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Evaluation of Raw Baobab Seed (*Adanosonia digitata*) Meal on the Performance of Weaned Rabbits

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Authors' contributions

This work was carried out in collaboration between all authors. Author AIA designed the coordinated the collection of data. Author RJW performed the analysis, wrote the protocol and the first draft on the manuscript. Author SZY managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study evaluates the effect of raw baobab seed meal (RBSM) on the performance of 40 weaned rabbits with an average weight of 683.00 ± 0.12 g. The rabbits were randomly allotted to four diets with five replicates in a completely randomized design containing 0%, 10%, 20% and 30% raw baobab seed meal (RBSM). Data were collected on growth performance, nutrient digestibility, carcass characteristics and haematological indices. The results of growth performance showed that the final body weight and total body weight gain of weaned rabbits fed 0% (T1), 10% (T2) and 20% (T3) RBSM were similar (P>0.05). However, the rabbits fed 30% (T4) RBSM recorded significantly lower (P<0.05) final body weight and total body weight gain. The feed intake decreased (P<0.05) beyond 20% (T3). The carcass characteristics and internal weight of organs followed similar trend. The nutrient digestibility was (P<0.05) influenced by inclusion levels of

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RBSM. Dry matter (DM) digestibility was significantly higher (67.20%) in T1 (0%) while the lowest value (55.40%) was observed in T4 (55.40). Crude protein (CP) digestibility ranges from 64.37 to 55.39% while the ether extracts (EE) was between 70.54 to 69.03%. The digestibility values for crude fiber (CF) and nitrogen free extract (NFE) ranges from 67.77 to 55.94 and 65.89 to 59.03%, respectively. The RBSM at 10% to 20% in the diet was found the best inclusion rate for rabbits.

Keywords: Performance; raw baobab seed; nutrient digestibility; carcass.

1. INTRODUCTION

In Nigeria, rabbits provide part of the proteins required in the diet and also serve as a ready source of cash for smallholder farmers [1]. Despite the importance of rabbits to the Nigeria population, its production is affected by cost and inadequate supply of feed most especially the conventional feedstuffs such as protein and energy sources. Therefore, research on cheaper and locally available feedstuffs is important. One of such alternative non-conventional feedstuffs is *Adanosonia digitata* seed (Baobab seed). *A. digitata* known as Baobab is a well-adapted deciduous tree native to the arid parts of Central Africa and widely spread in the savannah regions in Nigeria [2]. Its leaves, bark and fruit are used as food and medicinal purposes. In the Sahel, for example, baobab leaf is used in preparing soup called “miyan kuka” among Hausa speaking communities in Nigeria. The seed has a relatively thick shell which is not readily separated from the kernel. The kernel is edible but the difficulties of decorticating seem to have limited its use as food and consequently large quantities go into waste. The seed contains crude protein of 20% to 36%, energy of 1,898 kcal/kg to 4,465 kcal/kg and also contains vitamins, minerals and amino acids, particularly lysine and methionine which are limited in most tropical seeds [3]. Although, few studies were conducted on the effect of Baobab seed meal on poultry performance [4,5], there is paucity of information on the effect of Baobab seed meal on performance, carcass attributes and blood profile of weaned rabbits. Hence, this paper determines the effect of baobab seed meal on the growth performance, carcass characteristics, haematological and biochemical indices of weaned rabbits.

2. MATERIALS AND METHODS

2.1 Experimental Site

The study was conducted at the Rabbit Unit of Teaching and Research Farm of the Department of Animal Science and Range Management, Modibbo Adama University of Technology Yola from October to December 2016. Yola lies between latitude 7° and 11°N and longitude 11° and 14°E. The maximum temperature in the state can reach up to 40°C particularly on April while minimum temperature can be as low as 18°C from December to January [6].

2.2 Processing of Baobab Seed

Baobab seeds were procured, cleaned and milled using 2 mm sieve hammer milling machine then tagged as raw baobab seed meal (RBSM).

