Performance, blood indices and carcass yield of grower rabbits fed diet containing *Moringa oleifera*, *Aspilia africana* and *Azadirachta indica* leaf meals

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Abstract

The experiment was conducted to examine the effect of feeding varying dietary levels of *Moringa oleifera* meal (MOM), *Aspilia africana* meal (AAM) and *Azadirachta indica* meal (AIM) on performance, blood indices and carcass yield of grower rabbits. Eight one rabbits were grouped into 9 treatment, each treatment were replicated thrice, containing 3 rabbits per replicate. Diets containing MOM, AAM and AIM at 0, 15 and 30% respectively were formulated. Rabbits fed inclusion levels of 15%, 30% MOM and 15%AAM (4.92 g, 4.90 g and 4.95 g respectively) had the best feed conversion ratio. However, the inclusion of 30% MOM in the diet increased the weight gain and better protein intake. The nitrogen intake, nitrogen absorbed and retention followed the same trend. Inclusion levels of the leaves had no negative effect on the blood indices of rabbit fed the dietary treatments. Rabbits on 30% MOM had significantly ($p < 0.05$) higher slaughtered weight (1,224.3 g), carcass weight (902.64 g), dressing percentage (61.58%), loin (194.20 g) and shoulder (193.05 g) weights. It was concluded that inclusion of 30% MOM in the diet of grower rabbit had the best performance.

Keywords: *Moringa oleifera*, *Aspilia Africana*, *Azadirachta indica* and rabbits

Introduction

Most of the meats currently consumed in Nigeria, especially in the urban and peri-urban region, come from ruminant species, pigs and poultry, especially chickens which supply an Nigerian with 7.9 g of animal protein intake per day which is far below the recommended level of 35 g per day required by an average adult for proper health (FAOSTAT, 2011). The situation may become worse in the future unless there is drastic re-orientation aimed at increasing output in the livestock sub-sector.

Efforts have only focused on the major traditional livestock species including ruminants, pigs and chickens, with little attention paid to rabbit. One of the ways of bridging the demand supply gap of animal protein is through rearing of rabbits. What inspired the interest in rabbit are its short generation interval, high prolific, ability to

thrive on forages that cannot be consumed by man, efficient converter of feed to meat and utilizes up to 30% crude fibre as against 10% by most poultry species. Rabbit is increasingly becoming an important meat source worldwide and is now recommended for production in countries that are experiencing animal protein shortage (Ewuola *et al.*, 2012).

Rabbit have the potential of utilizing some tropical legumes and browse plants notably moringa (*Moringa oleifera*) (Ewuola *et al.*, 2012), *Mucuna utilis* leaf meal (Sese *et al.*, 2013), neem leaf (*Azadirachta indica*) (Ogbuewu *et al.*, 2010), Bush marigold (*Aspilia africana*). Leaf meals of these plants have attracted attention for their ability to provide large quantity of high quality forages all year round and readily come to mind as a protein source with lots of potentials to be exploited in rabbit feeding.

Haematological components of blood are

Rabbits fed diet containing Moringa oleifera, Aspilina africana and Azadirachta indica leaf meals

valuable in monitoring protein quality of feeds (Atansuyi *et al.*, 2012), feed toxicity especially with feed constituents that affect the formation of blood (Oyawoye and Ogunkunle, 1998). The serum chemistry and haematological blood components are influenced by the quality and quantity of feed and the level of anti-nutritional element or factors present in the feed (Akinmutimi, 2004). This study examines the effect of the leaf meals of *M. oleifera*, *A. africana* and *A. indica* on the performance, blood indices carcass yield of grower rabbits.

Materials and methods

Experimental site

The experiment was carried out at the Rabbitary Unit of Directorate of University Farms (DUFARMS), Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

Experimental animals and management

Eighty one, New Zealand white and red

weaner rabbits of both sexes between ages 5-6 weeks old with initial body weight of 516.42-516.67 g were used for the experiment. The rabbits were kept individually in a wooden hutch with a wire mesh floor. The condition of the housing and management were the same for all the experimental animals for a period of 12 weeks.

