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HAEMATOLOGY AND BIOCHEMISTRY OF WEST AFRICAN DWARF (WAD) BUCKS FED CROP BY-PRODUCTS IN HUMID TROPICAL NIGERIA

ABSTRACT

The haematology and blood biochemistry of West African Dwarf (WAD) bucks fed crop by-products: T_1 (Yam peels), T_2 (Cassava peels), T_3 (Sweet potato peels) and T_4 (Ripe plantain peels were investigated. On the last day of a 90-day experimental feeding and growth trial, two sets of blood samples were taken from 2 WAD bucks per dietary treatment via jugular venipuncture using a 10ml 20guage syringe. One set of the blood samples (5ml) was collected into plastic tubes containing the anti-coagulant ethylene diamine tetraacetic acid (EDTA) for the determination of haematological parameters. The other set of blood samples (5ml) was collected into anti-coagulant free plastic tubes, allowed to coagulate at room temperature and centrifuged for 10 mins at 3000 r pm. The supernatant sera were then stored in a freezer for subsequent biochemical analysis. Results revealed that the haematological values and blood biochemistry for the WAD bucks in all the treatment groups fell within the reference range for normal goats in terms of WBC (4 – 13 x 10^3 /µL), RBC (8.0 – 18.0 x 10^6/µl), MCV (16 – 25 fl), MCH (5.2 – 8.0 pg), MCHC (30 – 36 g/dl), Hb (8 - 12 x g/dl), PCV (24 – 48%), PLT (3– 6 x 10^{11} /L) and GLUC ((2.7 – 4.2 mmol/L), CREAT (59.7 – 134.8 µmol/L), CHOLES (1.54 mmol/L), BUN (32. 25 – 37.30 mg/dl), K (3.8 – 5.7 mmol/L), Na (136.6 – 151.5 mmol/L), CL (100.3 – 111.5 mmol/L), Ca (2.25 – 2.90 mmol/L), P (3.7 – 5.7 mg/dl) respectively. The utilization of crop by-products has no deleterious effects on the nutritional and health conditions of the bucks and is recommended for use by goat producers.

Key Words: Crop by-products, WAD bucks, Haematology, Blood biochemistry, Humid tropics.

1.0. INTRODUCTION

One of the problems of ruminant animal production in the humid tropics is the seasonal variation of forages and the non availability of conventional concentrate feed stuffs because of the additional competition for these feed stuffs by humans and monogastrics. There is therefore, the need to utilize crop by-products described as major non-conventional feedstuffs by goats (Devendra, 1989). Reports reveal that Crop by-products are available in large quantities in the rural villages of Cross River State (Kalio *et al.*, 2013). Some have been classified as 'kitchen wastes' (Adamu *et al*., 2010) or common 'household wastes' (Ademosun, 1987). Prominent among these are yam peels, sweet potato peels, Irish potato peels and cassava peels. Others may include cocoyam peels, rice bran, cowpea husk, rice husk, maize husk, banana peels and plantain peels. These household or kitchen waste could be used after processing as feed stuffs as they contain crude protein levels ranging from 1 to 23%, fibre levels ranging from 2 to 52% and metabolizable energy as high as 20 MJ/kg DM. Hence, small ruminants fed with these feed stuffs are healthier and heavier (Onwuka *et al.*, 1997).

Similarly, Animashaun *et al.*, (2006) emphasized that nutritional studies should not be limited to performance, carcass quality and nitrogen alone, but its effect on blood constituent is also very relevant (Animashaun *et al*. 2006). Blood is an important and reliable medium for assessing the health status of animals (Oduye, 1976).The comparison of an animal's hematologic and biochemical values with a reference interval provides evidence for numerous conditions such as infection, malnutrition and stress (Clifford and Briggs, 2007). Hence, laboratory tests on blood are very vital tools to detect any deviation from the normal in the animal body (Alemede, 2010).

This study is aimed at assessing the effect of yam peels, cassava peels, sweet potato peels and plantain peels on the hematologic and biochemical values of West African Dwarf (WAD) bucks owned by small-holder goat producers in the rural villages of Cross River State.

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2.1. MATERIALS AND METHODS

2.1.1. Experimental site

The experiment was conducted at the sheep and goats unit of the Teaching and Research farm of the University of Calabar, Calabar, Nigeria. Calabar is located at about latitude $4^0$58'N and longitude $8^0$17'E with an average annual temperature of 25 - 30^0C and annual rainfall of 1,830 mm (Eze and Effiong, 2010).

