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Performance and Blood Profile of Grower West African Dwarf (WAD) Bucks Fed Graded Levels of Toasted Baobab (*Adansonia digitata*) Seed Meal

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Abstract

An experiment was conducted to evaluate the performance and blood parameters of West African Dwarf (WAD) bucks fed graded levels of toasted baobab seed meal for 84 days. Baobab seeds were washed, sun-dried and toasted uniformly using a cast iron pan. The toasted baobab seeds were crushed with a roller mill grinding machine to make baobab seed meal (BSM). The BSM was included at 0%, 25%, 50% and 75% levels in diets 1, 2, 3 and 4 respectively to replace soybean. Each treatment was replicated four times in a completely randomized design. Uncoagulated blood samples were collected from WAD bucks at the end of the 84 days' feeding trial and analysed for packed cell volume (PCV), haemoglobin concentrate (Hb), red blood cells (RBC) and white blood cells (WBC). The mean corpuscular haemoglobin volume (MCV), mean corpuscular haemoglobin (MCH), platelets, neutrophils, lymphocytes, monocytes, eosinophils, and basophils were calculated using PCV, RBC and Hb. The blood meant for serological analysis was centrifuged at 1000 G for 10 minutes, after which the serum was separated and used for determining serum total protein (Tp), albumin, serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT). The inclusion of baobab seed meal up to 50% in the experimental diet did not have any negative effect on the performance of the goats and did not pose any health challenge to the animals during the study period.

Keywords

Baobab, Performance, Blood, Haematology, Biochemistry

1. Introduction

The high cost of conventional protein sources has made their incorporation in small ruminant diets uneconomical, hence the increased focus for their replacement by researchers. Use of less popular protein sources such as baobab seed has been reported to give less cost/kg weight gain [1].

Adansonia digitata (baobab tree) is a drought and fire-resistant tree that is found in most parts of Africa, including the deserts [2]. It is an indigenous leguminous plant that is cheap, readily available in the northern parts of Nigeria and its products are utilized for nutritional and medicinal purposes [3]. *Adansonia digitata* seed contains anti-nutritional factors such as oxalates (10%), phytates (2%), saponins (3% - 7%) and tannins (9% - 12%) which if not properly processed might limit its utilization in livestock feeding. These levels of the anti-nutritional factors are below the toxic level for most livestock species if properly treated [3]. While these anti-nutritional factors may not pose a challenge to ruminants because of the presence and activities of microbes in the rumen, better utilization may be achieved if the seeds are processed [1] [4].

It has been suggested that the use of different methods to process less popular feed-stuff will help to achieve their optimum benefits for ruminants [5]. Haematological indices of animals may give some insight into the performance potentials of West African Dwarf goats [6]. Nutrition, breed, sex, age, reproductive status, environmental factors, stress and transportation are known to affect haematological parameters of animals [7].

This research seeks to evaluate the effect of processing on the utilization of baobab seed meal, performance and blood profile of WAD goats.

2. Materials and Methods

2.1. Location and Climatic Conditions of the Study Area

The study was conducted on a private farm in North Bank within Makurdi metropolis of Benue State. Makurdi is located between latitude 7˚68'N and longitude 8˚62'E. The flood plain is between 106 m to 113 m above sea level, the area is warm with a minimum temperature range of 17.3˚C to 24.5˚C and a maximum temperature range of 29.8˚C to 35.6˚C. During the dry hot season between February and March, temperature may reach 40˚C, and rainfall is between 1500 mm to 1800 mm [8].

2.2. Collection and Preparation of Baobab Seeds

Adansonia digitata (baobab) seed pods were collected directly from farmers located in Amper, Kanke L.G.A in Plateau State. The baobab seed pods were crushed to remove the seeds and pulp together. The seed and pulp were soaked in water for one hour to soften the pulp and easy remove the pulp, after which the seeds were thoroughly washed and sun-dried. The dried baobab seeds were divided into two with the first part left raw. The second part was toasted using a

cast iron pan set over an open fire and stirred continuously to ensure uniform toasting and to prevent charring. When it turned dark brown, it was taken out of the pan to cool. The two different samples of the baobab seeds were then crushed separately using a burr mill to give the Baobab Seed Meal (BSM). Other ingredients used included *burkutu* spent grain, maize offal, full-fat soya bean meal, bone ash and common salt.

