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Voluntary intake, digestibility, serology and testosterone level of West African dwarf bucks fed air-dried *Moringa oleifera* leaf meal-based diets

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Abstract

Evaluation of blood parameters, testosterone and digestibility serve as an index of general physiology and performance of animals. A total of twenty (20) West African dwarf (WAD) bucks of about six (6) to eight (8) months of age with an average weight of 7.2±0.11 kg were used in the experiment for a duration of 98 days. The animals were allocated to 0, 5, 10 and 15 % Moringa oleifera leaf meal (MOLM)-based diets of three goats per treatment in a completely randomized design experiment. However, in 0, 5, and 15% MOLM, CP contents range from 7.93 to 8.54 %. All the experimental animals had adequate total dry matter intake (DMI) which ranged from 382.59 to 391.39 g/animal/day (p>0.05). The mean percentage crude protein digestibility value tended to be lowest in 0 % MOLM-based diet and increased with increasing proportion of MOLM in the diets (p<0.05). Total protein, albumin, globulin, glucose, creatinine, aspartate aminotransferase, were similar (p>0.05) while Alanine amino transferase was significantly different (p<0.05). In the present study, inclusion level of 10% MOLM caused the testosterone level to increase from 5.16 ng/ml to 5.30 ng/ml which was the highest level. Conclusively, Moringa oleifera leaf meal improved nutrient intake blood, indices and digestibility in WAD bucks. Animal protein intake could be improved by the incorporation of MOLM-based diets for WAD goats.

Keywords: Moringa oleifera, West African dwarf bucks, performance

Introduction

During the dry season, the native rangelands and crop residues available for ruminants after crop harvest are usually fibrous and devoid of most essential nutrients including proteins, energy, minerals and vitamins which are required for increased rumen microbial fermentation and improved performance of the host animal (Osuji *et al.*, 1995) resulting in weight losses, low digestibility, lowered resistance to disease and reduced blood indices (Onwuka *et al*., 1989). In response to these challenges, the usual practice has been to supplement livestock diets with protein rich ingredients such as groundnut cake (GNC), soybean meal (SBM) and cotton seed cake (CSC). Unfortunately, these supplements are often not fed due to their unavailability and their high costs (Nouala *et al.*, 2006; Olomola *et al.*, 2008). A cheaper alternative of enhancing utilization of low quality grass is by supplementation with the foliages of high nitrogen multipurpose trees (Norton, 1994; Abdulrazak *et al*., 1997). Browse plants with high nutritive values have been successfully fed to small ruminants in alley farming systems (Fasae and Alokan, 2006). Studies have shown that multipurpose trees can be

used as cheap protein supplements which can improve voluntary intake, digestibility and general performance of animals fed low quality feeds (Pezo *et al*., 1991; Makkar and Becker 1996; Paterson *et al*., 1999; Aregheore, 2004; Kakengi *et al*., 2007). Sarwatt *et al*. (2004) reported that moringa foliages are a potential inexpensive protein source for livestock feeding because it can be harvested several times in one growing season. *Moringa oleifera* Lam. Nigerian ecotype plant (Anwar, 2007) can be used for food, medication and industrial purposes and as livestock feed (Anjorin *et al*., 2010). This could be due to the claims that it increases animal productivity as it has nutritional, therapeutic and prophylactic properties (Anwar *et al.*, 2007). Evaluation of blood parameters, testosterone and digestibility serve as an index of general physiology and performance of animals (Tambuwal *et al.*, 2002). Hence, the objective of this study was to determine the blood profile, digestibility and testosterone level of West African Dwarf bucks fed air-dried *Moringa oleifera* leaf meal-based diets.

Material and methods

Study area

The study was carried out at the Kalahari Unit of the Institute of Food Security, Environmental Resources and Agricultural Research, Federal University of Agriculture, Abeokuta, Ogun State, which is located in the tropical rainforest zone in Nigeria within 7°13'47.41''N, 3°23'43.48''E. Seasonal distribution of rain is approximately 110.9mm (9.97%) in the late dry season (Jan-March) and 163.1mm (14.66%) in the early dry season (October – December) (OORBDA, 2012).