2.1.2. Feeds and feeding management

Crop by-products (T_1 - yam, T_2 - cassava, T_3 - sweet potato and T_4 - ripe plantain peels) that abound in the zone classified as common house hold food wastes were used. The crop by-products were offered to the animals at 3% of their body weight (dry matter basis) during a growth trial. The feed (crop by-products), water and mineral salt licks (TANLICK®) were provided *ad libitum*.

2.1.3. Haematology and Blood biochemistry

On the last day of a 90-day experimental feeding and growth trial, two sets of blood samples were taken from 2 WAD bucks per dietary treatment via jugular venipuncture using a 10ml 20guage syringe. One set of the blood samples (5ml) was collected into plastic tubes containing the anti-coagulant ethylene diamine tetraacetic acid (EDTA) for the determination of haematological parameters. The other set of blood samples (5ml) was collected into anti-coagulant free plastic tubes, allowed to coagulate at room temperature and centrifuged for 10 mins at 3000 r pm. The supernatant sera were then stored in a freezer for subsequent biochemical analysis.

Haematological values of the blood samples were estimated for packed cell volume (PCV) and haemoglobin (Hb) concentration. Red blood cell (RBC) and total white blood cell (WBC) as well as the differential WBC counts were determined using the Neubauer haemocytometer after appropriate dilution. Values for the constants: mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV) were calculated from RBC, Hb and PCV values. Biochemical constituents of the serum samples estimated include calcium, sodium and potassium, inorganic phosphorus, chloride, urea, creatinine and cholesterol.

2.1.3. Statistical analysis

The haematological and biochemical data obtained from the blood samples were compared statistically on the basis of the different dietary treatments using analysis of variance procedure for completely randomized design (CRD) and differences between means separated using the Duncan Multiple Range Test (Steel and Torrie, 1980).

3.1. RESULTS AND DISCUSSION

3.1.1 Haematological Parameters

The white blood cells (WBCs) of the WAD bucks fed the various crop by-products (peels) were significantly ($P < 0.05$) different (Table 1). The WBCs of the WAD bucks ranged from 7.35 – 12.56 x 10^3/µL for T_2 (cassava peels) and T_4 (plantain peels) respectively. The higher WBCs count recorded in the WAD bucks fed T_4 (plantain peels) may be as a result of the response of the animals to protect themselves against invading pathogens. Growths of some moldy substances were observed on the feed materials during storage. Hence it is probable that the higher WBCs observed were a response to possible threat of these pathogens to the animals' immune system (Aiello, 2000). The WBCs or leucocytes are the mobile unit of the body's protecting system (Aiello, 2000). Consequently, no deleterious conditions were observed among the animals in all the treatment groups in this experiment, since their WBC values fell within the normal range (4 – 13 x 10^3 /µL) (Aiello, 2000) for healthy goats.

The lymphocytes (one of the WBC precursors) in the WAD bucks were not significantly ($P > 0.05$) different; although a higher value (64.05%) was recorded by WAD bucks fed T_4 (plantain peels). Lymphocytes play an important role of impacting immunity (Sembulingam and Sembulingam, 2002). The lymphocytes values recorded by the WAD bucks in this study fall within the normal range (50 – 70%) for goats reported by Aiello, (2000), but contrary to those (49.8 – 53.7 %) reported for WAD goats by Belewu and Ojo-

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Alokomaro,(2007). The variations in the lymphocytes values recorded in this study as compared to those reported by the latter authors may be due to differences in diets (Bush, 1981).

The red blood cells (RBCs) of the WAD bucks fed the various crop by- products (peels) (Table 1) were significantly ($P < 0.05$) different. The RBCs of the WAD bucks fed the various crop by-products ranged from 11.45 – 15.22 x 10^6/µL for T_4 (plantain peels) and T_2 (cassava peels) respectively. These RBC values recorded for the WAD bucks were within the values (8.0 – 18.0 x 10^6/µl) reported by Banerjee, (2004) and Aiello, (2000) for normal goats.

The blood indices or the Red blood cell indices such as the Mean corpuscular volume (MCV) in the WAD bucks fed the various crop by-products were significantly ($P < 0.05$) different, while the Mean corpuscular haemoglobin (MCH) and the Mean corpuscular haemoglobin concentration (MCHC) were not significantly ($P > 0.05$) different. The MCV, MCH and MCHC values reported for the WAD bucks in this study were within the normal range 16 – 25 fl, 5.2 – 8.0 pg and 30 – 36 g/dl respectively reported by Aiello, (2000) and Banerjee, (2004). The normal Red blood cell indices recorded in this study for the WAD bucks gives a clear indication of the absence of anaemia among the animals.

