Moringa leaf meal supplementation for sheep: Effect on weight gain, blood serum chemistry and carcass characteristics

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Abstract

This study was conducted to assess growth performance, serum chemistry and carcass characteristics of West African Dwarf sheep fed varying levels of Moringa oleifera leaf meal (MLM) as concentrate diets. Eighteen growing sheep of varying live weights (9–17kg) were divided into three groups that comprised six animals each, and balanced for live weight. Each group was fed one of three experimental diets containing 0% (control diet), 5% and 10% MLM, respectively, for 37 days after a 21-day quarantine period in a completely randomized design; each animal being considered a replicate. There were no treatment effects on live weight gain ($P>0.05$) and serum chemistry except on alanine aminotransferase and aspartate aminotransferase where highest values (20.33 and 128.33 IU/L, respectively) were recorded in the control-diet sheep. Apart from Urea, values of blood chemistry were within normal reference range for clinically healthy animals. However, there were significant ($p<0.05$) differences in dressing percentage, breast muscle and liver weight, with highest values of 94.42% (in 10% MLM), 1.68 % (in 5% MLM), and 1.84 % (in 5% MLM), respectively. Thus, inclusion of up to 10% MLM in concentrate diet may not cause any major health disorders in West African dwarf sheep while supplementation at 5% level may improve carcass quality.

Keywords: Sheep, Moringa, blood biochemistry and carcass characteristics

Introduction

Sheep constitute a very important part of livestock sub-sector in Nigerian agricultural economy (Lakpini *et al.*, 2002). The use of sheep for religious and social ceremonies underscored their socio-economic importance in the lives of Nigerians. They fulfil a most useful task in supplying human population with meat, milk, skin, hair and other products (Adeloye, 1998).

The full exploitation of the numerous attributes of small ruminants is limited by the constraints in production and reproduction. Producers of sheep face problems of seasonal malnutrition resulting in fluctuating productivity and economic

loss (Lakpini *et al.*, 2002). Consequently, the use of unconventional feed resources has been advocated as a way out of this problem. Some of the unconventional feed resources include browses such as *Leucaena leucocephala*, *Enterolobium cyclocarpum*, *Gmelina arborea* and *Moringa oleifera*. *Moringa* is a tropical evergreen tree that belongs to the family *Leguminosae* and sub-family *Mimosoideae*. It originated in India, from the southern Himalayas. Today, it can be found in tropical and sub-tropical regions of the world. *Moringa* is known to thrive well in poor soil conditions and it is minimally affected by difficult climatic conditions such as drought; it grows quickly as soon as

seeds are sown and can also be propagated vegetatively (Mughal *et al.*, 1999). *Moringa*, when used as feed supplement, can supply essential protein and minerals for animals. It serves as a cheap and ready alternative of protein supply in animal diet. This study sought to determine the effectiveness of *Moringa* as a feed supplement in sheep diet.

Materials and Method

Experimental site

The experiment was carried out at the sheep unit, Directorate of University Farms (DUFARMS), of the Federal University of Agriculture, Abeokuta, Ogun state, Nigeria. The farm is located in the humid tropical zone of South-Western Nigeria with minimum and maximum temperatures of 20.66 and 35.48°C, respectively. It is located within Latitude 7°13'49.46"N and Longitude 3°26'11.98"E. The altitude is 76 meters above sea level (Google Earth, 2015).

Experimental Animals and Management

Eighteen (18) growing West African Dwarf (WAD) sheep weighing between 9 - 17 kg were used for this study. The animals were quarantined and acclimatized for a period of three weeks in order to ascertain their suitability for the experiment. During the period, the animals were gradually introduced to the control diet in order to adjust their rumen flora/fauna to the feed. The pens were cleaned every morning and clean water provided in the morning (0700h) and evening (1800h). High level of hygiene was maintained to avoid introduction of diseases during the experimental period.