Experimental procedure

The rabbits were randomly allotted on weight equalization basis into 9 dietary treatments with 9 rabbits per treatment. Treatment 1 (T₁) – 0% concentrate only; Treatment 2 (T₂) – 15% *Moringa oleifera*; Treatment 3 (T₃) – 30% *Moringa oleifera*; Treatment 4 (T₄) – 0% concentrate only; Treatment 5 (T₅) – 15% *Azadirachta indica*; Treatment 6 (T₆) – 30% *Azadirachta indica*; Treatment 7 (T₇) – 0% concentrate only; Treatment 8 (T₈) – 15% *Aspilina africana*; Treatment 9 (T₉) – 30% *Aspilina africana*

Table 1: Composition of the experimental Diet

	<i>Moringa oleifera</i>			<i>Azadirachta indica</i>			<i>Aspilina africana</i>		
Ingredients	T ₁ 0%	T ₂ 15%	T ₃ 30%	T ₄ 0%	T ₅ 15%	T ₆ 30%	T ₇ 0%	T ₈ 15%	T ₉ 30%
Maize	30	20	10	30	20	10	30	20	10
Wheat offal	20	20	20	20	20	20	20	20	20
Rice husk	25	20	20	25	20	20	25	20	20
Soy bean	20	20	20	20	20	20	20	20	20
<i>M. oleifera</i>	-	15	30	-	-	-	-	-	-
<i>A. indica</i>	-	-	-	-	15	30	-	-	-
<i>A. Africana</i>	-	-	-	-	-	-	-	15	30
Fish meal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bone meal	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Oyster shell	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Premix	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Total	100	100	100	100	100	100	100	100	100

Data analysis

All data collected were subjected to a 3x3 completely randomized design using SPSS (Release 20.0) statistical package (SPSS, 2011). Model sums of squares were

partitioned to linear, quadratic and cubic trends (Gomez and Gomez, 1983) and significant differences were compared using Duncan's multiple range test (Duncan, 1955).

Results

The performance characteristics of grower rabbits (Table 2) revealed that the parameters were significantly ($P < 0.05$) affected with the exception of average initial weight which ranged from 516.42 g to 516.67 g. It was observed that rabbits fed 30% inclusion level of *M. oleifera* leaf meal had highest average final live weight 1475.87 g, followed closely by 15% *M. oleifera* leaf meal (1445.00 g) but were higher than 15% and 30% *A. indica* leaf meal and *A. africana* leaf meal.

Average daily feed intake ranged from 52.74 to 60.40 g. Rabbits fed diet containing 0% *M. oleifera*; *A. africana* leaf meal and *A. indica* leaf meal were significantly ($P < 0.05$) higher on average daily feed intake value of 59.60g, 60.34g

and 60.40g respectively. Rabbits on 15% *A. africana* leaf meal had the least ($P < 0.05$). Best feed conversion ratio of 4.92 g was recorded in 15% *M. oleifera* leaf meal followed by 30% *Moringa oleifera* leaf meal 4.94 g and 15% *A. africana* leaf meal 4.95 g. Similar values were obtained for all treatments with the exception of the control diet 0% and 30% *A. indica* leaf meal which had the worst (Q: C: $P < 0.05$) feed conversion ratio. The average daily weight gain as affected by inclusion of leaf meals followed a significant cubic trend (C: $P < 0.05$) which ranged from 9.33 to 11.42 g. Rabbits fed 30% *M. oleifera* leaf meal gained 11.42 g which was significantly ($P < 0.05$) higher than other treatments while rabbits fed with 0% *M. oleifera* leaf meal had the least ($P < 0.05$) value of 9.33 g.

Table 2: Effect of the dietary leaf meals on the performance characteristics of grower rabbits

