Blood Profile of West African Dwarf (WAD) Goats Fed Cassava Peel Meal Based- Diets Supplemented with African Yambean Concentrate

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ABSTRACT

The blood profile of twenty (20) West African Dwarf bucks fed cassava peel meal based diets supplemented with varying levels of African yambean meal (AYBM) concentrate was investigated. Four diets were formulated with AYBM at 0, 10, 20 and 30 % levels designated as T1, T2, T3 and T4 respectively. Before the commencement of the study, a baseline status of the blood was established. Thereafter at the end of the study, the haematological and serum biochemical values were investigated to show if the difference existed principally due to the feedstuffs fed. Results showed that values for packed cell volume (PCV), haemoglobin concentration (Hb), red blood cell counts (RBCs) and white blood cell counts (WBCs) differed significantly ($P< 0.05$) between the respective diets. Average PCV value was highest in the control diet (T1) and least in diet T4 (30% YBSM). Serum biochemical values for total bilirubin (TB), serum urea, creatinine, total protein, cholesterol, glucose, serum glumate oxalotransaminase (SGOT) and serum glutamate pyruvatetransaminase (SGPT) differed significantly ($P<0.05$) between dietary treatments. The control diet had higher serum urea, but diets T2, T3, and T4 were statistically similar. The control diet had higher creatinine value, similar to diets T2 and T3 but different from diet T4. Cholesterol value was higher in the control diet similar to diet T2 different from diets T3 and T4. SGOT was higher in the control (diet T1) but differed from diets T2 and T3. SGPT was higher in the control diet, very different from other diets. Though some of the results were inconsistent, total protein, creatinine, cholesterol and SGOT and SGPT were lower in animals fed the supplemented concentrate. Therefore, the results suggest the positive potential of the use of crop residues (cassava peel meal) supplemented with varying levels of AYBM concentrate in the feeding of goats without deleterious effects on blood chemistry.

Keywords: *Blood, African Yambean, Goat.*

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1. INTRODUCTION

Increasing demand and subsequent high cost of conventional feedstuffs have rekindled interest in the use of crop residues and some novel legumes as feed for ruminants and monogastric animals. Increasing population pressure (over 182 million) and other developments in Nigeria has led to the most cropped area being extended to land hitherto considered unsuitable for this purpose. This has resulted in increased pressure on the small ruminant component of the farming system because of reduced feed availability especially in the dry periods of the year. Also, most Multipurpose Trees and Shrubs (MPTS) commonly used as browse are becoming extinct or important components of most afforestation programmes hence restricted from usage as cut-and carry browses for goats.

Cassava (*Manihot* Spp.) is one of the most important annual root crops grown widely by tropical and sub-tropical farmers. It is the highest supplier of carbohydrates among staple crops and ranks fourth among food crops in developing countries after maize, rice and wheat [1]. Cassava peels are produced in large quantities in Southern Nigeria, from the processing of cassava for human, industrial and export purposes. Unfortunately, this enormous feed resource has received very little attention and is often discarded as waste. Cassava peel is rich in metabolizable energy (3.03 Mcal/Kg DM) but low in nitrogen [2]. Generally, fibrous crop residues are poor sources of fermentable nitrogen, as their crude protein is below the level required by rumen microorganisms. Also, these crop residues are also low in easily degraded carbohydrates, minerals and other nutrients required to balance the products of digestion to requirements. All these results in limited feed intake, poor rumen function, increased methane emission and low animal productivity. The use of African yambean (*Sphenostylis stenocarpa)*, an under-exploited and often classified minor grain legume that is cheap and readily available protein source in cassava peel meal based diets is a strategy that intends to overcome the nutritional constraints of using cassava peel, it will close the feed deficit gab, reduce feed cost and sufficiently tackle seasonal fluctuations in forage quality and quantity. This would on the long run encourage increases in flock sizes, provide insurance against external shocks as well as increase the productivity of goats.

Blood is a liquid tissue that is constantly circulating in the arteries, veins, and capillaries of all animals. Blood consists of plasma, the to provide information on the blood profile of these animals. Against this background, the present study was designed to investigate the haematology and serum biochemistry of WAD bucks fed a basal diet of cassava peel meal supplemented with varying levels African yambean seed meal concentrate

2. MATERIALS AND METHODS

2.1. Location of Experiment

The experiment was carried out in the Sheep and Goat Unit of the Teaching and Research Farm, Faculty of Agriculture, University of Calabar, Calabar. Calabar is located on latitude $4^{0}57^{/}$N and longitude $8^{0}19^{/}$E of the equator. Annual temperature and rainfall range from 25 – 30 ^{0}C and from 1260 to 1280 mm respectively. The relative humidity is between 70 and 90% and Calabar is 98 meters above sea level [3].