Fresh gmelina (*Gmelina arborea*) leaves and stalk were harvested within the experimental site and used as the basal diet.

2.3. Experimental Animals and Management

A total of sixteen grower West African dwarf bucks of 5 - 7 months of age were purchased from Makurdi metropolis and environs. The bucks were quarantined on arrival and vaccinated against *pestes des petite ruminants* (PPR). Ivermectin was administered to control both endo and ecto-parasites, before the feeding trial began.

The experimental house was a high walled building with wide windows and high roof for cross ventilation. The house was divided into pens and each pen was divided into individual compartments. The floor made of concrete was covered with wood shavings to serve as litter material and beddings. Feed troughs and drinkers were kept in each compartment which were cleaned daily and the litter materials changed forth-nightly or as the need arose to ensure good sanitation. A week to the arrival of the animals, the house was thoroughly washed with detergent and disinfectant (izal) and allowed to dry before introducing wood shavings to each compartment. The drinking troughs and feeders were also thoroughly washed and sun-dried before placing them in the individual compartments. On arrival, the animals were allowed a period of fourteen days to acclimatize to the feed and environment before data collection commenced. Thereafter, all the animals were weighed and randomly distributed into four treatments of four replicates each. The animals were subsequently weighed to determine their weight gain in each week. At the commencement of the study, weighed quantities of feeds were supplied to each animal, and the left over feeds were weighed at the end of each week and deducted from the feed supplied at the beginning of the week to determine feed intake. They were fed with concentrates at 08:00 hour and later fed with *gmelina* at 10:00 hour and 15:00 hour daily. The feeding was done at different times to reduce feed wastage and encourage intake by the animals. Mineral supplements were provided for each animal in form of mineral blocks. Fresh clean water was provided to the experimental animals *ad libitum* daily.

2.4. Experimental Diets

Four experimental diets were formulated to contain 0%, 25%, 50% and 75% toasted baobab seed meal and designated as T1, T2, T3 and T4 respectively (**Table 1**). Diet 1 (T1) was the control.

Table 1. Gross composition of experimental diets.

Experimental Diet				
Ingredients	**T1**	**T2**	**T3**	**T4**
M.O	71.49	71.49	71.49	71.49
FFSBM	20.51	15.38	10.25	5.13
BSM	0.00	5.13	10.25	15.38
BSG	5.00	5.00	5.00	5.00
Bone ash	2.00	2.00	2.00	2.00
Common Salt	1.00	1.00	1.00	1.00
	100.00	100.00	100.00	100.00
Calculated Analysis (%)				
Crude Protein	17.00	16.50	15.99	15.49
Crude Fibre	9.97	10.48	10.99	11.50
Ether Extract	5.95	6.59	7.23	7.88
Nitrogen-free Extract	67.08	66.43	65.79	65.13
Ash	3.88	3.98	4.08	4.18
ME (kcal/kg)	3463.51	3474.61	3485.69	3497.26

BSG: Burkutu spent grain; M.O: Maize offal; BSM: Baobab seed meal; FFSBM: Full fat soyabean meal; M.E: Metabolizable energy. Metabolizable energy was calculated according to the formula of Pauzenga (1989).

2.5. Performance Parameters and Blood Sample Collection

Blood samples were collected from the jugular vein of the WAD goats on the 84th day of the feeding trial in the morning before feeding using needles and syringes. Five millilitres (5 ml) of blood was collected from the jugular veins of the goats in each replication using syringes and needles, and preserved in plastic sample bottles containing ethylene diamine tetraacetic acid (EDTA) for haematological analysis. The parameters analysed werepacked cell volume (PCV), haemoglobin concentration (Hb), red blood cells (RBC), white blood cells (WBC) and the mean corpuscular volume (MCV). The mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), platelets, neutrophils, lymphocytes, monocytes eosinophils and basophils were determined by calculation.

2.6. Sample Analysis

The chemical analysis of feed samples and blood samples were determined [9] method while all data collected were subjected to analysis of variance (ANOVA) as described by [10]. Treatment means were separated and compared using the Duncan Multiple range test using statistical software [11].