Forage	Level (%)	AIW (g)	AFW (g)	ADFI (g)	ADWG (g)	FCR (g)	PER (g)	PI (g)
<i>Moringa oleifera</i>	0	516.67	1300.00 ^f	59.60 ^a	9.33 ^{cd}	6.38 ^{ab}	1.04 ^d	8.98 ^c
	15	516.42	1445.00 ^b	54.37 ^b	11.05 ^{ab}	4.92 ^d	0.77 ^f	14.14 ^{ab}
	30	516.67	1475.87 ^a	56.43 ^{ab}	11.42 ^a	4.94 ^d	0.77 ^f	14.66 ^a
<i>Azadirachta indica</i>	0	516.42	1298.00 ^f	59.60 ^a	9.26 ^d	6.43 ^a	1.03 ^c	8.97 ^c
	15	516.67	1398.33 ^d	57.34 ^{ab}	10.50 ^{bc}	5.46 ^c	1.07 ^c	9.79 ^b
	30	516.67	1383.00 ^e	57.60 ^{ab}	10.31 ^c	5.59 ^b	1.05 ^d	9.90 ^b
<i>Aspilia Africana</i>	0	516.67	1297.00 ^f	59.59 ^a	9.24 ^d	6.45 ^a	1.03 ^e	8.94 ^d
	15	516.67	1411.67 ^c	52.74 ^c	10.65 ^b	4.95 ^d	1.55 ^a	6.85 ^f
	30	516.42	1383.33 ^e	54.77 ^b	10.32 ^c	5.31 ^c	1.45 ^b	7.12 ^e
SEM		0.38	1.23	0.02	0.02	0.01	0.00	0.01
Forage effect		0.999	0.000	0.000	0.000	0.000	0.000	0.000
Level effect		0.910	0.000	0.000	0.000	0.000	0.724	0.424
Linear		0.923	0.941	0.064	0.876	0.482	0.000	0.000
Quadratic		0.927	0.937	0.048	0.960	0.722	0.000	0.000
Cubic		0.943	0.069	0.018	0.076	0.085	0.000	0.000

^{abcdef} Means along the same column with different superscripts are significantly different ($P < 0.05$).

^{*} $P < 0.05$ Probability^a for Linear, Quadratic and Cubic

SEM- Standard Error of Mean

AFW- Average Final Weight

ADWG- Average Daily Weight Gain

PER- Protein Efficiency Ratio

AIW- Average Initial Weight

ADFI- Average Daily Feed Intake

FCR- Feed Conversion Ratio

PI- Protein Intake

The nitrogen utilization was significant across the treatments except for faecal nitrogen ranged from 1.85% to 2.32% and nitrogen output ranged from 2.71% to

3.15% in Table 3. Nitrogen intake increased significantly (C: $P < 0.05$) from 0% to 30% across the treatments. Highest value of 14.88% was achieved at 20% *M. oleifera*

leaf meal.

Urinary nitrogen followed similar trend with a higher value of 1.23% achieved at 30% *A. indica* leaf meal resulting in a significant linear, quadratic and cubic relationships (L: Q: C: $P < 0.05$). Nitrogen absorbed and nitrogen retention followed similar trend significantly as the inclusion levels increased with increasing levels across the dietary treatments (C: $P < 0.05$). 30% *M. oleifera* leaf meal recorded a significant ($P < 0.05$) higher value of 12.94% for nitrogen absorbed and 12.02% for nitrogen retention as the control diet had the least value. % nitrogen retention ranged from 73.88% to 80.76% was significant ($P < 0.05$) across the dietary treatments.

The results presented in Table 4 shows that the highest Hb and RBC values of 13.10 g/dl, 13.07 g/dl and 7.01, 7.03 $\times 10^6/\mu\text{l}$ were obtained in 15% and 30% *M. oleifera* inclusion levels which were significantly ($P < 0.05$) influenced. The RBC counts was significantly affected in a linear, quadratic and cubic trends (L: Q: C: $P < 0.05$). WBC counts ranged from $3.37 \times 10^3/\mu\text{l}$ to $8.40 \times 10^3/\mu\text{l}$ where 15% ($8.30 \times 10^3/\mu\text{l}$) and 20% ($8.40 \times 10^3/\mu\text{l}$) *A. indica* leaf meal had highest value which was significantly (L: Q: C: $P < 0.05$) different from other treatments. Inclusion level of *M. oleifera* leaf meal at 15% had the least value of ($3.37 \times 10^3/\mu\text{l}$) with no differences when comparing 0% ($4.17 \times 10^3/\mu\text{l}$) and 30% ($3.60 \times 10^3/\mu\text{l}$) *M. oleifera* leaf meal and 0% *A. africana* leaf meal $4.00 \times 10^3/\mu\text{l}$ respectively.

There was a slight increase in the values of Total serum protein (g/dl) and Albumin (g/dl) which ranged from 5.60 to 7.40 (g/dl) and 3.77 to 4.20 (g/dl) respectively and were significant (L: Q: $P < 0.05$).

Globulin value ranged from 1.57 to 3.40 (g/dl). The inclusion levels of *M. oleifera*

leaf meal and *A. africana* leaf meal declined significantly as the inclusion levels increases from 0% to 30% across the treatments. The creatinine value ranged from 0.26 to 1.37 (mg/dl) but had no significant ($P > 0.05$) differences across the treatment.