The haemoglobin value of the WAD bucks fed the various crop by-products (peels) were significantly ($P < 0.05$) different (Table 1). The haemoglobin of the WAD bucks ranged from 7.85 – 9.00 x g/dl for T_4 (plantain peels) and T_2 (cassava peels) or T_3 (sweet potato peels) respectively. The haemoglobin values of the WAD bucks fed T_1 (yam peel), T_2 (cassava peels) and T_3 (sweet potato peels) were within the normal range (8 - 12 x g/dl) for goats (Aiello, 2000; Ikhimioya and Imasuen, 2007). However WAD bucks fed T_4 (plantain peels) exhibited lower haemoglobin values. The haemoglobin values reported for the WAD bucks fed T_1 (yam peel), T_2 (cassava peels) and T_3 (sweet potato peels) were relatively high and seemed to be capable of supporting high oxygen carrying capacity of blood in the animals (Ikhimioya and Imasuen, 2007).

The packed cell volume (PCV) value of the WAD bucks fed the various crop by-products (peels) were significantly ($P < 0.05$) different (Table 1). The PCV value of the WAD bucks fed the various crop by-products ranged from 32.95 – 42.75% for T_4 (plantain peels) and T_2 (cassava peels) respectively. These PCV values reported in the study for the WAD bucks were within the normal range (24 – 48%) reported by Banerjee, (2004) for healthy goats.

The platelets or thrombocytes value for the WAD bucks were significantly ($P < 0.05$) different (Table 1). The values recorded for the WAD bucks were within the normal range 3– 6 x 10^{11} /L for goats reported by Aiello, (2000).

3.1.2. Blood biochemistry

The blood glucose values for the WAD bucks fed the crop by-products were not significantly ($P > 0.05$) different (Table 2). However, WAD bucks fed T_2 (cassava peels) had superior numerical values of blood glucose when compared to those fed the other feed stuffs. The superiority of the blood glucose value could be attributed to the ability of the feed stuff to conform to the recommended energy value for an average diet (6 – 13 MJ/kg/DM) (Steele, 2006). In addition, the blood glucose values for the WAD bucks were within the normal range (2.7 – 4.2 mmol/L) for goats (Aiello, 2000). This numerical blood glucose value portrayed by T_2 (cassava peels) although not statistically significant may have the potential for better performance in terms of weight gains (g/day) and feed intake. On the contrary, WAD bucks that exhibited low glucose values as was observed in the goats fed T_4 (ripe plantain peels) may likewise show poor performance in terms of weight gains (g/day) and feed intake. This is in agreement with the reports of Lazzaro, (2001) who reported gross reduction in weight gain, milk yield and alteration in the fatty composition in the milk of livestock due to very low level of glucose in blood. The blood glucose values exhibited by the WAD bucks in this study were indicative of their nutrient status. Turner *et al.* (2005) observed that blood glucose has been used to monitor the nutrient status in goats.

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The creatinine levels for the WAD bucks fed the crop by-products were not significantly ($P > 0.05$) different (Table 2). The creatinine levels recorded for the WAD bucks were 60.00, 60.15, 62.75 and 64.50 µmol/L for T_4 (ripe plantain peels), T_1 (yam peels), T_3 (sweet potato peels) and T_2 (cassava peels) respectively. The creatinine level recorded in this study for the WAD bucks were slightly higher (61.85 µmol/L) than those recorded (57.46 µmol/L) for WAD bucks in South eastern Nigeria by Opara *et, al*. (2010). However, these levels were within the baseline serum creatinine ranges (59.7 – 134.8 µmol/L) reported irrespective of the sex and breeds of goats by Aiello, (2000). The creatinine levels in blood and urine may be used to calculate the creatinine clearance (CrCl), which reflects the glomerular filtration rate (GFR). The GFR is clinically important because it is a measurement of renal or kidney function (Nabili and Shiel, 2010). In this study the serum creatinine levels in the WAD bucks were within the normal range reported by Aiello, (2000). This implies that the animals have properly functioning kidneys.