3. Results

Performance parameters of West African Dwarf goats fed diets containing graded levels of toasted baobab seed meal (BSM) are shown in Table 2. There was no significant ($P > 0.05$) difference in final body weight but total weight gain and mean daily weight gain were significantly ($P < 0.05$) different. The total weight gain ranged from 2.51 kg (T4) to 3.84 kg (T1) with the highest value recorded in T1 (0% BSM) which was closely followed by T2 (3.48 kg) containing 25% of toasted Baobab Seed meal. Feed intake values were not significantly ($P > 0.05$) different among treatments, but mean daily feed intake was significantly ($P < 0.05$) different and ranged from 0.35 kg to 0.37 kg. The feed conversion ratio recorded were 33.13, 34.08, 35.60 and 42.52 for T1, T2, T3 and T4 respectively.

Haematological parameters of WAD bucks fed the experimental diets are presented in Table 3. Dietary treatment had no significant ($P > 0.05$) effect on Packed cell volume (PCV), Haemoglobin (Hb), Mean corpuscular haemoglobin (MCH) and Mean corpuscular haemoglobin concentration (MCHC). PCV values were 31.75%, 29.25%, 29.25% and 28.00% in T3, T1, T4 and T2 respectively. Hb concentration were 10.58, 9.50, 9.50 and 9.33 g/dl in the same order. Mean corpuscular haemoglobin gave 7.88, 8.05, 9.20 and 11.00 pictogram for T4, T3, T1 and T2 respectively while the MCHC values recorded were 33.33, 33.28, 33.30 and 32.40 for T1, T2, T3 and T4 respectively. Red blood cells (RBC), White blood cells (WBC) and Mean corpuscular volume were significantly ($P < 0.05$) different. RBC contents were 9.40, 12.60, 13.00 and 13.80 $\times 10^{12/l}$ for T2, T4, T1

Table 2. Performance of WAD goats fed experimental diets.

Parameters	Experimental Diets				
	T1	T2	T3	T4	SEM
Initial body weight (kg)	6.23	6.30	6.30	6.30	-
Final body weight (kg)	10.10^{a}	9.78^{a}	9.33^{ab}	8.81^{b}	0.69*
Total weight gain (kg)	3.84^{a}	3.48^{a}	3.03^{ab}	2.51^{b}	0.48*
Mean daily weight gain (kg)	0.046^{a}	0.037^{ab}	0.036^{ab}	0.029^{b}	5.17*
Total concentrate intake (kg)	8.78	8.57	8.42	8.56	0.30ns
Total forage intake (kg)	22.72^{a}	22.02^{a}	21.08^{ab}	21.15^{ab}	0.54*
Mean daily feed intake (kg)	0.375	0.364	0.354	0.353	8.43ns
Total feed intake (kg)	31.50	30.59	29.71	29.50	0.72ns
Feed conversion ratio	33.13	34.08	35.60	42.52	5.72ns

a, b: Means within the same row bearing different superscripts differ significantly ($P < 0.05$). *: Significant; ns: Not significant; SEM: Standard error of mean.

Table 3. Haematological parameters of WAD goats fed experimental diets.

	Experimental Diets				
Parameter	T1	T2	T3	T4	SEM
PCV (%)	29.25^{ab}	28.00^{b}	31.75^{a}	29.25^{ab}	1.53ns
HB (g/dl)	9.50^{ab}	9.33^{ab}	10.58^{a}	9.50^{ab}	0.54ns
RBC ($10^{12/l}$)	13.00^{a}	9.40^{b}	13.80^{a}	12.69^{ab}	1.78*
WBC ($10^{9/l}$)	12.80^{ab}	15.50^{a}	14.60^{a}	7.25^{b}	2.48*
MCV (fl)	24.55^{ab}	33.00^{a}	24.00^{ab}	23.98^{ab}	4.33*
MCH (pg)	9.20	11.00	8.05	7.88	1.48ns
MCHC (g/dl)	33.33	33.28	33.30	32.40	0.47ns

a, b: Means within the same row bearing different superscripts differ significantly ($P < 0.05$). SEM: Standard Error of Mean; *: Significant; ns: Not significant; PCV: Packed Cell Volume; Hb: Haemoglobin Concentration; RBC: Red Blood Cell; WBC: White Blood Cell; MCV: Mean Corpuscular Volume; MCH: Mean Corpuscular Haemoglobin; MCHC: Mean Corpuscular Haemoglobin Concentration.

and T3 respectively. WBC values were 15.50, 14.60, 12.80 and 7.25 × $10^{9/l}$ for T2, T3, T1 and T4. Mean corpuscular volume produced 33.00, 24.55, 24.00 and 23.98 femtolitre for T2, T1, T3 and T4 respectively. Total protein, albumin, globulin, cholesterol, creatinine, urea and alkaline phosphate of WAD bucks fed the experimental diets were presented in **Table 4** where there were no significant ($P > 0.05$) differences among the dietary treatments except for serum transaminases (ALT and AST).