Table 5 shows the inclusion levels of the experimental diets on carcass parameters of grower rabbits. There were significant ($P < 0.05$) differences for all the cut part parameters with the exception of the head and neck weight that were not ($P > 0.05$) influenced by the dietary treatments. The results obtained for the average final live weight shows that rabbits fed 30% *M. oleifera* leaf meal obtained highest value 1475.87 g followed by 15% *M. oleifera* leaf meal 1445.00 g which was better than ($P < 0.05$) 1411.67 g obtained for rabbits in 15% inclusion level of *A. africana* leaf meal and 15% *A. indica* leaf meal 1398.33 g. The values obtained for fore limb increased with increasing levels of *M. oleifera* leaf meal and decrease with increasing levels in *A. africana* leaf meal from 0% to 30%. For the inclusion levels of *A. indica*, the values increased from 0% to 15% and declined further as the levels of inclusion increased to 30% in the diet. The values ranged from 111.39 to 126.39 g. Hind limb ranged from 143.26 to 174.23 g the values increased with increasing levels for *M. oleifera* leaf meal while the inclusion levels of *A. africana* leaf meal and *A. indica* leaf meal increased with increasing level from 0% to 15% that later declined as the levels increased to 30% in the diet. However, loin weight was significant ($P < 0.05$) across the treatments at quadratic and cubic trends (Q: C: $P < 0.05$). Values ranged from (148.39 g to 194.20 g) *M. oleifera* leaf meal, (121.74 g to 177.53 g) and *A. indica* leaf meal (170.07 g to 187.51 g) *A. africana* leaf meal and respectively. *M. oleifera* leaf meal at 30% had the highest of 194.20 g and the least value was obtained at

Table3: Effect of the dietary leaf meals and levels of inclusion on nitrogen utilization (%) of grower rabbits

Forage	Level (%)	Nitrogen Intake	Faecal Nitrogen	Urinary Nitrogen	Nitrogen Output	Nitrogen Absorbed	Nitrogen Retention	% Nitrogen Retention
<i>Moringa oleifera</i>	0	12.05 ^{ef}	2.32 ^a	0.83 ^e	3.15 ^a	9.73 ^g	8.90 ^g	73.85 ^f
	15	13.76 ^e	1.85 ^e	0.85 ^d	2.71 ^f	11.91 ^c	11.05 ^b	80.31 ^b
	30	14.88 ^a	1.94 ^c	0.92 ^c	2.86 ^c	12.94 ^a	12.02 ^a	80.76 ^a
<i>Azadirachta indica</i>	0	12.04 ^f	2.32 ^a	0.84 ^{de}	3.16 ^a	9.72 ^g	8.88 ^g	73.75 ^g
	15	12.89 ^d	1.95 ^c	1.07 ^b	3.02 ^d	10.93 ^f	9.86 ^f	76.51 ^e
	30	13.75 ^c	1.86 ^c	1.23 ^a	3.09 ^c	11.89 ^d	10.67 ^e	77.54 ^d
<i>Aspilta Africana</i>	0	12.06 ^e	2.32 ^a	0.84 ^{de}	3.16 ^a	9.73 ^g	8.90 ^g	73.80 ^f
	15	13.75 ^c	1.92 ^d	1.06 ^b	2.99 ^c	11.83 ^c	10.77 ^d	78.29 ^c
	30	14.01 ^b	2.07 ^b	1.06 ^b	3.13 ^b	11.94 ^b	10.88 ^c	77.64 ^d
SEM		0.01	0.01	0.01	0.01	0.01	0.03	0.01
Forage effect		0.000	0.000	0.000	0.000	0.000	0.000	0.000
Level effect		0.000	0.000	0.000	0.000	0.000	0.000	0.000
Linear		0.390	0.605	0.002	0.053	0.410	0.599	0.943
Quadratic		0.657	0.625	0.004	0.156	0.708	0.839	0.983
Cubic		0.029	0.431	0.013	0.039	0.052	0.038	0.064

^{abcde} Means along the same column with different superscripts are significantly different (P < 0.05).