2.3 Experimental Diets, Design and Management

The experimental diets were compounded using RBSM at 0%, 10%, 20% and 30% inclusion levels. These levels were designated as T1, T2, T3 and T4 respectively as shown in Table 1.

Forty (40) weaned rabbits were purchased from the National Veterinary Research Institute (N.V.R.I) Vom, Plateau State, Nigeria. The rabbits, 5 to 6 weeks old with an average weight of 683±0.12 g were randomly assigned to the five dietary treatments consisting of 10 rabbits per treatment (2 per replicate) in CRD. Each rabbit was housed individually in a hutch measuring 60×50×45 cm fitted feed and water containers.

Prior to the experiment, hutches were thoroughly disinfected with Diazintol® and were allowed to dry. Each animal was dewormed using Piperazine®; Antibiotics and coccidiostats were also administered against bacterial infection and coccidial infections. The rabbits were fed twice daily in the morning 7.00 am and evening 4.00 pm as described [7]. Water was made available all the times.

2.4 Data Collection

Feed intake was determined as the difference between feed offered and feed left over. Rabbits were weighed weekly to determine weekly weight gain. Feed intake and weight recorded were used to calculate feed conversion ratio (FCR).

2.5 Carcass and Organs Weight Determination

Four rabbits from each treatment were randomly selected at the 8^{th} week to determine the effect of RBSM on carcass and internal organs weight. The rabbits were processed to obtain the carcass weight; internal organs were weighed and expressed in percentage live weight. Dressing percent was determined as

$$\text{Dressing percentage (D \%)} \quad \frac{\textit{Dressed weight}}{\textit{Live weight}}\ x\ 100$$

2.6 Haematological and Biochemical Indices

On the last day of the experiment, blood samples were collected from four rabbits per treatment for determination of haematology and serum biochemical parameters. The blood samples amounting 5mls were collected from the ear vein using a disposable needle and syringe into specimen test tubes containing EDTA as anticoagulant for haematological parameters (packed cell volume, red blood cells, heamoglobin concentration, white blood cells. The erythrocytic component; mean corpuscular volume (MCV), mean corpuscular heamoglobin (MCH) and mean corpuscular heamoglobin concentration (MCHC) were determined using the formula as described [8]. Another 5ml were placed in test tubes without anticoagulant to determine the serological parameters (total protein, albumin, urea, cholesterol, globulin).

2.7 Digestibility Study

At week 7^{th} of the experiment, fecal samples from each replicate were collected for five days bulked and sun-dried. The fecal samples were milled before chemical analysis. The proximate composition of the experimental diets and the fecal samples were analyzed for dry matter, crude protein, crude fibre, Ash, ether extracts as described [9]. The digestibility values were calculated as nutrient intake minus nutrient excreted divided by nutrient intake multiplied by hundred.

2.8 Statistical Analysis

All data obtained during the experiment were subjected to Analysis of Variance (ANOVA) [10]. Means were separated using Duncan Multiple Range Test [11].

Table 1. Ingredient composition of experimental diets for weaned rabbits

Ingredients	**Dietary treatments**			
	T1	**T2**	**T3**	**T4**
Maize	45.00	42.30	39.60	36.90
Soybean	23.00	15.70	8.40	1.10
RBSM	0.00	10.00	20.00	30.00
Ground haulms	10.00	10.00	10.00	10.00
Wheat offal	18.50	18.50	18.50	18.50
Fishmeal	1.25	1.25	1.25	1.25
Bone meal	1.50	1.50	1.50	1.50
Premix*	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Total	100	100	100	100
Determined analysis (%)				
Dry matter	89.75	89.03	89.25	89.67
Crude protein	19.06	18.46	18.25	18.15
Crude fibre	8.10	8.20	8.10	8.20
Ether extracts	5.20	4.60	4.50	4.70
NFE	61.44	63.66	64.11	63.94
ME(Kcal/Kg)	3307.54	3315.55	3315.65	3322.12

