HAEMATOLOGICAL PARAMETERS OF WEST AFRICAN DWARF BUCKS FED DIETS CONTAINING GRADED LEVELS OF *MORINGA OLEIFERA* LEAF MEAL

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ABSTRACT

A trial was conducted to determine the effect of diets containing graded levels of *Moringa oleifera* leaf meal (MoLM) on haematological parameters of West African Dwarf bucks at the Small Ruminant Section of Large Animal Experiment Station, National Veterinary Research Institute, Vom. Sixteen (16) West African Dwarf bucks between 9 and 12 months of age and weighing on average 12.5kg were randomly assigned to four treatment groups of four bucks per treatment, with one buck serving as a replicate in a Completely Randomized Design (CRD). The bucks were fed four concentrate diets formulated to contain MoLM at 0, 10, 20 and 30% designated as T_1, T_2, T_3, and T_4 respectively at the rate of 0.3kg per head per day in the morning before being released for grazing on controlled natural pasture. Kikuyu (*Cenchrus cladestinus*) grass hay was supplemented to cater for any shortfall during grazing. Mineral lick was provided. Fresh drinking water was provided *ad libitum* throughout the period of the trial which lasted for 120 days excluding acclimatization and observation. Haematological parameters were assessed at days 1, 60 and 120 of the trial. Data obtained were subjected to Analysis of Variance. Results obtained indicated that haematological indices such as packed cell volume was not significantly different across the treatment groups ($p>0.05$); haemoglobin concentration showed some statistical difference ($p<0.05$) at the middle, but not at end of the trial. White blood cell count showed significant differences ($p<0.05$), but did not follow any particular trend. Lymphocytes, neutrophils, monocytes, eosinophils and basophils showed no significant differences ($p>0.05$). Red blood cells, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and mean corpuscular volume of the bucks did not

show any statistical differences ($p>0.05$). The haematological parameters assessed were not also adversely affected by the test diets. It is concluded that *Moringa oleifera* leaf meal in concentrate diets can be utilized as a protein source and as a supplement for West African Dwarf bucks, and by extension, other ruminants, especially in periods of forage scarcity. More leaf meals should be utilized to enhance nutrition and wellbeing of small ruminants especially during the dry season when forage is scarce.

Keywords: hormones, blood, moringa, leaf meal

Introduction

Increasing the productivity of each animal per unit area of land is a major objective of achieving food security. Opara *et al*. (2005) submitted that there is need to improve the productivity of small ruminant animals through feeding and management. *Moringa oleifera* Lam commonly known as *Moringa*, is a medicinally important multipurpose plant belonging to the family *Moringaceae,* is a suitable candidate in achieving this objective. It is a small or medium sized tree up to 10 m tall, with thick, soft, corky, deeply fissured bark, growing mainly in semi-arid, tropical and subtropical areas. The feeding value of *Moringa* has been reported to be similar to that of soybeans and rapeseed meal (Soliva *et al.*, 2005). Various parts of the *Moringa oleifera* plant apart from serving as veritable nutritional supplement, have been confirmed to contain phytochemicals possessing some peculiar antioxidant properties. *Moringa* leaf could prove very useful in improving not only the nutritional status of livestock, but also enhancing their reproductive capacity, especially in the face of scarcity of food in Nigeria. *Moringa* leaf is abundant especially during the rainy season, and can be preserved for use during the dry season via drying. The cost of production of *Moringa* is low since it is a tree crop, requiring very little maintenance. Sheep and goats are important domestic animals in the tropical livestock production system, particularly to the subsistent farmers and pastoralists who depend on these animals for most of their livelihood. However, increase in the human population and scarcity of production resources exert severe pressure on the small-scale mixed farming system and threaten their existence (Peters and Laes-Fettback*,* 1995). There is therefore a need to boost small ruminant production using medicinal plants and leaf meals like *M. oleifera* in an attempt to augment animal protein intake of the masses. This research was designed to investigate the effect of feeding diets containing graded levels of *M. oleifera* on haematological parameters of West African Dwarf bucks.

Materials and Methods

Study location

The experiment was conducted at the Small Ruminant Section of the Livestock Investigation Division, National Veterinary Research Institute (NVRI), Vom. Vom is located in Jos South Local Government Area of Plateau State, Nigeria and is located on latitude 8°45′ E and longitude 9°43′ North and on an altitude of 1280 metres within the northern Guinea Savannah ecological zone of Nigeria. The area is characterized by two distinct climatic seasons – the dry season, lasting between October and March, while the rainy season lasts between April and September. The area experiences an annual rainfall ranging between 1300 and 1450mm, with the highest rainfall usually recorded during the wet months of July and August (Ibeawuchi, 1984). The temperature ranges from 10 to 31°C with averages between 19 and 22°C. Located on an elevation of 1239.4 meters above sea level, the climate has also been described as near temperate (Blench, 1999). The vegetation is mostly of grasses with short shrubs on a rocky, hilly terrain and with planted trees around residential areas.