P * < 0.05 Probability^a for Linear, Quadratic and Cubic

SEM- Standard Error of Mean

Rabbits fed diet containing Moringa oleifera, Aspilia africana and Azadirachta indica leaf meals

Table4: Effect of the dietary leaf meals and levels of inclusion on blood indices of grower rabbits

Forage	Haematological Parameters					Serum Biochemistry Parameters				
	Level (%)	PCV (%)	HB (g/dl)	WBC (x103/μl)	RBC (x106/μl)	TSP (g/dl)	ALBUMIN (g/dl)	GLOBULIN (g/dl)	CREATININE (g/dl)	UREA (g/dl)
<i>Moringa oleifera</i>	0	36.88 ^b	12.35 ^b	4.17 ^d	6.57 ^b	7.40 ^{ab}	4.00 ^{abc}	3.40 ^b	1.07 ^b	41.00 ^a
	15	39.49 ^a	13.10 ^a	3.37 ^f	7.01 ^a	6.10 ^c	3.90 ^{abc}	2.20 ^e	1.03 ^b	33.20 ^d
	30	34.03 ^c	13.07 ^a	3.60 ^e	7.03 ^a	5.80 ^f	3.77 ^{bc}	2.03 ^f	0.90 ^e	30.37 ^e
<i>Azadirachta Indica</i>	0	36.89 ^b	12.36 ^b	4.18 ^d	6.56 ^b	7.40 ^{ab}	5.00 ^a	2.40 ^d	1.06 ^b	40.00 ^a
	15	32.67 ^d	10.88 ^f	8.30 ^a	6.27 ^d	6.27 ^d	4.17 ^{ab}	2.10 ^f	1.03 ^b	34.13 ^d
	30	36.00 ^b	12.21 ^c	8.40 ^a	6.40 ^c	7.03 ^c	4.20 ^{ab}	2.83 ^c	1.03 ^b	36.87 ^b
<i>Aspilia Africana</i>	0	36.87 ^b	12.34 ^b	4.16 ^d	6.58 ^b	7.50 ^a	4.00 ^{abc}	3.50 ^a	1.08 ^b	41.00 ^a
	15	33.98 ^c	11.35 ^e	7.10 ^b	6.12 ^c	6.97 ^c	4.17 ^{ab}	2.80 ^c	1.17 ^a	33.23 ^d
	30	36.00 ^b	11.95 ^d	6.40 ^c	6.40 ^c	5.60 ^g	4.03 ^{abc}	1.57 ^g	1.20 ^a	35.30 ^e
SEM	0.27	0.02	0.04	0.02	0.02	0.04	0.33	0.03	0.02	0.33
Forage effect	0.000	0.000	0.000	0.000	0.000	0.000	0.058	0.000	0.000	0.000
Level effect	0.181	0.098	0.032	0.591	0.000	0.000	0.964	0.001	0.737	0.000
Linear	0.088	0.004	0.002	0.000	0.000	0.651	0.658	0.451	0.001	0.789
Quadratic	0.063	0.014	0.003	0.001	0.001	0.598	0.768	0.756	0.000	0.908
Cubic	0.144	0.012	0.004	0.000	0.000	0.000	0.572	0.000	0.000	0.032

able Means, above the same column with different superscripts are significantly different (P < 0.05).

^{abcde} Means along the same column with different superscripts are significantly different (P < 0.05).

P < 0.05 Probability^a for Linear, Quadratic and Cubic

SEM- Standard Error of Mean

HB- Haemoglobin

RBC- Red Blood Cell

WBC- White Blood Cell

TSP- Total Serum protein

PCV- Packed Cell Volume

Table 5: Effect of the dietary leaf meals and levels of inclusion on the performance characteristics of grower rabbits

