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Haematology and Serum Biochemistryof Growing West African Dwarf (Wad) Goat Fed Graded Levels of Cassava Peels-Cassava Foliage Concentrate Supplements

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ABSTRACT:- Twenty West African Dwarf bucks about4-6 months with an average body weight of 5.02±0.20kg were used for a Completely Randomized Design experiment to investigate their haematology and serum biochemistry. They were randomly assigned to five dietary treatments: 100% cassava peel (Diet 1), 50:50 cassava peel - cassava foliage (Diet 2), 60:40 cassava peel- cassava foliage (Diet 3), 70:30 cassava peels-cassava foliage (Diet 4) and 80:20 cassava peels- cassava foliage (Diet 5). At the start of the experiment, all haematological parameters examined were not significantly ($P<0.05$) influenced but all parameters except mean corpuscular haemoglobin were significantly ($P<0.05$) affected at the end of the experiment. Significant ($P<0.05$) value increase was observed for lymphocyte in diets 2, 3, 4 and diet 5. Neutrophil showed significant ($P<0.05$) value increase only for diet1 and 5. Serum biochemical indices at the start of the experiment showed significant ($P<0.05$) difference for ALT and AST. Total protein, globulin, creatinine, ALT and AST showed significant ($P<0.05$) variation across the treatments at the end of the trial. The study revealed that cassava peels- cassava foliage supplementation to growing WAD goats has potentials to improve blood components without deleterious effects on the physiology and health status of the goats.

Key words: Cassava, foliage, haematology, serum biochemistry, WAD.

I. INTRODUCTION

Livestock production remains one of the veritable ways of achieving sustainable and rapid production of high quality protein to meet the increasing demand of the Nigerian teeming populace [1]. In Nigeria, there is inadequate supply of livestock feeds both in quantity and quality. This thereby leads to slow growth of animals culminating into reduced meat and milk yield especially in ruminants. The growth and development of animal industry is confronted by high cost of feed and drugs and their occasional shortages [2]. Obviously, the high price of conventional feed ingredients in Nigeria has triggered feed production cost to about 80% of the total cost of livestock production[3].This calls for the need to incorporate cheap source of concentrate supplementation in small ruminant production enterprise. Goats are multipurpose animals producing meat, milk, skin and hairs. However, out of these products, meat is the major form in which goats are consumed in Nigeria [4]. Goat meat is widely accepted and consumed in Nigeria because there is no taboo against consumption of chevon across cultural and intercultural boundaries.

Cassava peel forms the bulk of residues from cassava root after post-harvest and processing. It is a good source of energy in ruminant feeding systems, serving either as the main basal diet or as a supplement. Poultry manure, cassava foliage and cassava peels are materials whose utilization have not attracted competition by man, livestock and feed processing industry in Nigeria [5]. Presently, these wastes constitute environmental nuisance in that their disposal becomes a menace. These materials could be harvested and harnessed into a dry season feed for ruminant by this approach feed problem would be alleviated [6]

Hematological studies are of ecological and physiological interest in helping to understand the relationship of blood characteristics to the environment [7] and so could be useful in the selection of animals that are genetically resistance to certain diseases and environmental conditions [8]. Blood act as a pathological reflector of the status of exposed animals toxicant and other conditions [9]. [8] stated that animals with good blood composition are likely to show good performance. Blood constituents change in relation to the physiological condition of health [10]. This study was conducted to investigate haematology and serum biochemistry of growing West African Dwarf goats fed cassava peel meal- cassava foliage supplements.

II. MATERIALS AND METHODS

This experiment was conducted at the goat unit of the teaching and Research farm of Kogi State University, Anyigba. Anyigba lies between latitude $7^0$5'N and $7^0$21'E of the equator and longitude 7°ll'N and 7°32'E of the Greenwich meridian with an attitude of about 420m above sea level. The zone is characterized by 6-7 months of average annual rainfall of about 1600mm and the daily temperature ranges between 25°C and 35°C[11]. Processed cassava peel was obtained from Ojiapata Cluster Livestock Feeds along Ankpa road and cassava foliage was obtained from Anyigba and its environs. The foliage was sundried for two to three days and milled before included in diet compounding. A total of twenty growing West African Dwarf bucks of about 4-6 months with an average body weight of 5.02±0.20kg were obtained from goat producers within Anyigba town for a 60 days experiment. Goats were housed in well-ventilated wooden cages in the pens. Before the goats were brought in, the pen was cleaned, washed and disinfected with izal solution two weeks prior to arrival. The entire goat house was fumigated using strong fumigants (Dimethoate 40% and Action 40%) against fleas. Prophylactic treatments were given to all the goats: they were dewormed and vaccinated against pests des petits ruminantae (PPR). Treatment against ecto-parasites was done with the use of Amitraz solution. Multivitamin was also administered to boost appetite. A14 day adjustment period was allowed for the goats before data collection commenced. The goats were randomly assigned to five treatments with four replicates in a Complete Randomize Design (CRD). 100% treated cassava peel was allotted to as diet 1, 50% untreated cassava peel + 50% cassava foliage was allotted to diet 2, 60% untreated cassava peel + 40% cassava foliage was allotted to diet 3, 70% cassava peel + 30% cassava foliage allotted to diet 4 and 80% Cassava peel + 20% cassava foliage allotted to diet 5 respectively. Goats were fed daily supplementary diets on 5% body weight after about 5-6 hours daily grazing.