**Vitamin-mineral premix provider per kg the following: Vit. A 1500 IU; Vit.D_3 3000 IU; Vit.E 30 IU; Vit.K 2.5 mg; Thiamine B_1 3 mg; Riboflavin B_2 6 mg; Pyrodoxine B_6 4 mg; Niacin 40 mg; Vit. B_{12} 0.02 mg; Pantothenic acid 10 mg; Folic acid 1 mg; Biotin 0.08 mg; Chloride 0.125 mg; Mn 0.0956 g; Antioxidant 0.125 g; Fe 0.024 g; Cu 0.006 g; 10.0014 g; Se 0.24 g; Co 0.240 g*

3. RESULTS AND DISCUSSION

3.1 The Proximate Compositions of Raw Baobab Seed Meal

The proximate composition of baobab seed meal is shown in Table 2. The meal contains 21.36% crude protein, 12.29% ether extracts, 6.04% crude fiber and nitrogen free extracts of 55.97%.

Table 2. Proximate analysis and anti-nutritional composition of raw baobab seed meal

Nutrient	Percentage composition
Dry matter	92.02
Crude protein	21.36
Crude fibre	6.04
Ether extracts	12.29
Ash	4.34
Nitrogen free extracts	55.97
ME(Kcal/Kg)	3772.74
Anti -nutritional factors	
Oxalate	11.36
Phytate	6.28
Trypsin inhibitor	5.90
Saponin	7.00
Tannin	3.00

Metabolizable Energy = ME (kcal/kg) = 37 x % CP + 81 x % EE + 35.5 x % NFE.
Calculated according to the formula of [14]

The crude protein content of RBSM observed in this study was similar to 21.75% reported in [4] but higher than 18.4% and 11.2% as reported in [12,13], respectively. The ether extracts of 12.29% was comparable with 12.20% reported in [12] and 12.70 reported in [4]. The crude fibre content (6.04%) was lower than 16.20% reported in [12] but similar to the value of 6.71% [4]. These differences in nutrient composition can be attributed to soil, climate, method of analysis, processing methods and strain [12].

The results of anti-nutritional factors revealed that trypsin inhibitor level of 6.20% was higher than (5.7%) in [12]. Trypsin inhibitor was implied to be one of the factors responsible for growth suppression and pancreatic hypertrophy in the experimental animals [7]. The tannin content was higher than 2.30% reported in [13] and 2.82% in [4]. Furthermore, the value of Phytate observed was higher than the 2.00% reported in [4] but lower than 7.3% in [12]. Saponin content was similar to the value of 7.16% reported in [4].

3.2 The Performance of Weaned Rabbit Fed Raw Baobab Seed Meal

The performance of weaned rabbit fed raw baobab seed meal (RBSM) is shown in Table 3. The final body weight and total body weight gain of weaned rabbits fed T2 and T3 diets were not significantly different (P>0.05) from that of T1. However, rabbits fed T4 diet recorded significantly lower (P<0.05) final body weight and total body weight gain.

The feed intake was affected by inclusion of baobab seed meal in the diets. There was significant decrease in feed intake beyond T3 diet. The feed conversion of weaned rabbit fed T2 and T3 diets was similar to that of the control diet (T1). However, poor feed conversion ratio was observed on weaned rabbits fed T4 diet indicating poor utilization of the meal.