Preparation of experimental diet

Fresh *Moringa* leaves were collected from existing trees, and sundried until they are crispy to touch while retaining their greenish colouration. The leaves were then

milled to obtain a product herein referred to as *Moringa* leaf meal (MLM), and stored in sacs until needed for inclusion in the concentrate diet. Three experimental concentrate diets were formulated using 0%, 5% and 10% inclusion levels of the dried *Moringa* leaves. The dried *Moringa* leaves were mixed with PKC, Wheat offal, Rice bran, Oat meal, Premix (GBF®) and salt to formulate a concentrate diet milled at a commercial feed mill (Table 1). The animals were fed *Panicum maximum* as basal diet in the morning and the experimental diet was served as supplement in the evening. The *Panicum* was offered *ad-libitum* while concentrate diet was served at 4% of their body weight.

Experimental design

The eighteen (18) WAD sheep were allotted to three treatment groups of six (6) animals per group on weight equalization basis. Each group was randomly allotted to the three (3) experimental diets in a completely randomized design (CRD).

Data Collection

Bodyweight

Individual animals were initially weighed at the commencement of the experiment and at 7 days interval throughout the period of the experiment. Weighing was done in the morning before feeding.

Feed intake

The feed offered and refusals feed were measured manually on daily basis. It was calculated as thus: Feed offered – refusals.

Feed conversion ratio

Body weights were used to calculate the daily weight gain and feed conversion ratio (FCR). It was obtained using the formula: Feed conversion ratio (FCR) = Feed intake (g)/Weight gain (g)

Chemical Analysis

The proximate composition of MLM and the experimental diets was carried out

according to the methods of A. O. A. C., (2002).

Blood Sample Collection

Five millilitres (5 ml) of blood was collected via jugular veni-puncture using hypodermic needle and syringe at the beginning and at the end of the experiment. The blood was collected into sample bottles for blood serum analysis.

Carcass analysis

At the end of the experimental period, three sheep per treatment were randomly selected, starved for 24 hours and slaughtered by cutting the jugular vein to bleed. The slaughtered sheep were de-haired using flame and eviscerated to evaluate their carcasses. Empty body weight was determined, by subtracting the gut content from the slaughter weight. Dressing percentage was determined by dividing the hot carcass weight by the live weight and multiplying by hundred. The hot carcass weight was weighed by removing the head, feet and gastrointestinal tract

(GIT) within an hour of slaughter with organs (heart, liver, kidney, and spleen) being carefully excised and weighed as described by Fasae *et al.*, (2011). The carcasses were cut into parts and each part was weighed as described by Adu and Brinckman (1981).

Statistical analysis

Data collected were subjected to one-way Analysis of variance (ANOVA) in a completely Randomized Design (CRD). Significantly different means were separated using the new Duncan's Multiple Range Test (Duncan, 1955) as contained in SPSS (2010).

Results and Discussion

Table II presents the influence of *Moringa* leaf meal supplementation on growth performance of the experimental animals. There were no significant effects of supplementation of *Moringa* ($p < 0.05$) on all performance characteristics considered.

Table I: Ingredient composition and calculated analysis of experimental diet

Ingredients	(0% MLM; 100 % Concentrate)	(5% MLM: 95 % Concentrate)	(10% MLM: 90 % Concentrate)
PKC	19.24	18.26	16.79
Wheat offal	20	20	20
Rice bran	40	37	35
Oat meal	20	18.99	17.46
Premix (GBF)	0.25	0.25	0.25
Salt	0.5	0.5	0.5
MLM	0	5	10
Total	100	100	100
Determined analysis (%)			
Moisture	4.03	10.56	2.60
Dry matter	95.97	89.44	97.40
Crude protein	22.92	25.58	27.66
Crude fat	4.56	3.85	4.96
Crude fibre	9.26	8.61	10.11
Total ash	6.21	5.82	6.98

Table II: Performance characteristics of West African Dwarf sheep fed *M. oleifera* leaf meal at varying levels of inclusion.