4. Discussion

Performance of the WAD bucks as presented in **Table 2** showed no significant ($P > 0.05$) difference in final body weight. Total weight gain varied significantly ($P < 0.05$) among dietary treatments with bucks in the control recording the highest weight gain (3.84 kg). However, it was observed that bucks in T2 (3.48 kg) had similar weights and comparable with the control. The average weight gain obtained in this study was higher than the weight gain (2.09 kg - 3.26 kg) reported by [1] for fermented Baobab seed meal used to replace Palm kernel cake and the range (2.35 kg - 2.52 kg) reported by [12] for Baobab whole fruit and Pulp meal as supplement to wheat offal. A corresponding significant ($P < 0.05$) mean daily weight gain was recorded for T1 (0.046 kg) followed closely by goats on 25% BSM, (0.037 kg), 50% BSM, (0.036 kg) while the lowest was by goats on 75% BSM, T4 (0.029 kg). This means that nutrient contribution of diet containing BSM was adequate for growth. There was no significant ($P > 0.05$) difference in feed intake. Feed intake was reported to be governed by dietary Crude Protein, palatability and other factors like gut fill in WAD goats fed cassava peel based diets [13]. Feed conversion ratio was not significant as reported by [1] for fermented Baobab seed meal fed to WAD goats.

Table 4. Serum biochemical indices of WAD goats fed treatment diets.

	Treatment Diets				
Parameters	T1	T2	T3	T4	SEM
T-Protein	4.93	5.45	5.43	4.73	0.99ns
Albumin	3.00	3.05	3.30	3.03	0.22ns
Globulin	1.78	2.40	2.13	1.70	1.06ns
Cholesterol	103.38	93.05	99.92	107.35	18.57ns
Urea	24.80	28.05	34.65	35.65	9.81ns
Creatinine	2.18	2.00	2.10	1.98	0.76ns
AST (u/l)	20.95^{ab}	14.75^{b}	16.27^{b}	35.50^{a}	5.05^{*}
ALT (u/l)	51.47^{a}	14.85^{bc}	33.58^{b}	46.83^{ab}	11.50^{*}
ALP (u/l)	43.88	46.42	46.83	41.40	9.66ns

SEM: Standard Error of Mean; ns: Not significant.

The blood profile of WAD goats fed the experimental diets are presented in Table 3 and Table 4. The PCV, Hb and MCH were not significantly ($P > 0.05$) different. The PCV values (28.00% - 31.75%) in this study were within the normal range (21% - 35%) reported by [14] for healthy goats. Haemoglobin (Hb) is estimated to assess the oxygen carrying capacity of the blood circulatory system. The Hb concentration in this study ranged from 9.33 g/dl (T2) to 10.58 g/dl (T3) among treatment groups. This is within the normal range of 8 - 15 g/dl reported for normal blood functions by [14] and [15]. The Hb values showed that the experimental diets were adequate for the nutritional requirement and BSM did not pose any danger to the goats. Red blood cells (RBC) carry respiratory pigments which include Hb, a decrease in the quantity of the circulating RBC shows there is a decrease in the quantity of Hb and this reduces oxygen carrying capacity of the animal. RBC count ranged from 9.40×10^6/ml to 13.80×10^6/ml and there was significant difference ($P < 0.05$) among treatment groups. The values of RBC were comparable to the range of 9.20×10^6- 13.50×10^6/ml [16] and 9.9×10^6 - 18.7×10^6/ml [17] reported for WAD sheep and goats respectively. White blood cell (Leukocyte) count is a test that measures the white blood cells (WBC) in the body. It plays an important role in fighting against diseases and protection from infections. WBC count was similar for goats in T2 (15.50×10^6) and T3 (14.60×10^6) but differ from the values of T1 (12.80×10^6) which is the control and T4 (7.25×10^6). WBC values in this study can be comparable to the values (6.80 - 20.1×10^6) reported by [14] for haematological and biochemical parameters of WAD goats. The animals suffer any disease condition throughout the study period which revealed that feeding the test diets did not affect their health negatively. Mean Corpuscular volume (23.98 fl - 33.00 fl) was higher than 22.19 fl - 24.63 fl reported by [18] for Haematological and serum biochemical indices of WAD goats with foreign body impaction and 21.83 fl - 22.18 fl reported by [19]

for Blood profiles of WAD bucks fed varying levels of Shea nut cake based rations in Nigeria but within the normal healthy range reported by [14] and [20] for WAD goats. Mean Corpuscular Haemoglobin and Mean Corpuscular Haemoglobin Concentration were not significantly different within dietary treatment. The animals did not suffer any disease condition throughout the study period which revealed that feeding the test diets did not affect their health negatively. MCH and MCHC further buttress the fact that the animals were not anaemic.