The similarity in final body weight and total body weight gain of weaned rabbits fed T2 and T4 diets is an indication that weaned rabbit can tolerate up to 20% inclusion of RBSM without any adverse effect on the growth performance. This finding disagreed with earlier report of [15] who reported decreased in final weight and weight gain of rabbits fed raw baobab seed meal beyond 10% inclusion. Variation in the performances could be due to differences in the concentration of anti- nutrient in the seed. Climatic factors, strain and storage of baobab seed were reported to affect the nutrient and chemical composition of seed meal [13]. However, depressed feed intake and poor FCR observed on weaned rabbit fed T4 diet lead to the inability of the rabbit to tolerate the high level of inclusion. Odunsi et al. [16], reported that at high inclusion levels of unconventional feed stuffs may alter the texture, colour, taste and odour of diets, therefore feed consumption will ultimately be affected by one of the above factors independently or in combination. The depression in feed intake observed on rabbit fed T4 diet could be due high concentration of anti-nutritional factors (Table 2) as a result of high inclusion of RBSM (30%) T4. Anti-nutritional factors have reported to impaired feed utilization, depressed growth and pancreatic hypertrophy in the experimental animals [7].

3.3 The Nutrient Digestibility by the Weaned Rabbits Fed raw Baobab Seed Meal

The nutrient digestibility of the weaned rabbits fed RBSM is shown in Table 4. The digestibility of dry matter, crude protein (CF), crude fibre (CF), ether extract (EE) and nitrogen free extract (NFE) were similar (P<0.05) in weaned rabbits fed T2, T3 and T1 diets. However, rabbit fed T4 diet recorded significant decreased in DM, CF, CF, EE and NFE. The values for DM, CP, EE and CF obtained in this study were lower than the values reported in [17]. This could possibly be due to differences in the type and nutrient composition of diets [18].

3.4 Carcass Characteristics and Internal Organ Weight

Table 5 shows the carcass characteristics and internal organ weight of the rabbits fed RBSM. Live weight and dressing percent of the rabbits fed T1, T2 and T3 diets were similar (P<0.05) and higher (P<0.05) than those fed T4. The poor carcass quality of weaned rabbits on T4 diet compared to the other inclusion levels could be attributed to the impaired nutrients utilization from the diets as a result of the effects of anti-nutritive factors. [19,20] reported that nutrition exert several influences on the development of carcass trait, organs and muscular growth of an animal. Internal weight organs (kidneys, liver, heart, spleen and lung weights) showed significant (P<0.05) variation across the inclusion levels. The significantly (P<0.05) large liver and kidney of weaned rabbit fed T4 could be due to the anti-nutritional factors. Increase in weight of liver and kidney were observed in experimental animals as a result of increased metabolic rate of these organs in an attempt to reduce toxic elements or to convert the anti-nutritional agents to non-toxic metabolites [21].

3.5 Haematological and Biochemical Indices of Weaned Rabbit fed RBSM

The results of haematological and biochemical indices are shown in Table 6. The haematological indices studied were significantly (P<0.05) influenced by inclusion levels. Packed cell volume (PCV), white blood cell (WBC) and mean corpuscular haemoglobin concentration (MCHC) of weaned rabbits fed T1,T2 and T3 diets were significantly similar but significantly lower (P<0.05) than those fed T4 diet. Total protein (TP) was significant different (P<0.05) among inclusion levels. TP of weaned rabbits fed T1, T2 and T3 diets were similar (P<0.5) but significantly (P<0.05) higher than those fed T4 diet. Albumin of weaned rabbits fed T4 was significantly different (P<0.05) from rabbits fed T1, T2 and T3 diets. The globulin and urea were significantly different (P<0.05). Weaned rabbits fed T4 diet recorded higher values of globulin (g/dL) globulin and urea (g/dL). Glucose levels of weaned rabbits fed T1, T2 and T3 diets were not significantly different (P<0.05) from each other.

Haematological and biochemical indices are reflection of the effects of dietary treatments on the animal in terms of the type, quality and amounts of the feed ingested and available for the animal to meet physiological, biochemical and metabolic processes [22]. The PCV and Hb values obtained in weaned rabbits fed T1 to T3 were within range of 30-50% PCV and 8.0-17.5 g/dL for normal physiological function reported by [23,24]. Lower values of PCV and Hb recorded in T4 (30%) could be attributed to effects of the anti- nutritive factors on the blood profile these blood profile. The total protein values observed in this study was within the normal range 5.5 -8.0 g/L of healthy rabbits reported by [25,26] expect for T4 diet which was below the normal range. The low level of total protein observed on weaned rabbits fed T4 diet suggested some alteration in protein metabolism.