Forage	Level (%)	AIW (g)	AFW (g)	Slaughtered Weight (g)	Carcass weight (g)	Dressing (%)	Head (g)	Forelimb (g)	hind limb (g)	Neck (g)	Loin (g)	Shoulder (g)
<i>Moringa oleifera</i>	0	516.67	1300.00 ^f	1101.3 ^c	674.67 ^e	51.97 ^f	103.10 ^c	111.39 ^{ab}	145.23 ^d	37.53 ^{ab}	148.39 ^c	157.11 ^{ab}
	15	516.42	1445.00 ^b	1219.7 ^b	884.33 ^{ab}	61.41 ^{ab}	108.55 ^b	125.83 ^a	161.46 ^c	40.57 ^a	169.72 ^c	189.70 ^a
	30	516.67	1475.87 ^a	1224.3 ^a	902.64 ^a	61.58 ^a	102.95 ^d	126.39 ^a	161.94 ^c	32.75 ^b	194.20 ^a	193.05 ^a
<i>Azadirachta indica</i>	0	516.42	1298.00 ^f	1067.0 ^f	669.67 ^e	51.78 ^f	111.98 ^{ab}	111.95 ^{ab}	143.59 ^c	40.52 ^a	145.33 ^f	157.15 ^{ab}
	15	516.67	1398.33 ^d	1047.7 ^b	833.33 ^c	59.59 ^c	100.30 ^e	122.64 ^{ab}	174.23 ^a	30.33 ^c	177.53 ^b	131.03 ^{bc}
	30	516.67	1383.00 ^e	993.3 ^b	765.00 ^d	55.31 ^e	95.87 ^f	116.56 ^{ab}	143.26 ^c	30.50 ^c	121.74 ^g	121.90 ^{bc}
<i>Aspilia Africana</i>	0	516.67	1297.00 ^f	1116.3 ^d	680.00 ^e	51.99 ^f	111.35 ^{ab}	111.40 ^{ab}	145.26 ^d	40.27 ^a	149.00 ^d	157.24 ^{ab}
	15	516.67	1411.67 ^c	1158.0 ^c	843.33 ^b	59.76 ^b	102.49 ^d	121.45 ^{ab}	173.62 ^{ab}	37.87 ^{ab}	187.57 ^{ab}	99.43 ^c
	30	516.42	1383.33 ^e	1048.0 ^g	786.00 ^d	56.86 ^d	115.78 ^a	84.03 ^b	166.66 ^b	34.67 ^b	170.07 ^c	102.80 ^c
SEM		0.38	1.23	0.34	2.02	0.03	0.03	12.04	0.01	0.02	0.62	14.11
Forage effect		0.999	0.000	0.000	0.000	0.000	0.000	0.371	0.000	0.000	0.000	0.001
Level effect		0.910	0.000	0.282	0.000	0.000	0.196	0.535	0.000	0.000	0.008	0.066
Linear		0.923	0.941	0.451	0.700	0.706	0.042	0.690	0.793	0.892	0.110	0.001
Quadratic		0.927	0.937	0.756	0.708	0.664	0.083	0.624	0.107	0.283	0.002	0.022
Cubic		0.943	0.069	0.000	0.099	0.181	0.081	0.285	0.215	0.139	0.001	0.023

^{abcde} Means along the same column with different superscripts are significantly different (P < 0.05)

P < 0.05 Probability² for Linear, Quadratic and Cubic

SEM- Standard Error of Mean

AIW- Average Initial Weight

AFW- Average Final Weight

30% *A. indica* leaf meal 121.74 g. Rabbits fed 15% and 30% inclusion levels of *M. oleifera* leaf meal 189.70 g and 193.05 g respectively had highest (L: Q: C: $P < 0.05$) value for shoulder weight while the inclusion level of *A. indica* leaf meal at 30% obtained the least (L: Q: C: $P < 0.05$) value 121.90 g.

Discussion

The performance characteristics of rabbits fed the dietary treatments as influenced by the levels of inclusion of the leaf meals shown in Table 2 revealed that the parameters measured were significantly ($P < 0.05$) affected. The animals had similar body weight at the start of the experiment. Rabbits fed 30% MOM had the higher final weight than their counterparts fed control and 30% AAM and AIM diets.

The increased weight gain observed in treatment 3 with rabbits fed 30% MOM could be attributed to the high crude protein content of the leaf compared to the control diet and other treatment groups. The increase in fibre level resulted to a decrease in body weight gain.

However, the reduced weight gain of rabbits fed *A. africana* and *A. indica* leaf meals agreed with the findings of Olabode *et al.* (2013). Ogbuewu *et al.* (2010) also reported a reduction in growth rate of rabbits fed neem leaves. Poor weight gain observed in 30% AAM and AIM compared to 30% MOM could be due to the presence of secondary metabolite observed in the leaves. The feed conversion ratio decreased with a decrease in daily feed intake. Poor FCR obtained could be a reflection of the poor feed quality and utilization of the diet. The findings of Esonu *et al.* (2006); Ogbuewu *et al.* (2010); Obikaonu *et al.* (2012) revealed that 15% AIM is the tolerance level for laying birds and adult rabbits. The values were similar

to the findings of Sese *et al.* (2013) with value of 4.39- 6.44g when weaner rabbits were fed *Mucuna utilis* leaf meal but were generally, higher than the report of 2.24-2.53g by Olabode *et al.* (2013).