Experimental design

A total of twenty (20) West African Dwarf goats consisting of sixteen (16) bucks and four does ranging between 9 and 12 months and with body weights ranging between 11.8 and 12.8kg were used for the study. The ages of the experimental animals were determined via farm records and confirmed via dentition. The bucks were reared under semi-intensive system with similar management practices. On arrival, the experimental animals were kept in a holding pen and clinically examined and observed for 14 days for any obvious signs of ill health before being introduced to the experimental pen. Furthermore, another 7 days was allowed into the experiment for adjustment/acclimatization to the new environment before commencement of the trial. The experimental animals were treated against ecto-parasites and endo-parasites and also vaccinated against *peste des petits ruminants* (PPR) prior to the trial.

Collection, preparation and determination of phytochemical and proximate composition of *Moringa oleifera* leaf meal

Fresh *Moringa oleifera* leaf plus their stalks/twigs were obtained from Vom environs, rinsed in clean water and drained properly. The leaves were carefully detached from the stalks/twigs and air dried at room temperature (27^{o}C) until it became crispy to touch while retaining their greenish colouration and thereafter, milled into very fine powder with an electric blender and stored in airtight containers until incorporation into the diets. Standard qualitative and quantitayive methods as described by Sofowora (1989) were used for the phytochemical screening of the *M. oleifera* leaf meal using water. Levels of presence of the phytochemicals were identified and recorded (Table 1).

Table 1 Phytochemical composition of *Moringa oleifera* leaf meal

Phytochemical	Level of presence (%)
Saponins	0.59
Tannins	1.25
Steroids	0.88
Cardiac glycoside	0.56
Alkaloids	1.12
Flavonoids	3.61
Anthraquinone	2.32
Total phenols	2.02

Samples of the air dried *M. oleifera* leaves were taken to the nutritional biochemistry laboratory of the National veterinary research Institute, Vom for proximate analysis using standard procedures of the Association of Official Analytical Chemists (AOAC, 1990). The Ash and Metabolizable Energy (ME) (Table 2) of the *Moringa oleifera* leaf meal used in this trial were calculated (Pauzenga, 1985).

Table 2 Proximate Composition of *Moringa oleifera* Leaf Meal

Crude Protein	Fat	NFE	Ash	Crude fibre	Moisture
27.14	4.78	46.31	10.30	11.18	3.12

Table 3 Gross composition of concentrate diets containing graded levels of *Moringa oleifera* leaf meal fed to West African Dwarf bucks

	Experimental	Diets		
Ingredient (%)	**1**	**2**	**3**	**4**
Maize	10	5	5	5
Wheat offal	15	25	12	5
Maize offal	24.5	16	20.5	17.5
Rice bran	35.0	35.5	35	37
Groundnut cake	13	6.0	5	3
*MoLM	0	10	20	30
Limestone	1	1	1	1
Bone meal	1	1	1	1
Common salt	0.5	0.5	0.5	0.5
Total	**100**	**100**	**100**	**100**
Calculated analysis				
**ME (Kcal/kg)	2483	2312	2477	2501
Crude Protein (%)	16.0	15.9	16.5	16.9
Ether Extract (%)	6.92	6.75	6.91	6.10
Crude Fibre (%)	9.60	10.44	10.46	10.42
Calcium (%)	0.78	1.47	2.15	2.83
Available Phosphorus	0.44	0.48	0.46	0.44

*MoLM = *Moringa oleifera* Leaf Meal
**ME = Metabolizable energy

Composition of concentrate diets and feeding of experimental animals

Four concentrate rations were formulated to contain the *M. oleifera* leaf meal (MoLM) at 0, 10, 20, and 30% composition respectively (Table 3). On commencement of the trial, the animals were first fed the concentrate ration containing graded levels of *M. oleifera* at the rate of 0.3kg per head per day in the morning before being released for grazing on controlled natural pasture. Kikuyu grass hay was provided as a supplement to cater for any shortfall during grazing. Fresh drinking water was provided *ad libitum* throughout the period of trial. Mineral lick was also provided. The sixteen (16) WAD bucks were randomly allocated to four treatment groups denoted as T_1, T_2, T_3 and T_4, with four bucks per treatment, and one buck in each treatment serving as replicate in a Completely Randomized Design (CRD). Animals in T_1 (0% MoLM) served as control while those in T_2, T_3 and T_4 were fed the treatment feeds containing 10, 20 and 30% respectively of the *M. oleifera* leaf meal daily for 120 days.