Table 3. Growth performance of weaned rabbit fed raw baobab seed meal

Parameters	Dietary treatments				
	T1	T2	T3	T4	SEM
Initial body weight (g)	682.67	683.67	680.45	681.60	6.80^{ns}
Final body weight (g)	1898.50^{a}	1845.78^{a}	1812.67^{a}	1633.50^{b}	17.90*
Total body weight gain (g)	1215.83^{a}	1162.11^{a}	1132.22^{a}	951.90^{b}	11.16*
Average daily body weight gain (g)	21.71^{a}	20.75^{a}	20.21^{a}	16.99^{b}	0.79*
Total feed intake (g)	2740.00^{a}	2628.10^{a}	2563.60^{ab}	2178.98^{b}	24.77*
Average daily feed intake (g)	48.92^{a}	46.93^{a}	45.77^{a}	38.91^{b}	0.44*
Feed conversion ratio	2.25^{a}	2.26^{a}	2.26^{a}	2.28^{b}	0.02*

Means in the same row bearing different superscripts differ significantly (P<0.05),
**=Significantly different (P<0.05), SEM = Standard error mean*

Table 4. Nutrient digestibility of weaned rabbits fed RBSM

Parameters	Dietary treatments				
	T_1	T_2	T_3	T_4	SEM
Dry matter	67.20^a	64.34^a	64.60^a	55.40^b	0.62^*
Crude protein	64.37^a	63.56^a	63.48^a	55.39^b	0.62^*
Ether extracts	70.54^a	70.10^a	70.03^a	69.03^b	0.69^*
Crude fibre	67.77a	67.56^a	66.60^a	55.94^b	0.64^*
NFE	65.89^a	66.70^a	66.60^b	59.03^b	0.65^*

Means in the same row bearing different superscripts differ significantly (P<0.05)
**=Significantly different (P<0.05), SEM = Standard error mean, NFE = Nitrogen free extracts*

Table 5. Effects of raw baobab Seed meal on carcass characteristics and internal organs of weaned rabbit

Parameters	Dietary treatments				
	T_1	T_2	T_3	T_4	SEM
Live weight (g)	1824.51^a	1818.68^a	1808.56^a	1601.20^a	17.63^*
Carcass weight (g)	1340.00^a	1332.90^a	1328.73^a	1185.63^b	12.96^*
Dressed weight (g)	979.10^a	962.07^a	984.93^a	749.06^b	9.18^*
Dressing (%)	53.65^a	53.19^a	54.45^a	46.78^b	0.52^*
Internal weight organ (% live weight)					
Liver weight	0.82^d	1.02^c	2.48^b	3.55^a	1.96^*
Heart weight	0.22^b	0.88^b	1.06^a	1.89^a	0.01^*
Lungs weight	0.88^b	0.98^b	1.47^a	1.93^a	0.01^*
Kidney weight	0.97^b	1.89^b	2.84^a	3.92^a	0.02^*
Spleen weight	0.75^b	0.85^b	0.87^b	1.70^a	0.01^*

Means in the same row bearing different superscripts differ significantly (P<0.05)
**=Significantly different (P<0.05), SEM = Standard error mean*

Table 6. Haematological and biochemical indices of weaned rabbits fed raw baobab seed meal

Parameters	Dietary treatments				
	T1	T2	T3	T4	SEM
PCV (m/%)	30.01^b	32.36^b	32.86^b	44.40^a	0.34^*
Haemoglobin (g/dl)	15.43^a	15.40^a	15.33^a	8.86^b	0.13^*
MCHC (%)	29.96^d	36.45^a	33.30^b	35.10^a	0.33^*
WBC ($\times10^6$/mm^3)	7.14^b	7.32^b	7.56^b	8.54^a	0.07^*
Cholesterol (mg/dl)	30.70^a	27.37^b	28.50^b	25.50^c	0.28^*
Total protein (g/dl)	6.30^a	6.73^a	6.83^a	4.94^b	0.06^*
Albumin (g/dl)	3.30^b	3.40^b	3.54^b	2.16^b	0.03^*
Globulin (g/dl)	2.45^b	2.47^b	2.60^b	3.67^a	0.02^*