The serum cholesterol levels for the WAD bucks fed the crop by-products were not significantly ($P > 0.05$) different (Tale 2). The cholesterol levels ranged from 1.50 – 1.73 mmol/L with the WAD bucks fed T_1 (yam peels) exhibiting lower cholesterol levels as against the T_4 (ripe plantain peels) group with the highest cholesterol levels respectively. The levels of serum cholesterol recorded in this study were slightly higher than those reported by Opara *et al.* (2010) among WAD bucks (1.54 mmol/L) but lower than the reference serum cholesterol levels (1.7 – 3.5) for normal goats reported by Aiello, (2000). The serum cholesterol levels for the WAD bucks in this study were low. This situation gives a clear indication that the WAD bucks were normal and not susceptible to heart disease, since a high level of serum cholesterol is an indicator for diseases such as heart disease (Chatterjea and Shinde, 2007).

The blood urea nitrogen (BUN) levels for the WAD bucks fed crop by-products were not significantly ($P > 0.05$) different (Table 2). The BUN levels for the WAD bucks ranged between 31.60 and 36.62 mg/dl for T_1 (yam peel) and T_3 (sweet potato peel) groups respectively. The levels recorded in this study was higher than the reference values (12.6 – 25.8 mg/dl) reported by Aiello, (2000), but within the range (32. 25 – 37.30 mg/dl) for WAD goats when fed with feedstuffs with crude protein (CP) ranging between 8.44 – 29.85% (Ikhimioya and Imasuen, 2007), although the CP levels of the crop by-products used in this study were lower (Table 1). The BUN levels in the study were within the recommended limits which suggest that the kidneys and liver in the body of the WAD bucks were functioning well

The blood potassium (K) levels for the WAD bucks fed the crop by-products were significantly ($P < 0.05$) different (Table 2). Their blood K levels ranged between 3.79 mmol/L and 5.64 mmol/L in the animals fed T_4 (ripe plantain peels) and T_2 (cassava peels) respectively. The K levels recorded in this study were within the reference serum K values (3.8 – 5.7 mmol/L) for normal goats reported by Aiello, (2000). The maintenance of this K levels by the WAD bucks in this study suggests that this substance was able to maintain cellular tonicity, maintain fluid balance, maintain P^H, regulate metabolic processes as well as involved in regulation of neural and muscular function (Cheesebrough, 2004).

The blood sodium (Na) levels for the WAD bucks fed the crop by-products ranged between 135.49 – 141.50 mmol/L for the T_2 (cassava peel) and T_3 (sweet potato peel) groups respectively. The Na levels recorded in this study were within the reference serum Na values (136.6 – 151.5 mmol/L) for normal goats reported by Aiello, (2000). The maintenance of this Na levels by the WAD goats in this study suggests that this substance was able to maintain cellular tonicity, maintain fluid balance, maintain P^H, regulate metabolic processes as well as involved in regulation of neural and muscular function (Cheesebrough, 2004). Furthermore, Na and K as electrolytes are used to assess renal functions and since these values were within the normal range described above the normal body functions of the WAD goats were maintained.

The serum chloride levels for the WAD bucks fed the crop by-products were not significantly ($P > 0.05$) different. The serum chloride levels recorded were 103.50, 105.50, 108.50 and 110.00 mmol/L for T_1 (yam peels), T_3 (sweet potato peels), T_2 (cassava peels) and T_4 (ripe plantain peels) respectively. The chloride levels recorded in this study by the WAD bucks were within the reference serum chloride values (100.3 – 111.5 mmol/L) for normal goats reported by Aiello, (2000).The maintenance of the serum chloride within the normal

range for goats in this study suggests that the feeding of these crop by-products to WAD goats may not have any deleterious effects as to cause nephritis, diabetic acidosis or excessive fluid loss (Cheesebrough, 2004).

The blood calcium (Ca) levels for the WAD bucks fed the crop by-products were significantly ($P < 0.05$) different. The blood Ca levels ranged between 2.25 – 2.76 mmol/L for the T_3 (sweet potato peel) and T_1 (yam peel) groups respectively. The Ca levels recorded in this study by the WAD bucks were within the reference serum Ca values (2.25 – 2.90 mmol/L) for normal goats reported by Aiello, (2000). The maintenance of the serum calcium within the normal range for goats in this study suggests that the feeding of these crop by-products to WAD goats may not have any deleterious effects as to cause hyperparathyroidism, hypervitaminosis D, multiple myoloma and neoplastic disease in high serum Ca levels or osteomalacia, rickets and renal failure in low serum Ca levels among the WAD goats under investigation (Cheesebrough, 2004).