Harvesting and processing of Moringa oleifera leaves

***Moringa oleifera* leaves, Nigerian ecotype was obtained in Odeda Local Government, Ogun state.** The harvested Moringa leaves were **air-dried by** spreading on a tarpaulin or cemented floor in a roofed and well ventilated room. The leaves were frequently turned until they were crispy to touch while retaining their greenish colouration. The leaves were then hand-milled to obtain a product herein referred to as Moringa leaf meal (MOLM) which was stored in sacs until needed. The table of experimental diet is as shown in Table 1.

Table 1: Ingredients composition (%dm) of concentrate diets

	Moringa inclusion levels in diets			
Parameters	***0%***	***5%***	***10%***	***15%***
Moringa oleifera leaf	0.00	5.00	10.00	15.00
PKC	54.00	49.00	44.00	39.00
Corn bran	40.00	40.00	40.00	40.00
Molasses	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00
Salt	1.00	1.00	1.00	1.00
Premix	1.00	1.00	1.00	1.00
Total	**100.00**	**100.00**	**100.00**	**100.00**

Management and feeding of experimental animals

A total of twenty (20) WAD bucks of about six (6) to eight (8) months of age with average weight of 7.2±0.11 kg were used in the experiment for duration of 98 days (14 days of adjustment period, 84 days for the trial). Prior to the start the experiment, flock treatment was carried out during which they were administered with broad spectrum antibiotics (Oxytrox 20% Long Acting injection, dose: 1ml per 10 kg) and dewormed using Albidol orally. The animals were managed under semi-intensive system. 20kg of concentrate were offered to the animals at 08:00 hours every morning before allowing them to graze around 10.00am on *Brachiaria ruziziensis* as the basal diet and water was given *ad libitum.* They were randomly divided into four treatments 0, 5, 10 and 15 % *Moringa oleifera* leaf meal (MOLM)-based diets.

Haematological and biochemical analysis

Blood samples were harvested from the jugular vein of each of the animals using sterilized needles and syringe. About 3 millilitres were collected into plastic bottles containing an anticoagulant, Ethylenediaminetetraacetic Acid (EDTA) for haematological evaluation and the contents agitated gently by repeated inversion or rocking. The blood serum parameters were determined for activities of Aspartate aminotransaminase (Henry *et al.*, 1974) and Alanine aminotransaminase according to Doumas and Briggs (1972).

Digestibility trial

The digestibility trial was carried out using four bucks, one animal was selected from each of the four treatments. The animals were transferred into separate metabolic cages provided with net for collection of faeces and nylon for urine collection. The animals were fed weighed amounts of concentrate diets and water was provided *ad libitum*. There were 7 days adaptation period and 7 days excreta (faeces) collection. Daily feed intake (feed offered minus ort), faecal output were collected, well labelled, weighed and recorded for each animal. To prevent nitrogen loss from urine via volatilization and bacteria growth, urine collection bottles were rinsed with 10% H_2S0_4 (Oxytetraoxosulphate IV acid), after which urine was introduced into the bottles, covered with cap and refrigerated in deep freezer before chemical analysis (Chen and Gomez, 1992).

Statistical analysis

All data collected from parameters investigated were based on Completely Randomized Design using the procedure of statistical analysis software SAS 9.1 (SAS, 2003) and treatment means were compared using Duncan's procedure of the same software. The statistical model focused primarily on inclusion level effect as the main treatment. The following model was thus used: $Y_{ij} = \mu + M_j + e_{ij}$; where Y_{ij} is the dependent, continuous variable; μ is the overall mean; M_j is the fixed effect of the *j*th inclusion of air-dried *Moringa oleifera* leaf meal (j = 0%, 5%, 10% and 15%) and e_{ij} is the residual error.

Results and discussion

The chemical composition of concentrate diets at various levels of inclusions of *Moringa oleifera* leaf meal Nigerian ecotype is shown in Table 2. The CP content of 7.26% for 10% MOLM was lowest, followed by CP content of 7.93% in 15% MOLM and 8.17% in 5% MOLM, then 8.54% CP in 0% MOLM. The CP content of 7.25% for 10% MOLM was slightly below the minimum level for maintenance of 7.7% for goats (NRC, 1981). The replacement of MOLM