*Means in the same row bearing different superscripts differ significantly (P<0.05). *= significantly different (P<0.05), WBC= While blood cell. MCHC= Mean corpuscular haemoglobin concentration SEM= Standard error, PCV= Packed cell volume RBC=Red blood cell*

Iyayi and Tewe [27] reported that serum protein and albumin syntheses are related to the amount of available protein in the diet of animal. This implied that anti- nutritional factors have inhibited protein metabolism which could have resulted poor in protein absorption and utilization from the gastro-intestinal tract of the animals [28]. The higher level of globulin in weaned rabbit fed T4 diet could be corresponding response of its body defense mechanism to combat the effects of anti-nutritional factors in diet. The cholesterol levels were within the normal range of 20-83mmol/L reported by [25]. Weaned rabbits fed T4 diet had the lowest value (25.50 mg/dL). The decreased in cholesterol as the levels RBSM increases, it is evident that anti-nutritional factors in the RBSM has cholesterol depressing effects. Tannin has been reported to have cholesterol lowering ability [29,7].

4. CONCLUSION

It could be concluded that RBSM can be included up to 20% in weaned rabbits' diet without adverse effect on the growth performance, blood parameters, carcass and internal organs characteristics.

ETHICAL CONSIDERATION

The study was conducted with permission from the animal welfare and ethics committee of Department of Animal Science and Range Management, Modibbo Adama University of Technology Yola Adamawa State Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Nworgu FC, Egbunike GN, Osayomi OJ. Performance of growing rabbit fed a mixture of leaf meals and concentrates. Tropical Animal Production Investigation. 2001;4:37-4.
2. FAO. Traditional Food Plants. Food and agricultural organization (FAO/UN). Rome Food and Nutrition Paper. 1988;42.
3. Murray SS, Schoeninger MJ, Bunn HT, Pickering TR, Marlett JA. Nutritional composition of some wild plant foods and honey used by Hadza Foragers of Tanzania. J. Food Comp. Anal. 2001;13:1-11.
4. Nkafamiya II, Osemeahon SA, Dahiru D, Umaru HA. Studies on the chemical composition and physio-chemical properties of the seeds of baobab (*Adansonia digitata*). Afr. J. Biotech. 2007; 6:756-759.
5. Mwale M, Mupangwa JF, Mapiye C, Saina H, Chimvuramahwe J. Growth performance of Guineafowl keets fed graded levels of baobab seed cake diets. Int. J. Poult. Sci. 2008;7(5):429-432.
6. Adebayo AA. Climate II: In Adamawa state in maps. Ed. A. A. Adebayo and L. Tukur. Paraclete publishers. Yola Nigeria. 1999; 11-23.
7. Yakubu B, Wafar RJ. Effects of processing methods of *Leptadenia hastate* on growth performance, nutrient digestibility and carcass characteristics of weaner rabbits. IOSR J. Agric. & Veterinary Sci. (IOSR-JAVS). 2014;7(I&II):53-58.
8. Jenkins JR. Rabbits. In: Jenkins, JR. and Brown, SA. (ed.) Practioner's guide to rabbits and ferrets. American Animal Hospital Association, Lake wood, U.S.A. 1993;1-42.
9. AOAC. Official methods of analysis. 19th Edn, Assoication of official Analytical chemists, Washington D.C U.S.A; 2010.
10. Steel RGD, Torrie JH. Principles of procedures of statistics. A biometric approach. 2nd ed. McGraws-Hill Book co; 1980.
11. Duncan DB. Multiple range and multiple F-test. Biometrics. 1955;11:1-42.
12. Magdi AO. Chemical and nutrient analysis of baobab (*Adansonia digitata*) fruit and seed protein solubility. Plant Foods for Human Nutrition. 2004;59:29–33.
13. Heuzé V, Tran G, Bastianelli D, Archimède H. African baobab (*Adansonia digitata*). Feedipedia. org A programme by INRA, CIRAD, AFZ and FAO. 2013; [Online]. Available:http://www.feedipedia.org/node/525
14. Pauzenga U. Feeding parent stock. Zootech characteristics of weanling rabbits fed graded levels International. 1985;34: 22-25.
15. Oladunjoye IO. Akinlade M, Lawal Z, Performance Z. Digestibility, carcass and blood profile of grower rabbits fed baobab (*Adansonia digitata*) pulp and seed meal. Indian Journal of Fundamental and Applied Life Sciences. 2014;4(2):234-240.
16. Odunsi AA, Farinu GO, Akinoloa JO. Influence of dietary wild sunflower (*Tithoniadiversifolia Helms A. Gray)* leaf meal on layers performance and egg quality. Nigerian Journal of Animal Production. 1996;23:28-32.
17. Amaefule KU. Mbagwu II, Iyang NE. Performance, nutrient utilization and intestinal environment of weaned rabbits fed diets supplemented with organic acid in the humid Tropics. Nigerian Journal of Animal Science. 2011;13:69-79.
18. Iyegbe-Erakpotobor GT, Adeyinka IA, Oyedipe EO, Edovie IO. Effects of flushing on body weight changes, nutrient digestibility and litter size of nulliparous does. Tropical Journal of Animal Science. 2005;8(2):49-55.
19. Schrews FJG. Post mortem changes in chicken muscle. World Poultry Science Journal. 2000;53:319-346.
20. Mathew UD, Tegbe TSB, Omaji JJ, Adeyinka IA. The effects of duration of cooking pigeon pea, (*Cajanus cajan*) seeds on the performance and carcass characteristics of broiler chicks. Nigeria Journal of Animal Production. 2010;37: 13–24.