Determination of the hematological parameters

The live body weights of the bucks were measured in kilogrammes by following the procedure described by Akpa *et al* (1998). The weight of the holder was taken first and then while carrying each animal individually and standing on a weighing scale. The difference between both weights gave the net weight of the animal. Weighing was done first thing in the morning at the beginning and thereafter weekly, and at the end of the experiment.

Five (5) mls of blood was collected via the jugular vein of each animal using a syringe and needle at days 0, 60 and 120 respectively, of the trial and emptied into each labelled vial containing ethylene diamine tetra acetic acid (EDTA). Each vial was immediately capped and the content mixed gently for about 2 minutes by repeated inversion to avoid clotting of the blood sample and placed on ice packs before being transported to the haematology laboratory of Central Diagnostic Unit of NVRI Vom for analysis. Haematological parameters determined were: red blood cell count (RBC), haemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean

corpuscular haemoglobin concentration (MCHC), white blood cell count (WBC) and leucocytes differential count (LDC) according to the methods described by Dacie *et al.* (2008).

Data analysis

Data obtained were presented variously as percentages, while others were subjected to Analysis of Variance (Steel and Torrie, 1980). The Least Significant difference (LSD) technique was used to separate the means. P-value less than 0.05 was considered statistically significant.

Results and Discussion

Results on the haematological parameters of West African Dwarf bucks fed diets containing graded levels of *Moringa oleifera* leaf meal (MOLM) are presented in Tables 4, 5 and 6.

Table 4 Haematological parameters of West African Dwarf Bucks fed diets containing graded levels of *Moringa oleifera* leaf meal (Day 1)

Duration	Treatment					
	T_1(0%)	T_2(10%)	T_3(20%)	T_4(30%)	SEM	
Packed cell volume	26.67^{ab}	20.00^{b}	23.00^{b}	33.50^{a}	1.88	*
Haemoglobin Concentration	9.00^{ab}	7.00^{b}	7.50^{b}	11.50^{a}	0.66	*
White Blood cell	4.33	5.15	4.75	4.75	0.28	NS
Lymphocytes	50.00	44.50	58.50	44.50	2.52	NS
Neutrophils	47.67	46.50	36.50	41.50	2.30	NS
Monocytes	0.00	2.00	0.00	1.50	0.46	NS
Eosinophils	1.33^{c}	6.50^{ab}	4.00^{bc}	10.00^{a}	0.88	*
Basophils	1.00	0.50	1.00	0.50	0.58	*
Red Blood cell	3.53	3.25	3.60	3.70	0.18	NS
MCH	25.33^{ab}	21.50^{b}	21.00^{b}	31.00^{a}	2.03	*
MCHC	33.67^{ab}	35.00^{a}	32.00^{b}	34.00^{ab}	0.88	*
MCV	75.33^{b}	62.00^{c}	64.50^{c}	91.00^{a}	5.92	*

^{a,b,c} Means in the same row with different superscripts are significantly different (P<0.05)
SEM = Standard Error of Mean
NS = Not significant (P>0.05).
Sig. = Level of significance
MCH = Mean corpuscular haemoglobin
MCHC = Mean corpuscular haemoglobin concentration
MCV = Mean corpuscular volume

Table 5 Haematological parameters of West African Dwarf Bucks fed diets containing graded levels of *Moringa oleifera* leaf meal (Day 60)

Duration	Treatment					
	T_1(0%)	T_2(10%)	T_3(20%)	T_4(30%)	SEM	
Packed cell volume	26.50	24.00	22.67	20.50	0.96	NS
Haemoglobin concentration	7.67^{ab}	9.10^{a}	8.10^{ab}	6.90^{b}	0.34	*
White Blood cell	4.90	5.55	4.30	4.35	0.22	NS
Lymphocytes	56.00	43.50	45.00	50.00	2.56	NS
Neutrophils	43.00	49.00	39.50	45.00	1.70	NS
Monocytes	3.00^{b}	6.00^{a}	6.00^{a}	5.00^{a}	0.52	*
Eosinophils	1.00	1.00	1.00	0.00	0.32	NS
Basophils	1.00	0.50	0.00	0.00	0.24	NS
Red Blood cell	3.57	3.50	3.65	3.85	0.07	NS
MCH	21.33^{ab}	26.00^{a}	22.50^{ab}	18.00^{b}	1.21	*
MCHC	34.00	34.50	34.00	33.50	0.33	NS
MCV	63.67	75.50	66.00	53.50	3.46	NS