Table 2: Proximate composition of experimental diets

	Moringa inclusion levels in diets			
Parameters	**0%**	**5%**	**10%**	**15%**
Crude protein	8.54	8.17	7.25	7.93
Crude fibre	6.44	9.01	7.57	6.80
Fat	14.23	8.66	2.51	6.67
Ash	15.51	24.07	18.66	16.44
Nitrogen free extract	55.28	50.09	64.06	62.16
Acid detergent fibre	49.17	37.31	22.00	36.55
Neutral detergent fibre	32.38	11.47	11.59	21.27

could be responsible for the decline in the CP contents of the diets 5, 10% and 15% MOLM. However, CP contents range of 7.93 to 8.54 % was within the minimum level necessary to provide the minimum ammonia levels required by rumen micro-organisms to support optimum rumen activity (Norton, 2003). The CF was within the range of 6.44% - 9.01%. While fat, ash, nitrogen free extract, acid detergent fibre and neutral detergent fibre were 2.51%-14.23, 15.51 – 24.07, 50.09-64.06, 22.00 – 49.17 and 11.47-32.38 respectively. Different mixtures composed by different parts of Moringa plants have different nutritional value. Thus, the mixtures with different proportions of Moringa leaves, twigs, or branches have different CP and NDF contents (Aregheore, 2002). The mixture of Moringa leaf meal with soft twigs has lower CP and higher NDF contents (Murro *et al.,* 2003; Fujihara *et al.,* 2005). Depending upon the quality of different Moringa fractions, the farmers can decide which animals can utilize these fractions in the best way. For example, low CP meals (Moringa leaves with twigs) can be easily consumed by bucks which require low nutrients' fodders. Nouala *et al.* (2006) outlined that the environmental conditions of the rumen are normally in favour of the fibrolytic microorganisms which aid the degradation of high fibre diets in contrast to the negative effects of concentrates high or sole concentrate diets which were very high in carbohydrates.

Table 3: Nutrient intake of West African dwarf bucks fed *Moringa oleifera* leaf meal -based diets

	Moringa inclusion levels in diets				
Parameters	**0%**	**5%**	**10%**	**15%**	
Dry Matter	382.90	382.59	366.88	391.39	15.73
Crude Protein	173.81^{d}	382.59^{a}	192.43^{c}	262.90^{b}	1.80
Ether Extract	61.57^{a}	39.69^{b}	10.88^{c}	34.43^{b}	6.87
Crude Fibre	27.87^{c}	41.27^{a}	32.80^{bc}	35.16^{ab}	1.93
Ash	59.51^{c}	92.09^{a}	68.46^{b}	71.16^{b}	2.61
Neutral Detergent Fibre	140.41^{a}	52.43^{c}	50.69^{c}	109.76^{b}	14.69
Acid	297.29^{a}	231.19^{b}	46.39^{c}	193.41^{b}	35.10

^{a,b,c} **means within a row with different superscript are significantly different ($p<0.05$) ns means not significantly different ($p>0.05$)**

Table 3 shows the nutrient intake of *Moringa oleifera* leaf-based diets fed to West African dwarf Goat. All the parameters were significantly ($p<0.05$) different for the dietary treatments except for dry matter intake. All the experimental animals had adequate total dry matter intake (DMI) which ranged from 382.59 to 391.39 g/animal/day. These values were comparable to values ranging from 288.48 to 354.49 g/animal/day for WAD goats fed *M. oleifera,* dried leaves as supplements (Asaolu *et al.,* 2012; Tona *et al.,* 2014). These values exceeded the minimum daily DMI of 3% of body weight recommended for small ruminants (NRC, 1985). The DMI of the treatment diets were observed to increase in the order of the increase of MOLM. This intake could be a reflection of the relative palatability and acceptability of these diets as was also observed by Tona *et al.* (2014). This is in line with the reported inverse relationship existing between DMI and Fibre content of feed (Reid and Kloptentstein, 1983). This tends to suggest that with the decreasing levels of crude fibre contents, palatability increased.

Table 4: Digestibility coefficients of West African dwarf bucks fed *Moringa oleifera* leaf meal -based diets

Parameters	Moringa inclusion levels in diets					
	0%	**5%**	**10%**	**15%**	**SEM**	**P-VAL.**
Dry Matter	59.54^{c}	64.16^{b}	60.54^{bc}	70.78^{a}	1.26	
Crude protein	49.26^{c}	50.82^{c}	54.82^{b}	59.71^{a}	1.10	
Ether extract	32.36^{d}	51.59^{c}	58.66^{b}	60.63^{a}	2.89	
Crude fibre	46.86^{c}	52.75^{b}	54.81^{b}	61.64^{a}	1.44	
Ash	45.89^{b}	42.09^{c}	47.36^{b}	55.69^{a}	1.32	
Neutral Detergent Fibre	32.58^{c}	57.99^{a}	59.05^{a}	50.79^{b}	2.78	
Acid Detergent Fibre	94.25^{a}	92.50^{b}	51.00^{d}	88.00^{c}	4.58	