High nitrogen intake and nitrogen retention obtained in this study at 30% MOM could be attributed to high digestibility of the nutrients in the dietary treatments. McDonald *et al.* (1993) reported that the dietary nitrogen intake by animals is related to the proportion of nitrogen in the feed. Nitrogen could not be stored within the body system of animals; excessive intake of nitrogen above optimum requirement will result in wastage as accumulation of gas in the rumen result in belching or eructation. The values for faecal and urinary nitrogen in this study 1.85-2.32% and 0.82-1.23% were generally higher than 0.41-0.64% and 0.14-0.39% reported by Asaolu *et al.* (2011).

Aro *et al.* (2013) stated that haematological components, which consists of red blood cells, white blood cells or leucocytes, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration are valuable in monitoring feed toxicity, especially, with feed constituents that affect the blood as well as the health status of livestock and even humans. The PCV values (%) for the treatment groups were below normal range for healthy growing rabbits (32.67-39.49) though significant differences ($P < 0.05$) existed among treatment groups. Values obtained shows that the feed were nutritionally adequate for the growing rabbits. Reduction in the concentration of PCV in the blood usually suggests the presence of a toxic factor (e.g. Haemagglutinin) which has adverse effect on blood formation (Oyawoye and Ogunkunle, 1998). Lower PCV and Hb value obtained at 15% AIM is as a result of genetic differences in the animals. 15% and 30% AIM had the highest WBC. High white

blood cell count is usually associated with microbial infection or the presence of foreign bodies or antigens in the circulating system (Ahamefule *et al.*, 2008). Similarities also exist between the red blood cell counts. Increase in Red blood cell counts were associated with high quality protein and disease free animal.

Furthermore, Total protein (g/dl) has been reported as an indication of the protein retained in the animal body (Akintola and Abiola, 1999; Esonu *et al.*, 2001). The values fell within the range (5.4-7.5) for rabbits. The presence of increased blood urea in this study shows that the animal might be in a state of negative nitrogen balance. This could be attributed to the presence of some bioactive compounds contained in the diet. Eggum (1970) reported that blood urea levels are associated with poor protein quality or excess tissue associated with protein deficiency (Oduye and Adaderoh, 1976). The presence of increasing urea and creatinine concentration in the blood is used in the evaluation of the effects of chemicals on the kidney (Davis and Berndt, 1994).

The slaughtered weight values of 993.3-1224g in this study were generally lower than the 1290.33-1530.33g ; 1200-1425g ; 1809-2281g reported by (Nuhu, 2010; Bolarin *et al.*, 2013 ; EL-Badawi *et al.*, 2014) respectively but were similar to the report of 988.24-1335.00 g by Biya *et al.*(2008) and higher than 849.00-877.00 g by Ogbuewu *et al.* (2010). The lower slaughtered weight observed in this study is probably because of lower feed intake by the rabbits. The inclusion level of *M. oleifera* leaf meal (MOM) at 30% in this study had highest slaughtered weight value and was superior to the control diet and 30% AAM and AIM. Higher slaughtered weight of rabbits fed control diet over those

on 15% and 30% inclusion of AIM showed the superiority of the diet over 15% and 30% inclusion levels. The dressing percentage values obtained from the present study were higher than 46.51-52.27 g reported by Biya *et al.* (2008) but lower than those reported by Bolarin *et al.* (2013) and 62.96-65.55 g observed by EL- Badawi *et al.* (2014). However, the values were similar to the observations of 51.59-53.50% reported by Ogbuewu *et al.* (2010).

It was observed that there were variations in the retail part across the dietary treatments. Lebas (1991) however, reported that variation in nutritional plane of growing rabbits might modify the anatomical equilibrium and chemical composition of carcass tissue. Fanimu *et al.* (2003) also reported that forelimb, hind limb, and loin are the most economically important portion of carcass because they provide the greatest portion of edible meat.

Conclusion and Recommendations

From this study it was observed that for optimum performance of rabbit, 15% and 30% inclusion level of *M. oleifera* should be fed for good performance of the rabbits. This study also confirms the safety of *Aspilia africana* leaf meal and Neem leaf meal in feeding rabbit. It could be tolerated at 15% inclusion level for rabbit to obtain the highest value of live body weight, enhancing feed intake, and improved feed conversion ratio without any detrimental effects on blood parameters.

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