The biochemical indices presented in **Table 4** did not show any significant variation ($P > 0.05$) amongst treatment except for the transaminases (AST and ALT). Total protein reduced steadily from T2 (5.45 g/l) to T4 (4.73 g/l) and showed no significant difference. [21] found that serum protein is important in osmotic regulation, immunity and transport of several substances in body. The lower values for Total protein, Albumin and Globulin in this study which were similar to that of [22] indicated that there were no traces of anti-nutritional factors that could diminish nutrient permeability in the gut walls [22].

Cholesterol values were high compared to authors elsewhere [1] and [19], this indicates that the meat quality was not safe for consumers avoiding high cholesterol content. Since there was no variation in Urea treatments it showed utilization of Baobab seed meal as protein and energy sources did not cause any deleterious effect on the goats despite the high values (24.80 - 35.65 mmol/l) which were above the normal serum urea (3.5 - 9.70 mmol/l) reported for WAD goats by [14].

The creatinine content (1.98 mg/dl - 2.18 mg/dl) in this study was higher than the values (0.70 - 1.5 mg/dl) reported by [23] and 0.9 - 1.8 mg/dl reported by [24] for normal values of creatinine for goats. However, the animals did not suffer any muscular wastage or kidney disease connected to high creatinine level in goats.

The concentrations of AST and ALT varied significantly, ranged from 14.75 u/l - 35.50 u/l and 14.85 u/l - 51.47 u/l respectively. Serum transaminases (AST) concentration in the blood was reliable tests for liver damage; however, values obtained in this study did not indicate any malfunctioning of the liver of the experimental animals.

5. Conclusion

The inclusion of baobab seed meal up to 50% in the experimental diet did not have any negative effect on the performance of the goats and did not pose any health challenge to the animals during the study period. Baobab can serve as a feed resource in supplementing diets for grower WAD goats and can be utilized during the dry season when there is a shortage of feed due to its abundance and availability all year round.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Ikyume, T.T., Eigege, N.N., Bashi, D.T., Oche, N.P., Abdulraheem, A.I., Ojabo, M. and Akalika, I.P. (2018) Growth Performance, Blood Profile and Economics of WAD Goats Fed Fermented Baobab (*Adansonia digitata*) Seed Meal. *Animal Husbandry and Dairy Science*, **2**, 30-36.

[2] FAO (1988) Traditional Food Plants. Food and Agriculture Organisation (FAO/UN), Rome.

[3] Nkafamiya, I., Osemeahon, S., Dahiru, D. and Umaru, H. (2007) Studies on the Chemical Composition and Physiocochemical Properties of the Seeds of Baobab (*Adansonia digitata*). *African Journal of Biotechnology*, **6**, 656-659.

[4] Gurbuz, Y. and Alarson, O.F. (2017) The Effects of Different Supplemented Pellets, Binders in Lambs Diet on Fattening Performance and Carcass. *Journal of Animal Production*, **58**, 15-23.

[5] Longvah, T., Deosthale, Y.G. and Kumar, P.U. (2000) Nutritional and Short Term Toxicology Evaluation of Perilla Seed Oil. *Food Chemistry*, **70**, 13-16. https://doi.org/10.1016/S0308-8146(99)00263-0

[6] Ewuola, E.O., Jimoh, O.A., Atuma, O.V. and Soipe, O.D. (2012) Haematological and Serum Biochemical Response of Growing Rabbit Fed Graded Levels of Graded Levels of *Moringa oleifera* Leaf Meal. *Proceedings*, 10*th Annual World Rabbit Congress*, Sharm El-Sheikh, 3-6 September 2012, 679-683.