21. Bone FJ. Anatomy and physiology of farm animals. 2nd Edn., Reston Publishing Comp, Inc Virginia, USA. 1979;560.
22. Ewuola EO, Folayan OA, Gbore FA, Adebunmi AI, Akanji RA, Ogunlade JT, Adeneye JA. Physiological response of growing West African Dwarf goats fed groundnut shell-based diets as the concentrate supplements. Bowen J. Agric. 2004;1(1):61-69.
23. Jenkins, JR. Rabbits. In: Jenkins JR, Brown SA. (ed.) Practioner's guide to rabbits and ferrets. American Animal Hospital Association, Lake wood, U.S.A. 1993;1-42.
24. Hillyer EV. Rabbits. Small Anim Pract. 1994;24:25-65.
25. Mitruka BM, Rawnsley HM. Clinical Biochemical and haematological reference values in normal experimental animals. Masson Pub. USA Inc., N.Y. 1977;21-84.
26. Benerjee GC. A text book of animals husbandry. Eight edition of forth and IBH Publishing Co PVT. Ltd New died. 1998; 132-139.
27. Iyayi EA, Tewe OO. Serum total protein, urea and creatinine levels as indices of quality of cassava diets for pigs. Trop. Vet. 1998;16,59-67.
28. Riley RT, Wang E, Schroeder JJ, Smith ER, Plattner RD, Abbas H, Yoo HS, Merrill AH evidence for disruption of sphingolipid metabolism as a contributing factor in the toxicity and the carcinogenicity of fumonisin. Nat. Toxins. 1996;4:3-15.
29. Nuhu F. Effects of moringa leaf meal (MOLM) on nutrients digestibility, growth, carcass and blood indices of weaner rabbits. M.sc thesis animal science department, Kwame Nkrumah University of Science and Technology, Kumasi; 2010.

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