 8.34 g, respectively for R1, R2 and R3. This result may be due to the reduction in urinary N output (Ben and Makkar, 2009) which increase nitrogen retention and reflected on animal gain.

3.2 Rumen parameters

Data in Table 3 indicated that there were no significant (P<0.05) differences among groups in overall mean of ruminal pH, ammonia and total volatile fatty acids, being (6.06, 21.69 and 12.56), (6.14, 21.73 and 12.56) and (6.17, 21.74 mg 100 mL^{-1} R.L. and 12.83 meq 100 mL^{-1} R.L.), respectively for R1, R2 and R3. These results indicated that all animals were in normal healthy case.

Table 3 Overall mean of rumen parameters for sheep fed the experimental rations

Item	Experimental rations			±SE
	R1	R2	R3	
pH value	6.06	6.14	6.17	1.56
NH_3-N, mg 100 ml^{-1} R.L.	21.69	21.73	21.74	1.58
VFA's, meq 100 ml^{-1} R.L.	12.56	12.56	12.83	1.65

Note: [a,b,c....]Means in the same row with different superscripts are significantly differ (P<0.05). R1: Total mixed ration (TMR) contained soybean meal as a protein source, R2: TMR contained MSC provide 25% from soybean meal protein, R3: TMR contained MSC provide 50% from soybean meal protein.

3.3 Growth performance

Effect of the experimental rations on growth performance is presented in Table 4, data mentioned that there were no significant (P<0.05) differences among groups in initial body weight, final body weight, total body gain and daily body gain. However, the highest total and daily weight gain was recorded with R3 followed by R2 then R1, being (20 and 0.222), (18.75 and 0.208) and (18.25 and 0.203 kg), respectively. These increases with R3 may be due to the highest TDN intakes compared with those in either R1 or R2, being 927, 910 and 885 g hd^{-1}, respectively. This result agreed with findings of Annison et al. (2002), Ben and Makkar (2009), that feeding sheep on ration contained defatted moringa seed meal increased ME intake which reflected on increases in weight gain.

Table 4 Impact of feeding experimental rations on nutrients intake, live body weight gain and feed conversion of growing lambs

Item	Experimental rations			±SE
	R1	R2	R3	
A) Live body weight, kg				
Initial live body weight	27.50	27.25	27	1.00
Final live body weigh	45.75	46	47	1.06
Total body weight gain	18.25	18.75	20	1.12
Daily body weight gain	0.203	0.208	0.222	0.019
B) Feed intake, kg hd^{-1}.				
Total DMI	1.150	1.100	1.125	
TDN intake	0.910	0.885	0.927	
C) Feed conversion, g feed g^{-1} gain				
Dry matter intake (DMI)	5.67	5.14	5.06	
Total digestible nutrients intake (TDNI)	4.48	4.25	4.18	

Note: [a,b,c....]Means in the same row with different superscripts are significantly different (P<0.05). R1: Total mixed ration (TMR) contained soybean meal as a protein source, R2: TMR contained MSC provide 25% from soybean meal protein, R3: TMR contained MSC provide 50% from soybean meal protein.

Data in the same table indicated that the best feed conversion ratio, g feed g^{-1} gain, as DMI or TDN was recorded with R3 followed by R2 then R1, being (5.06 and 4.18), (5.14 and 4.25) and (5.67 and 4.48), respectively. This may be due to either the improvement in rumen fermentation or due to low rumen degradation of MSM (Hoffmann et al., 2003).

4 Conclusions

From the previous results, it could be concluded that moringa seeds cake can be incorporated in growing lambs ration as a source of protein instead of soybean meal up to 50% of protein without any adverse effects on growth performance.

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