^{a,b,c} Means in the same row with different superscripts are significantly different (P<0.05)
SEM = Standard Error of Mean
NS = Not significant (P>0.05).
Sig. = Level of significance
MCH = Mean corpuscular haemoglobin
MCHC = Mean corpuscular haemoglobin concentration
MCV = Mean corpuscular volume

Table 6 Haematological parameters of West African Dwarf Bucks fed diets containing graded levels of *Moringa oleifera* leaf meal (Day 120)

Duration	Treatment					
	T_1(0%)	T_2(10%)	T_3(20%)	T_4(30%)	SEM	
Packed cell volume	23.00	20.00	23.00	22.50	0.74	NS
Haemoglobin concentration	8.00	7.00	7.50	7.50	0.24	NS
White Blood cell	9.00^{ab}	8.00^{ab}	7.00^{b}	11.50^{a}	0.72	*
Lymphocytes	51.67	58.50	58.00	56.00	1.56	NS
Neutrophils	38.67	34.00	32.00	36.50	1.38	NS
Monocytes	1.33	2.50	4.50	2.00	0.53	NS
Eosinophils	9.00	5.50	3.50	5.50	0.94	NS
Basophils	0.00	1.50	0.00	0.00	0.24	NS
Red Blood cell	4.10	4.40	4.05	3.85	0.13	NS
MCH	19.67	16.00	19.00	19.50	1.03	NS
MCHC	35.00	35.00	32.50	33.50	0.48	NS
MCV	57.00	46.00	49.50	58.50	4.23	NS

^{a,b,c} Means in the same row with different superscripts are significantly different (P<0.05)
SEM = Standard Error of Mean
NS = Not significant (P>0.05).
MCH = Mean corpuscular haemoglobin
MCHC = Mean corpuscular haemoglobin concentration
MCV = Mean corpuscular volume
Sig. = Level of significance

Packed Cell Volume

The highest percentage packed cell volume (PCV) of the bucks at the beginning of the trial was observed as 33.50 for bucks in T_4 (30% MOLM), followed by 66.67 for bucks in T_1 (0% MOLM), and 23.00 for bucks in T_3 (20%MOLM), while the lowest value of 20.00 was observed for bucks in T_2 (10% MOLM). The highest mean value of 33.50 did not differ from those of bucks in T_1, but differed significantly ($p<0.05$) from the values for bucks in T_2 and T_3, whereas it was not different from the values for bucks in T_1. However, the values obtained for bucks in T_1, T_2, and T_3 were similar.

At day 60, the PCV values for all treatment means were not significantly different ($p>0.05$). The PCV values obtained for the bucks was numerically highest in T_1 (26.50), followed by T_2 (24.00), T_3 (23.67) and the least from T_4 (20.50). The highest PCV values obtained on day 120 were 23.00 for T_1 and T_3 respectively, followed by 22.50 for T_4, while the least value of 20.00 was observed in T_2. These values followed the same trend as that on day 60.

Haemoglobin Concentration

Values for haemoglobin concentration of the bucks at the beginning of the experiment were 9.00 for T_1, 7.00 for T_2, 7.50 for T_3 and 11.5 for T_4. The value of 11.5 for T_4 was statistically similar ($p>0.05$) to 9.00 for T_1, but significantly higher than the values for T_2 and T_3, while that of T_1 was also statistically similar to T_2 and T_3.

At day 60, the values for haemoglobin concentration of the bucks were 7.67 for T_1, 9.10 for T_2, 8.10 for T_3 and 6.90 for T_4 respectively. The highest value of 9.10 observed for bucks in T_2 was statistically similar to the values of 8.10 in T_3 and 7.67 in T_1, but statistically different ($p<0.05$) from 6.90 recorded for bucks in T_4. The values in T_3 and T_1 were however statistically similar ($p>0.05$) to T_2. At day 120, the values for haemoglobin concentration of the bucks were 8.00 for T_1, 7.00 for T_2, 7.50 for T_3 and 7.50 for T_4 respectively. There was no significant difference among the values ($p>0.05$).