[7] Balikei, E., Yildiz, A. and Gurdogan, F. (2007) Blood Metabolite Concentrations during Pregnancy and Post-Partum in Akkaraman Ewes. *Small Ruminant Resource*, **67**, 247-251. https://doi.org/10.1016/j.smallrumres.2005.10.011

[8] T.A.C. (2009) Makurdi Weather Element Records. Nigerian Air Force Tactical Air Command. Makurdi Metrological Station, Makurdi.

[9] A.O.A.C. (1995) Official Method of Analysis. 16th Edition, Association of Analytical Chemists, Washington DC.

[10] Steel, R.G.B. and Torrie, S.A. (1990) Preambles and Procedures of Statistics. A Biological Approval. 2nd Edition, McGraw-Hill Book, New York.

[11] Minitab (2016) Statistical Software, Version 16. Minitab Incorporation, State College.

[12] Illori, H.B., Salami, S.A., Makoja, M.A. and Okunda, D.O. (2013) Acceptability and Nutrient Digestibility of WAD Goat Fed Different Dietary Inclusion of Baobab (*Adansonia digitata*). *IOSR Journal of Agriculture and Veterinary Science*, **6**, 22-26. https://doi.org/10.9790/2380-0632226

[13] Ukanwoko, A.I. and Onuoha, C.A. (2011) Growth Performance and Characteristics of West African Dwarf (WAD) Goats Fed Oil Palm Leaf Meal-Cassava Peel Based Diets. *Continental Journal of Animal and Veterinary Research*, **3**, 1-6.

[14] Daramola, J.O., Adeloye, A.A., Fatoba, T.A. and Soladoye, A.O. (2005) Haematological and Biochemical Parameters of West African Dwarf Goats. *Livestock Resource for Rural Development*, **17**, 3-5.

[15] Blood, D.C., Studdert, V.P. and Gay, C.C. (2007) Sanders Comprehensive Veterinary Dictionary. 3rd Edition, Elsevier, Oxford.

[16] Tambuwal, F.M., Agale, B.M. and Babagana, A. (2002) A Haematology and Biochemical Values of Apparently Healthy Red Sokoto Goats. *Proceedings of the* 27*th Annual Conference of Nigerian Society for Animal Production* (*NSAP*), Akure, 17-21 March 2002, 50-53.

[17] Taiwo, V.O. and Ogunsanmi, A.O. (2003) Haematology, Plasma, Whole Blood and

Erythrocyte Biochemical Values of Clinically Healthy Captive-Reared Grey Duiker (*Sylvicarpa grimmia*), West African Dwarf Sheep and Goats in Ibadan, Nigeria. *Israel Journal of Veterinary Medicine*, **5**, 43-47. http://www.isrvma.org/article/5823htm

[18] Akinrinmade, J.F. and Akinrinde, A.S. (2012) Haematological and Serum Biochemical Indices of WAD Goats with Foreign Body Rumen Impaction. *Nigerian Journal of Physiological Science*, **27**, 83-87.

[19] Ogunbosoye, D.O., Abayomi, A. and David, A.A. (2018) Blood Profiles of WAD Growing Bucks Fed Varying Levels of Shea Nut Cake Based Rations in Nigeria. *Cogent Food and Agriculture*, **4**, Article ID: 1474620. https://doi.org/10.1080/23311932.2018.1474620

[20] Belewu, M.A. and Ojo-Alokomaro, K.O. (2007) Haematological Indices of West African Dwarf Goat Fed Leaf Meal Based Diets. *Bulgaria Journal of Agricultural Science*, **13**, 601-606.

[21] Ikhimioya, I. and Imaseun, J.A. (2007) Blood Profile of West African Dwarf Goats Fed Panicum Maximum Supplemented with *Afzeila africana* and *Newbouldia laevis*. *Pakistan Journal of Nutrition*, **6**, 79-84. https://doi.org/10.3923/pjn.2007.79.84

[22] Ogunleke, F.O., Ajayi Morakinyo, O.A. and Saka, A.A. (2014) Performance and Blood Profile of West African Dwarf Goat Fed Concentrate Supplement Containing Varying Levels of Corncobs. *American Journal of Experimental Agriculture*, **4**, 1861-1868. https://doi.org/10.9734/AJEA/2014/11271

[23] Fraser, C.M. (1986) The Merck Vet Manual. 6th Edition, Merck and Co. Inc., Rahway.

[24] Kaneko, J.J. (1989) Clinical Biochemistry of Domestic Animals. 4th Edition, Academic Press, San Diego, 117-120.