2.2. Processing of Cassava Peel and African Yambean Seed Meal

Fresh cassava peels of TMS 30555 variety were collected from the Department of Crop Science commercial "Garri" processing unit of the University of Calabar, Calabar. The peels were from 10-12 months old plants. The peels were properly sun dried for a period of 3-6 days during which they were regularly turned to give uniform drying to a moisture content of 10%. The peels could sometimes have tuber linings as a result of the method of removing the peels. The sun-dried cassava peels were then milled and used in the study as dried cassava peel meal (CPM). African yambean (*Sphenostylis stenocarpa)* seeds (Nsukka brown variety) were purchased from local farmers

in Obudu and Obanliku Local Government Areas in the Northern parts of Cross River State, Nigeria. The undecorticated brown seeds were boiled for 30 minutes following the method of Ukachukwu and Obioha [4] for mucuna seeds. Water was made to boil at 100^{0}C in a large (mammoth) cooking pot before the seeds were poured in. The seeds were allowed to boil for 30 minutes. Water was decanted using local baskets and the seeds sun-dried on aluminum roofing sheets for 3 days before being milled and used as African yambean seed meal (AYBM) to compound the experimental diets.

2.3. Experimental Diets

Four experimental diets designated as T_1, T_2, T_3 and T_4 were formulated as presented in Table 1. Diet T_1 was the control and contained no African yambean seed meal (AYBM). Diets T_2, T_3, and T_4, contained 10, 20, and 30% of AYBM respectively. The diets were allotted randomly to the four animal groups. Each animal within a group was offered 1 kg of an assigned concentrate diet daily for 90 days. The concentrate diets were fed at 0800 hours daily. Clean drinking water was provided *ad-libitum* for each animal within the period. Each animal was provided with salt lick block (TANLICK), a product of SKM Pharma (P) Limited JF-10, City Point, Infantry Road Bangalore – 560001 India. The salt lick had the following composition: Na, 35.96%; Zn, 0.25%; Fe, 0.30%; Mn, 0.20%; I, 0.003%; Co, 0.002%; Cu, 0.10% and Mg, 0.05%.

2.4. Chemical Analyses of Experimental Diets

All the experimental diets including CPM and AYBM were analyzed for proximate composition using AOAC [5] methods (Table 2).

Table-1. Gross Composition of Experimental Diets

Ingredients (%)	T_1	T_2	T_3	T_4	C	D
Cassava peel	46.00	46.00	46.00	46.00		
Yambean Seed Meal	-	10.00	20.00	30.00		
Wheat offal	33.00	23.00	13.00	3.00		
Palm kernel cake	18.00	18.00	18.00	18.00		
Bone meal	2.00	2.00	2.00	2.00		
Salt	1.00	1.00	1.00	1.00		
Total	100.00	100.00	100.00	100.00		

Table-2. Proximate composition and gross energy of experimental diets, cassava peel meal (CPM) and African yambean seed meal (AYBM)

Parameter (%)	T_1	T_2	T_3	T_4	CPM	AYBM
Dry matter	89.44	89.35	89.42	89.62	90.10	88.50
Crude protein	10.56	10.96	11.36	11.44	3.22	22.10
Crude fibre	12.47	11.05	10.31	10.11	14.73	5.92
Ether extract	4.50	4.61	4.80	4.94	0.91	7.53
N-free extract	51.38	53.61	54.33	54.62	65.67	47.67
Ash	10.35	9.12	8.62	8.49	5.57	5.28
Gross energy (Kcal/g)	3.45	3.42	3.31	3.28	3.60	5.23

2.5. Blood Collection and Analysis

Prior to the trial, animals were quarantined for 21 days. One week into this period, animals were assigned to their respective pens and duplicate blood samples (5 ml each) were drawn by jugular vein puncture from each of the 4 replicate bucks per treatment and bulked for analyses to establish a baseline for the assessment of the effect of experimental diets on blood parameters. The blood samples (5ml each) were used for the determination of the serum biochemical and haematological components are described by Dacie and Lewis [6]. The first lot of 5ml was collected in labeled sterile bijou bottles containing 1 mg/ml of ethylene Diamine tetraacetate (EDTA), an

anticoagulant. This was mixed thoroughly and used to determine the haematological components. The second lot of 5ml was collected in bijou bottles with no anti-coagulant. The blood was allowed to clot at room temperature and serum separated by centrifuging within 3 hours of collection. This was used to determine the serum biochemical components. On the 12th week (84th day specifically) of the investigation, the same process as above was repeated at the end of the feeding trial.