Parameters	(0% MLM; 100 % Concentrate)	(5% MLM: 95 % Concentrate)	(10% MLM: 90 % Concentrate)	SEM
Initial weight (g)	13750	13750	13750	620
Final weight (g)	15750	16000	17000	920
Weight gain (g)	2000	2250	3250	420
Weight gain (gday ⁻¹)	54.05	60.81	87.84	11.28

Despite the non-significant nature, increase level of *Moringa* increased the final weight gain (g) and weight gain (g). This result is in line with the result of Kimbi (1997) who found that there was no significant difference in growth rates of weaner goats. Also, the result corroborate with the work of Sarwatt *et al.* (2002) where supplementation of *Moringa* had no influence on growth of Tanzanian goats. These authors were of the opinion that there might be other factors like season, temperature, age, environmental temperature etc. contributing to the variability of growth performance, including the quality of the basal ration as suggested by Preston and Leng (1987). However, the non-significant higher values obtained for final weight (g) and weight gain (g) in sheep on 5 % and 10 % *Moringa oleifera* leaf meal can be partly attributed to the reported high mineral content of *Moringa* and grasses which could have increased live weight gain by improving nutrient utilization efficiency (Babayemi, 2009).

Table III shows the serum chemistry parameters of the experimental sheep at the commencement of the experiment. All parameters considered were not differed ($P>0.05$) significantly at the onset of the experiment. Although, the total protein values were not differed significantly, the

values were within the range 5.9-7.8 g/dl reported by RAR (2009) and Merck (2012). Kiran *et al.* (2011) also reported similar total protein values for clinically healthy sheep. The range of values (117.67-122.00 U/L and 19.67 – 22.00 IU/L) recorded for aspartate aminotransferase and Alanine aminotransferase were within the range of 82-144 (IU/L) and 12-57 (IU/L), respectively, for clinically healthy sheep (Kiran *et al.*, 2012; RAR, 2009; Addass *et al.*, 2012; Merck 2012). Also, the mean values (4.43 – 5.73 mg/dl) reported for urea were within the range for clinically healthy sheep reported by Kiran *et al.* (2011) and RAR (2009). Merck (2012) also reported a similar value. Thus, it can be inferred that the experimental sheep were clinically healthy for the experiment.

The serum biochemistry of West African Dwarf sheep fed varying levels of *Moringa* supplemented diets at the end of the experiment is presented in table IV. Aspartate aminotransferase and alanine aminotransferase were significantly ($P<0.05$) influenced by the varying levels of *Moringa* supplementation while total protein and urea were not significantly ($P>0.05$) affected by the dietary treatments. Aspartate aminotransferase values were within the normal reference range of 66-230IU/L reported by Fraser and Mays

Table III: Initial Serum Biochemistry of Experimental Animals

PARAMETERS	(0% MLM; 100 % Concentrate)	(5% MLM: 95 % Concentrate)	(10% MLM: 90 % Concentrate)	SEM
T.PROTEIN (g/dl)	6.27	6.43	5.83	0.29
AST (IU/L)	122.00	117.67	122.00	7.65
ALT (IU/L)	22.00	19.67	22.00	1.07
UREA (mg/dl)	4.90	5.73	4.23	3.92

T.PROTEIN= Total Protein

AST= Aspartate aminotransferase

ALT= Alanine aminotransferase

SEM= Standard Error of Mean.

(1986) and Merck (2012). This result corroborated with the observations of Mahmoud (2013) who reported significantly reduced mean values with increasing *Moringa* inclusion levels in growing lambs. This is however, in contrast with the report of Oni *et al.* (2012) who reported that aspartate aminotransferase values were not significantly influenced by varying levels of cassava leaves based concentrate diets for West African Dwarf goats. In a similar study on growing rabbits, no significant difference was observed (Ewuola *et al.*, 2012). The mean values obtained for aspartate aminotransferase reduced with increasing levels of *Moringa* inclusion.

Mean values (14.67 IU/L and 14.33 IU/L) of alanine aminotransferase reported in this study were lower in sheep fed 5% and 10% inclusion level of *Moringa* than the normal reference range of 15-52u/L reported by Merck (2011). However, sheep fed 0% inclusion level of *Moringa* had a mean value (20.33 IU/L), which is within the normal reference range (Kiran *et al.*, 2011). The significantly different means observed in this study is corroborated by Mahmoud (2013) who also reported a significantly reduced value with increasing levels of *Moringa* in growing lambs. It is however, in

contrast with the report of Yusuf *et al.* (2012) for West African Dwarf sheep fed *Panicum maximum* supplemented with *Newbouldia laevis*.