The blood phosphorus (P) levels for WAD bucks fed the crop by-products were as low as 3.75 mg/dl and as high as 4.77 mg/dl in the animals fed T_4 (ripe plantain peels) and T_2 (yam peels) respectively. The P levels recorded in this study by the WAD bucks were within the reference serum P values (3.7 – 5.7 mg/dl) for normal goats reported by Aiello, (2000). The maintenance of the serum phosphorus within the normal range by goats in this study suggests that the feeding of these crop by-products to WAD goats may not have any deleterious effects since a significant increase of the serum inorganic P level is often associated with nephritis and a mild rise may be associated with decreased parathyroid activity, while a decrease could indicate rickets and other related problems (Cheesebrough, 2004).

4.1. CONCLUSION

The utilization of the crop by-products has no deleterious effects on the nutritional and health conditions as determined by the blood analysis of the bucks. It's therefore recommended for use by goat producers as dry season feedstuffs.

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Table 1: Haematology of WAD Bucks fed the different crop by-products (peels)

Parameters	Crop by-products					
	T1	**T2**	**T3**	**T4**	**Mean**	**± SEM**
WBC(x 10^3/µL)	7.80^{b}	7.35^{b}	8.30^{b}	12.56^{a}	9.00	0.6
RBC(x 10^6/µL)	14.56^{ab}	15.22^{a}	13.87^{b}	11.45^{c}	13.78	0.73
Hb(g/dl)	8.90^{ab}	9.00^{a}	9.00^{a}	7.85^{c}	8.69	1.04
PCV (HCT) (%)	37.50^{b}	42.75^{a}	39.55^{ab}	32.95^{c}	38.19	5.06
MCV(fl)	21.40^{b}	22.95^{a}	18.45^{c}	17.15^{c}	19.99	1.34
MCH(pg)	6.15^{NS}	6.30^{NS}	6.00^{NS}	5.25^{NS}	5.93	0.53
MCHC (g/dl)	34.10^{NS}	33.95^{NS}	32.70^{NS}	31.15^{NS}	32.98	2.56
PLT(x 10^{11}/l)	4.25^{b}	5.52^{a}	4.25^{b}	3.76^{c}	4.45	0.38
LYMPHC (%)	52.55^{NS}	55.80^{NS}	59.25^{NS}	64.05^{NS}	57.91	2.9

T1 = Yam peels; T2 = Cassava peels; T3 = Sweet potato peels; T4 = Ripe plantain peels
WBC = White blood cells; RBC = Red blood cells; Hb = Haemoglobin; PCV (HCT) = Packed cell volume (Haematocrit); MCV = Mean corpuscular volume; MCH = Mean corpuscular haemoglobin; MCHC = Mean corpuscular haemoglobin concentration; PLT = Platelets; LYMPHC = Lymphocytes.

Table 2: Blood biochemistry of WAD goats fed the different crop by-products (peels)

Parameters	Crop by-products					
	T1	**T2**	**T3**	**T4**	**Mean**	**± SEM**
GLUC(mmol/L)	2.46^{NS}	2.55^{NS}	2.35^{NS}	2.30^{NS}	2.42	0.29
CREAT (µmol/L)	60.15^{NS}	64.50^{NS}	62.75^{NS}	60.00^{NS}	61.85	2.67
CHOLES (mmol/L)	1.50^{NS}	1.57^{NS}	1.70^{NS}	1.73^{NS}	1.63	0.12
BUN (mg/dl)	31.60^{NS}	32.02^{NS}	36.62^{NS}	34.02^{NS}	33.57	5.83
K (mmol/L)	5.27^{a}	5.64^{a}	4.03^{b}	3.79^{b}	4.68	0.52
Na (mmol/L)	139.57^{NS}	135.49^{NS}	141.50^{NS}	138.55^{NS}	138.78	1.85
Cl (mmol/L)	103.50^{NS}	108.50^{NS}	105.50^{NS}	110.00^{NS}	106.88	2.21
Ca (mmol/L)	2.76^{a}	2.74^{a}	2.25^{c}	2.43^{b}	2.55	0.08
INORGP (mg/dl)	4.77^{a}	4.52^{b}	4.52^{b}	3.75^{c}	4.39	0.14

^{a,b,c,}Means bearing different superscripts along the same row are significantly different ($p < 0.005$); T1 = Yam peels; T2 = Cassava peels; T3 = Sweet potato peels; T4 = Ripe plantain peels; GLUC = Glucose; CREAT = Creatinine; CHOLES = Cholesterol; BUN = Blood urea nitrogen; K = Potassium; Na = Sodium; Cl = Chlorine; Ca = Calcium; INORG P = Inorganic phosphorus.

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