The values for Packed Cell Volume of the bucks in all the treatments were not significantly different ($p>0.05$) at day 0, 60 and day 120. This is an indication that the diets were good enough to sustain the bucks, especially since they were all exposed to similar management conditions.

Values for haemoglobin concentration of the bucks at day 60 and day 120 were statistically similar ($p>0.05$).

Values for white blood cell count of the bucks at the beginning of the experiment and at Day 60 were not statistically different ($p>0.05$). The somewhat statistical difference between values of white blood cells did not follow any particular trend, and were similar at different comparative levels. Values of white blood cell differentials for lymphocytes of the bucks at the beginning and at Days 60 and 120 of the experiment were not statistically different ($p>0.05$). Values for white blood cell differentials for neutrophils of the bucks at the beginning and at Days 60 and 120 of the experiment were not also statistically different ($p>0.05$). Values of white blood cell differentials for monocytes of the bucks at the beginning of the experiment did not show any statistical difference ($p>0.05$). At day 60 of the trial, values for white blood cell differential count for monocytes of the bucks in treatment T_2, T_3 and T_4 were statistically higher than the value for T_1, but at day 120 of the trial, these values did not show any statistical difference ($p>0.05$). Values of white blood cell differentials for eosinophils of the bucks at the beginning of the experiment for bucks in T_4 and T_2 ($p>0.05$) were higher than the values observed for bucks in T_1 and T_3 ($p<0.05$). At days 60 and 120 of the trial, the values showed no significant differences ($p>0.05$) among the treatment means. This suggests a buffering effect of the diets on the oesinophils of the bucks. Values of white blood cell differentials for basophils of the bucks at the commencement and at days 60

and 120 of the experiment did not show any statistical difference ($p>0.05$).

At the beginning of the trial, values of red blood cells of the bucks for all treatments did not show any statistical difference ($p>0.05$). However, there was a steady increase in the number of red blood cells across all treatments at both day 60 and day 120 of the trial. Values for mean corpuscular haemoglobin (MCH) of the bucks at the commencement of the experiment and at day 60 were not significantly different. The trend was maintained up to day 90 as there were no statistical differences ($p>0.05$) among the values of the treatment means. At the beginning of the trial, values for mean corpuscular haemoglobin concentration (MCHC) of the bucks were not significantly different ($p>0.05$). At days 60 and 120 of the trial the treatment means did not also show any significant differences ($p>0.05$). At the beginning of the trial, values for mean corpuscular volume (MCV) of the bucks were statistically similar ($p>0.05$). At days 60 and 120, the treatment means did not show any significant differences ($p>0.05$).

That there were no differences between control and test diet for haematological parameters except WBC agrees with the report of Isitua and Ibeh (2013) that the MoLM could enhance hematopoietic activity and may not precipitate anaemia in a biologic system. The mean corpuscular volume (MCV), MCH, MCHC, neutrophils, lymphocyte, monocytes and eosinophils were not significantly affected ($p>0.05$) with the inclusion of *Moringa oleifera* leaf meal. This report agrees with the findings of Olatunji *et al*.(2016) when rabbits were fed varying levels of MoLM and the values fall within the normal range reported by Mitruka and Rawnsley (1977). The non significant difference ($p>0.05$) observed for this parameter is an indication of better utilization of MoLM by the bucks. The higher value of WBC observed in bucks fed MoLM based diets compared with the control is an indication that the immunity levels of the bucks could have been challenged. According to Soetan *et al*. (2013) high counts of WBC enhance adaptability to local environment and disease prevalent conditions. Addass *et al* (2010) pointed out that the extent of adaptation affects productivity and health status of goats. The Red blood cell values were not significantly ($p>0.05$) influenced by the inclusion of *Moringa oleifera* leaf meal, this means that oxygen and carbon dioxide were well distributed in the body to enhance respiration and good health status. The values recorded fall within the normal recorded by Mitruka and Rawnsley (1977) and agree with findings of Odetola *et al*. (2012). Ahemen *et al*. (2013) had earlier concluded that inclusion of *Moringa oleifera* leaf meal in the diets of weaner rabbits up to 15% had no adverse effect on their blood profile.

Conclusion and Recommendations

This study has demonstrated that *M. oleifera* leaf meal can be incorporated into the concentrate diets of breeding WAD bucks up to 30% inclusion without adversely affecting their haematological parameters. It is recommended that goat farmers should utilize *M. oleifera* leaf meal as a protein source and as a supplement to enhance reproductive capacity of West African dwarf bucks, and by extension, other ruminants, especially in periods of forage scarcity.

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