3. RESULTS AND DISCUSSION

The results of haematological and serum biochemical values obtained for WAD goats in this study are presented in Table 3 and 4, respectively. Packed cell volume (PCV) for the control group was 35.75%. This differed significantly ($P<0.05$) from the values of 30.55, 28.10 and 27.93% obtained for goats fed diets containing 10, 20 and 30 % AYBM respectively. However, these values are within the normal range of 22 – 35 % reported for goats [7] but slightly higher than 21.25% for WAD goats [8]. PCV is used as an index of toxicity in feed samples [9]. Reduction in the concentration of PCV suggests the presence of toxic factor(s). The mean value of 28.88± 0.20 % obtained for goats on diets T_2, T_3 and T_4 is lower than 35.75% for the control diet (T_1) and lower than the PCV value obtained in the baseline data at the beginning of this study (Table 3). This is an indication that the inclusion of AYBM in diets for goats led to a reduction in the value of PCV (Table 4), which therefore suggests the presence of anti-nutrients in the AYBM diets. African yambean seed is known to contain several anti-nutritional factors including a toxic alkaloid-rotenone which may have an adverse effect on blood formation. It is possible that traces of these anti-nutritional factors were still in the AYBM and the processing method used (boiling for 30 minutes) could not completely eliminate them.

The AYBM diets in this study might contain traces of anti-nutritional elements which could increase in concentration as the inclusion levels of AYBM in diets increased. This may be responsible for declining PCV values observed among treatment groups as the inclusion levels of AYBM increased from 0% in the control group to 30% in diet T_4. The haemoglobin (Hb) content in the blood of goats was significantly ($P<0.05$) affected by the level of AYBM in the diets. In absolute terms, diet T2 with 10% AYBM had the highest value (95.22 g/L) followed by the control (92.00 g/L). Diets T_3 (20%) and T_4 (30% AYBM), had statistically similar values (85.00 and 84.98 g/L) respectively. As observed there was a decline in Hb concentration in the blood as the level of AYBM content in the diets increased. This observation is in line with the report of Ukpabi [10] with mucuna seeds. However, the values obtained for all the diets are within the normal range of 80 - 120g/L for goats [7] and 70- 150 g/L for WAD goats [8]. The lower values obtained for diets T_3 and T_4 may also be related to traces of residual anti-nutritional factors in AYBM. Red blood cell (RBC) ($x10^6$/ml) values obtained for goats in this study showed that significant ($P<0.05$) differences existed between dietary treatments. Diet T_2 recorded a higher value (9.70 $x10^6$/ml) followed by diets T_1, T_3 and T_4 respectively. The values of 9.23 and 9.70 $x10^6$/ml obtained in this study for diets T_1 and T_2 respectively are within the normal range of 8 - 18 $x10^6$/ml reported for goats [7] and also agrees with the range of 9.2 - 13.5 $x10^6$/ml reported for WAD goats [8]. Although, diet T_2 had a higher and significant ($P< 0.05$) value compared to diet T_1, the values for diet T_3 (7.95 $x10^6$/ml) and T_4 (7.45 $x10^6$/ml) as well as the mean value of 8.37± 0.94 $x10^6$/ml for AYBM based diets suggest that increasing the level of AYBM in diets led to a reduction in RBC counts in WAD goats which may be attributed to traces of residual anti-nutritional factors in the AYBM which adversely affected blood formation [9-11].

The inclusion of AYBM in diets promoted higher white blood cell (WBC) counts than the control diet among goats. The values were 12.38, 13.30, 20.83 and 22.05 (x 10^3/ml) for diets T_1, T_2, T_3, and T_4, respectively and differed ($P<0.05$) significantly between dietary treatments. The values obtained in this study for diet T_1 and T_2 are

within the normal range of 4.00 - 13.00 x 10^3/ml reported for goats by Radostits, et al. [7]. On the other hand, the value for diet T_3 was within the range of 6.8 - 20.1 x 10^3/ml reported for WAD goats [8] while the value for diet T_4 (22.05 x 10^3/ml) was slightly out of the range of values reported above. As the levels of AYBM increased in the diets, WBC values also increased in a similar pattern in the treatment groups. Abnormal or high WBC counts in the blood are usually associated with invasion or presence of an antigen or 'foreign' body in the circulating blood [12]. The rising levels of WBCs (above the baseline data in Table 3) with increasing levels of AYBM in diets obtained in this study is in line with the report of Ahamefule [9] and supported the observation that there were traces of anti-nutritional or toxic elements in the diets. The presence of these foreign bodies in the blood might have triggered off a rise in immune response as the concentration of these anti-nutritional properties increased from diet T_2 to T_4. Neutrophil, lymphocyte and eosinophil counts did not differ ($P>0.05$) among dietary treatments. The normal level obtained for these parameters in this study tends to suggest that the processing methods were effective in reducing the anti-nutritional element (allelochemicals) to a tolerable level in the diets.