Enzymes are protein catalyst present mostly in living cells and are constantly and rapidly degraded although, renewed by new synthesis (Coles, 1986). Blood plasma transaminase enzymes activity (alanine aminotransferase and aspartate aminotransferase) are the most important indicators of liver cells activity where increasing the concentration of these enzymes indicate the tissue activity are destroyed (Molander *et al.*, 1957). Normal enzyme level in serum is a reflection of a balance between synthesis and their release, as a result of the different physiological process in the body (Zilva and Pannall, 1984). According to Carola *et al.* (1990), transaminase enzymes are those mostly responsible for the synthesis of nonessential amino acids through the processes in the body.

The mean total protein values obtained in this study were within the normal reference range of 5.9-7.8g/dl reported by Merck (2012). Sheep fed 5% inclusion level of *Moringa* was recorded to have the higher mean value (5.77g/dl) and lower (5.23g/dl) in treatments fed 0% and 10% inclusion level of *Moringa*.

Urea mean had higher value (6.70mg/dl) for sheep fed 5% and 10% inclusion levels of *Moringa* and the lower value (5.80mg/dl) for sheep fed 0% inclusion level of *Moringa*

Table IV: Blood serum chemistry of West African Dwarf Sheep fed *Moringa oleifera* leaf meal

PARAMETERS	(0% MLM; 100 % Concentrate)	(5% MLM: 95 % Concentrate)	(10% MLM: 90 % Concentrate)	SEM
T.PROTEIN (g/dl)	5.23	5.77	5.23	0.17
AST (IU/L)	128.33 ^a	93.33 ^{ab}	82.67 ^b	11.58
ALT (IU/L)	20.33 ^a	14.67 ^b	14.33 ^b	1.44
UREA (mg/dl)	5.80	6.70	6.70	3.17

^{a, b}: Means across rows with different superscripts are significantly ($P < 0.05$) different.

T.PROTEIN= Total Protein

AST= Aspartate aminotransferase

ALT= Alanine aminotransferase

SEM= Standard Error of Mean

which were lower than the normal reference range of 10-26mg/dl reported by Merck (2012) and 8-20mg/dl reported by RAR (2009). The different serum biochemical parameters may be caused by nutrition, environment and hormonal factors (Chineke *et al.*, 2002).

The results of the carcass characteristics of sheep fed *Moringa* leaf meal (MLM) at different levels of inclusion is presented in Table V. From this result, live weight, empty body weight, slaughter weight, and Hot carcass weight were not significantly ($p > 0.05$) influenced by *Moringa* supplementation. However, the dressing percentage is significantly ($p < 0.05$) influenced by *Moringa* supplementation. Animals fed 10% MLM had higher mean value (94.42%) compared to those fed 5% and 0% MLM. This result agrees the work of Madhavi *et al.* (2006) and Alkoiret *et al.* (2007) who reported a significant difference in the dressing percentage of Nelhore and Djallonke sheep. Also, the dressing percentage obtained in this study is higher than that reported by Mahgoub *et al.* (2000). With reference to the higher dressing percentage obtained in this study, it is expected that the chance of making more profit by the butcher would be guaranteed Fasae *et al.* (2011).

The results of the primal cuts of sheep fed *Moringa* leaf meal (MLM) at different levels of inclusion is presented in table VI. These results shows that the head, shank, rack, neck, hind limb, fore limb and the sirloin were not significantly ($p > 0.05$) influenced by *Moringa* supplementation. This result corroborates with the work of Shadnoush *et al.* (2004) who reported that most carcass characteristics of Lori-Bakhtiari Rams were not altered by lowering energy levels in the dietary treatments. It also agrees with the work of Fasae *et al.* (2011), on WAD sheep fed varying levels of maize and cassava hay. He reported that the proportions of carcass weight of retail cuts from sheep fed experimental diets had no effect on the meat components among the dietary treatments. However, the mean values obtained on breast is significantly ($p < 0.05$) influenced with *Moringa* supplementation. Animals fed 5% MLM had the higher mean value (1.68 %) compared to the value of those fed 10% MLM, while animals fed the control diet (0% MLM) had the least mean value (1.07 %). This is in agreement with the work of Feyera and Animut, (2011) for Horro sheep fed *Lathyrussativus*. The authors reported that there was significant increase of the breast muscle of the Horro sheep increases due to the increase in dietary supplementation.