^{a,b,c,d}means within a row with different superscript are significantly different ($p<0.05$)

Table 4 shows the digestibility coefficients of West African dwarf goat fed *Moringa oleifera* leaf-based diets. All the parameters observed were significantly different ($p<0.05$). The percentage crude protein digestibility value tended to be lowest in 0 % MOLM and started to increase with increasing proportion of MOLM in the diets. The dry matter digestibility coefficients in this experiment ranged from 59.54 to 70.78%, suggesting that the diets were highly digested which was similar to that reported by Manh *et al.* (2005).

Table 5: Serum biochemical parameters of West African dwarf bucks fed *Moringa oleifera* leaf meal -based diets

Parameters	Moringa inclusion levels in diets					
	0%	**5%**	**10%**	**15%**	**SEM**	**P-VAL.**
Total Protein (g/dl)	7.233	7.533	8.633	8.500	0.418	0.622
Albumin (g/dl)	3.833	4.067	4.600	4.533	0.223	0.625
Globulin (g/dl)	3.400	3.467	4.033	3.767	0.243	0.830
Glucose (mg/dl)	84.000	78.330	80.670	81.000	3.597	0.970
Creatinine (mg/dl)	0.733	0.677	0.533	0.733	0.070	0.773
Aspartateamino Transferase (u/l)	55.670	45.330	49.670	53.330	1.547	0.062
Alanine Amino Transferase (u/l)	24.000^{a}	25.000^{a}	17.670^{b}	26.000^{a}	1.248	0.044

a,b, Means within a row with different superscripts are significantly different ($p<0.05$)

Total protein, albumin, globulin, glucose, creatinine, aspartate amino transferase, were similar ($p>0.05$) while Alanine amino Transferase was significantly different ($p<0.05$). Total protein was in the range of 7.23g/dl to 8.63g/dl ($p<0.05$). According to Otesile *et al.* (1991) Serum biochemistry is a generalized medium of assessing the health status of animals. The monitored activities of the enzymes: alanine amino transferase, alkaline phosphate, aspartate amino transferase in the sera of the goats studied varied widely between the treatments. Enzymes are protein catalysts present mostly in living cells and are constantly and rapidly degraded although, renewed by the new synthesis (Coles, 1986). According to Zilva and Pannall (1984), normal enzymes levels in serum are a reflection of a balance between synthesis and their release, as a result of the different physiological processes in the body. Transaminase enzymes are those mostly responsible for the synthesis of non essential amino acids through the process known as transmination according to Carola *et al.* (1990). Serum levels of aspartate amino transferase are significantly high under disease conditions involving injuries to large number of metabolically active cells.

Table 6: Effect of various levels of *Moringa oleifera* leaf meal-based diets on testosterone concentration of West African dwarf bucks

Parameters	Moringa inclusion levels in diets					
	0%	**5%**	**10%**	**15%**	**SEM**	**P-VAL.**
Testosterone (ng/ml) start	5.16	5.12	5.16	5.26	0.13	0.9878
Testosterone (ng/ml) end	5.18	5.02	5.30	5.20	0.14	0.9281

The results of the testosterone levels obtained for 0, 5, 10% and 15% MOLM at the commencement and end of the experiments were 5.16ng/ml, 5.12ng/ml, 5.16ng/ml 5.26ng/ml; 5.18ng/ml, 5.02ng/ml and 5.30ng/ml, respectively. In the present study, inclusion level of 10% MOLM caused the testosterone level to increase from 5.16ng/ml to 5.30ng/ml which was the highest level. There was no significant difference across the treatment ($p > 0.05$). This was not in total agreement with the report that there was reduction in the levels of testosterone, luteinizing hormone (LH) and follicle-stimulating hormone (FSH) when the crude methanol extract of medicinal plant was administered to male albino rats (Raji *et al.*, 1997 and Bazrafkan *et al.*, 2010) as some increased.

Conclusion

The incorporation of *Moringa oleifera* leaf meal improved nutrient intake blood, indices and digestibility in WAD bucks. Animal protein intake could be improved by the incorporation of *Moringa oleifera* leaf meal in concentrate diet for WAD goats.

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