Total and conjugated bilirubin is indicators of protein quality and adequacy [9]. Conjugated bilirubin did not differ ($P>0.05$) significantly among dietary treatment groups. The values obtained in this study fell within the normal range of 0 - 2 µmol/l for goats [13]. The normal values observed for goats fed both the control and the AYBM diets suggest adequate or sufficient protein in the experimental diets for basic metabolic and physiological activities [9, 14].

Serum urea concentration was significantly higher ($P<0.05$) for goats fed the control diet (8.50 mmol/L) when compared with the values obtained for animals on diet T_2 (7.42 mmol/L), T_3 (7.22 mmol/L) and T_4 (7.20 mmol/L). However, serum urea concentration of goats on AYBM based diets was statistically similar. The concentration of urea in the blood decreased as the level of AYBM in the diets increased. The values obtained in this study are within the normal range of 0.80 – 9.70 mmol/L reported for WAD goats [8] and 5.4 - 11.8 mmol/L [13] but higher than the mean value of 4.7±2.1 mmol/L reported for Red Sokoto goats [15]. High levels of urea in the blood have been reported to indicate a lowered utilization of protein, poor quality protein or excess protein catabolism associated with protein deficiency [9-11, 14, 16]. The low blood urea levels recorded for diets containing AYBM in this study followed the same pattern reported by Ahamefule [9] and Ukpabi [10]. However, this observation suggests that diets with AYBM were better digested and the protein quality better than that of the control diet.

The serum creatinine contents differed significantly ($P<0.05$) between dietary treatments. However, the values decreased as the level of AYBM in the diets increased from 0 to 30 %. Diets T_1, T_2, T_3, and T_4 had the following values; 36.65, 35.60, 30.22 and 28.25mmol/L respectively. These values indicated that the animals were not surviving at the expense of body reserves. The creatinine level in an animal's blood increases when there is muscle wasting which results in the catabolism of creatinine phosphate [10, 17-19]. The lower values obtained for diets T_3 and T_4 indicated that AYBM protein is of good quality and was well utilized because serum creatinine concentrations are used indirectly to determine protein quality [10, 20-22].

Serum total protein concentration in this study differed significantly ($P< 0.05$) between dietary treatments. The values, however, increased from diet T_1 (71.25 g/L) to diet T_4 (78.10 g/L). These values were within the normal range of 6.3 - 8.5 g/100ml reported for WAD goats [8] and 5.9 – 7.4 g/100 ml reported for goats [13]. The increase in total serum protein is an indication that the proteins in the diets were well utilized and retained in the animal's body [10, 23]. This observation, therefore, indicated superior quality and better utilization of protein by goats fed AYBM based diets.

The cholesterol concentration obtained with diets containing AYBM differed (P<0.05) significantly from that of the control and are within the normal range of 2.7 – 10.0 mmol/L [24] and 2.073.36 mmol/L for goats [13]. In this study, the cholesterol level in the blood decreased as the level of AYBM increased from 0 - 30%. The reduction in cholesterol level may be attributed to either the absorption of intestinal cholesterol by dietary fibre and rapid excretion or a more specific effect of other components of the legume under investigation. The report of Ukpabi [10] collaborates this view in this study. Several workers, Akpodiete and Okagbare [25]; Carew, et al. [22] and Ukpabi [10] have reported low cholesterol levels in rats, layers, broilers, and goats when maggot meal, *Mucuna pruriens*, cooked bambara nut and *Mucuna cochinchinnensis* were fed. Cholesterol is implicated in the aetiology of arteriosclerosis and other heart diseases in man [26]. The low blood cholesterol level resulting from the feeding of AYBM in this study may have some nutritional and health importance. This aspect requires further investigation.