The results of the visceral organs of West African Dwarf sheep fed *Moringa oleifera*

Table V: Carcass characteristics of West African Dwarf sheep fed *Moringa oleifera* at different levels of inclusion.

Parameters	(0% MLM; 100 % Concentrate)	(5% MLM: 95 % Concentrate)	(10% MLM: 90 % Concentrate)	SEM
Live weight(kg)	14.0	12.50	12.50	0.55
EBW(kg)	8.83	7.68	7.38	0.53
HCW(kg)	8.50	9.00	8.38	0.33
DP (%)	92.71 ^b	92.53 ^b	94.42 ^a	0.36

^{a, b}: Mean values in the same row with different superscripts differ significantly ($p > 0.05$)

EBW: Empty body weight

HCW: Hot carcass weight

DP: dressing percentage.

SEM: Standard Error of Mean.

Table VI: Primal cuts (% of live weight) of West African Dwarf sheep fed *Moringa oleifera* at different level of inclusion.

PARAMETERS	(0% MLM; 100 % Concentrate)	(5% MLM: 95 % Concentrate)	(10% MLM: 90 % Concentrate)	SEM
Head (kg)	5.29	8.00	6.88	0.69
Shank (kg)	3.21	3.44	3.68	0.34
Loin (kg)	2.86	3.44	3.04	0.31
Shoulder (kg)	3.14	3.92	3.20	0.31
Rack (kg)	2.93	4.00	3.28	0.24
Neck (kg)	2.36	3.12	2.72	0.24
Hind limb (kg)	8.43	7.60	8.32	0.10
Fore limb (kg)	7.14	11.44	8.64	0.94
Breast (kg)	1.07 ^b	1.68 ^a	1.44 ^{ab}	0.13
Sirloin (kg)	2.43	3.04	3.20	0.24

Mean values in the same row with different superscripts differ significantly ($p > 0.05$)

SEM: Standard Error of Mean.

leaf meal (MLM) at different level of inclusion is presented in table VII. This result showed that the observed mean values obtained for Gut, Heart, Kidney, and Lungs/Trachea were not significantly ($p > 0.05$) influenced by *Moringa* supplementation. This agrees with the report of Fasae *et al.* (2011) for sheep fed varying levels of maize and cassava.

However, the mean values obtained for liver shows a significant ($p > 0.05$) difference among the dietary treatments. The animals fed 10% and 5% MLM shows the higher comparable mean values, than

the animals fed 0% MLM which had the least mean value. This is in contrast with the result of Fasae *et al.*, (2011) for sheep fed varying levels of maize and cassava hay. This might be attributed to the variation in the nutrient contents of the diets fed, breed difference and management system.

Conclusion

This study established that *Moringa oleifera* leaf meal is a good dietary protein source which can enhance performance and good carcass quality with no impairment of health status of the experimental sheep. Hence, higher levels of supplementation

Table VII: Visceral organs of West African Dwarf sheep fed *Moringa oleifera* at different level of inclusion.

PARAMETERS	(0% MLM; 100 % Concentrate)	(5% MLM: 95 % Concentrate)	(10% MLM: 90 % Concentrate)	SEM
Gut (%)	29.86	31.20	33.84	0.090
Liver (%)	0.64 ^b	1.84 ^a	1.60 ^a	0.024
Heart (%)	0.43	0.64	0.48	0.004
Kidney (%)	0.29	0.32	0.32	0.003
Lungs / Trachea (%)	1.50	1.68	1.52	0.008

^{a, b}: Mean values in the same row with different superscripts differ significantly ($p > 0.05$)

SEM: Standard Error of Mean.

should be included in sheep and goats diet in further studies to ascertain the usefulness as essential feed supplement.

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Received: 15th May, 2015
Accepted: 10th October, 2015