Glucose concentration in the blood of goats differed significantly (P<0.05). The blood glucose concentration of goats fed the control diet (2.30 mmol/L) compared favourably with those fed 10 % AYBM diet (2.35 mmol/L). These values were however significantly different from goats that received 20 % (3.77 mmol/L) and 30% (3.48 mmol/L) AYBM diets. Blood glucose levels were generally higher for goats fed AYBM diets than the control diet. The AYBM diets were marginally lower in energy than the control diet (Table 2), but were consumed more than the control suggesting therefore that more energy was available to the animals consuming the AYBM based diets and this increased from diets T_2 to T_4. This may account for the rise in blood glucose level for treatment T_3 and T_4. However, the range of blood glucose level obtained for goats in this study was higher than that obtained in the baseline data (Table 3) but fell within the normal range 3.2 - 4.2 mmol/L reported by Blood and Studdert [13]. This observation in this study is in line with that of Ahamefule [9] and Anya [27] and further suggests that the animals were not surviving at the expense of catabolized body tissues or gluconeogenesis [9, 10, 14, 28].

Table-3. Baseline data for some haematological and serum biochemical values of WAD goats at the beginning of the investigation

Parameters	Value
***Haematological**	
PCV (%)	31.50
Hb (g/L)	91.80
RBC (x 10^6)	11.80
WBC (x10^3)	13.26
Neutrophils (%0	42.82
Lymphocytes (%)	73.57
Eosinophils (%)	1.80
***Serum biochemical indices**	
TB (mmol/L)	0.45
CB (mmol/L)	0.20
Serum Urea (mmol/L)	4.92
Creatinine (mmol/L)	25.4
Total Protein (g/L)	70.95
Cholesterol (mmol/L)	2.05
Glucose (mmol/L)	1.51
SGOT (m/l)	24.82
SGPT (m/L)	15.45
TB: Total bilirubin	
CB: Conjugated bilirubin	
SGOT: Serum glutamate oxaloacetate transaminase	
SGPT: Serum glutamate pyruvate transaminase	

This view compliments the fact that none of the animals within the treatment groups suffered weight loss during the period under investigation. SGOT and SGPT concentrations were higher significantly (P<0.05) affected by treatments in the blood of goats fed the control diet than the AYBM based diets (Table 4). The values were 40.55 and 32.01 µ/1 for diet T_1, 38.85 and 31.55 µ/1 for diet T_2, 37.55 and 31.20 µ/1for diet T_3 and 37.15 and 30.10

for diet T_4. These values were within the normal range stipulated for goats [13, 24]. An increase in SGOT and SGPT values would signify necrosis or myocardial infractions which are all indicators of poor protein quality of the diet under investigation [9]. This tends to indicate that the quality of protein in the AYBM diets was better than that of the control diet and had no deleterious effects on the goats.

Table-4. Haematological and serum biochemical values of WAD goats fed cassava peel-based diets containing African yambean seed meal

Parameters	Diets				
	T_1	T_2	T_3	T_4	SEM
Haematological					
PCV (%)	35.75^{a}	30.55^{ab}	28.10^{b}	27.88^{b}	1.83
Hb (g/L)	92.00^{ab}	95.22^{a}	85.00^{b}	84.98^{b}	2.57
RBC (x 10^6)	9.23^{a}	9.70^{a}	7.95^{b}	7.45^{b}	0.53
WBC (x10^3)	12.38^{b}	13.30^{b}	20.83^{a}	22.05^{a}	2.50
Neutrophils (%)	62.10	62.10	61.20	61.15	0.27
Lymphocytes (%)	38.00	38.10	38.00	38.20	0.05
Eosinophils (%)	3.10	3.10	3.10	3.10	0.00
***Serum biochemical indices**					
TB (mmol/L)	0.55^{b}	0.60^{b}	0.71^{ab}	0.82^{a}	0.06
CB (mmol/L)	0.24	0.24	0.25	0.27	0.01
Serum Urea (mmol/L)	8.50^{a}	7.24^{b}	7.22^{b}	7.20^{b}	0.31
Creatinine (mmol/L)	36.65^{a}	35.60^{a}	29.22^{ab}	28.25^{b}	2.15
Total Protein (g/L)	71.25^{b}	71.35^{b}	75.33^{ab}	78.10^{a}	1.66
Cholesterol (mmol/L)	2.98^{a}	2.92^{ab}	2.88^{b}	2.85^{b}	0.03
Glucose (mmol/L)	2.30^{bc}	2.35^{bc}	3.77^{a}	3.48^{ab}	0.38
SGOT (m/l)	40.55^{a}	38.85^{ab}	37.55^{b}	37.15^{b}	0.77
SGPT (m/l)	32.01^{a}	31.55^{a}	31.20^{ab}	30.10^{b}	0.41

^{abc} Means on the same row with different superscripts differ significantly (P<0.05).
TB = Total bilirubin
CB= Conjugated bilirubin
SGOT = Serum glutamate oxaloacetate transaminase
SGPT = Serum glutamate pyruvate transaminase

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