2.1 Procedure of Blood collection

Blood sample was collected at the end of the experiment from four goats per treatment. The animals were bled in the morning between early morning hours to avoid excessive bleeding. Blood sample was collected from the jugular vein using sterile disposable needle after sterilizing the collection site with antiseptic. Specimen for hematological evaluation was collected into EDTA (ethylene diamine tetra acetic acid) treated tubes to prevent coagulation, the hematological indices determined were packed cell volume (PVC), red blood cell (RBC), white blood cell (WBC), hemoglobin (Hb), means corpular volume (MCV), means corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC). PVC was determined using wintrobe micro-haematocrist method [12]. Haemoglobin was determined by cyanomethaemoglobin method[13]. The improved neubaer haemocytometer method describe by [14] was used to determine WBC. Mean corpuscular volume (MCV), means corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were computed as outlined by [14]. Sample for serum biochemical analysis were centrifuged and subjected to laboratory analyses. Total protein, ALT and AST were determined using spectrophotometer.

III. STATISTICAL ANALYSIS

Data collected for haematological and serum biochemistry parameter were subjected to analysis of variance (ANOVA) and significant differences between means were separated using Duncan Multiple Range test (SPSS Version 19)

Table 1: Gross Composition of experimental diet (%)

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Cassava Peels	100	50	60	70	80
Cassava Foliage	-	50	40	30	20
Total	100	100	100	100	100

IV. RESULTS

Table 1 showed nutrient composition of supplementary diets, Dry matter ranged from 89.16% to 90.95% with diet 5 having the highest value. Crude protein was higher (15.35%) in diet 2 than other treatments. Crude fibre ranged from 4.45% to 8.09% while ether extract was higher in diet 2 (2.69%) and lower in the control diet (0.82%). Values of ash content ranged between 2.50% and 2.88% while nitrogen free extract was higher in control diet (86.53%) and lower in diet 2 (70.97%).

Table 2: Proximate Composition of graded levels of cassava peels- cassava foliage concentrate (%)

Nutrients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Dry Matter	89.16	90.05	89.88	89.69	90.95
Organic Matter	86.66	87.17	87.08	86.96	88.30
Crude Protein	5.27	15.35	13.33	11.32	9.30
Crude Fibre	4.45	8.09	7.37	6.64	5.90
Ether Extract	0.82	2.69	2.31	1.94	1.57
Ash	2.50	2.88 70.99	2.80	2.73	2.65
Nitrogen Free Extract	86.12		74.19	77.37	80.58

4.1 Haematological Profile of WAD goats fed cassava peel meals – cassava foliage concentrate supplements

The result of haematological parameters of WAD goats fed cassava peel – cassava foliage concentrate is presented in Table 3.

At the start of the experiment, all parameters were not significantly (P>0.05) influenced by dietary treatments. PCV values ranged from 29.00% in diet 5 to 32.00% in diet 1. Haemoglobin value was highest (10.70g/dl) in 70%: 30% of cassava peel – cassava foliage inclusion level. Red blood cell values ranged from 2.06 x 10^{12}/l to 2.81 x 10^{12}/l with diet 3 having the highest value. White blood cell value was higher in diet 4 (23.35 x 10^{9}/l). Mean corpuscular haemoglobin (MCH) fell between 32.95pg and 43.00pg while mean corpuscular haemoglobin concentration (MCHC) ranged between 32.00g/d to 40.00g/d. Higher value of mean corpuscular volume (fl) was observed in diet 4 (117.45fl). Lymphocyte was higher (79.00%) in diet 5 while neutrophil ranged between 20.50% and 43.00%.

At the end of the experiment, all parameters examined were significantly (P<0.05) influenced by dietary treatment except MCHC. There was a slight decline in the values of PCV in diet 1, 2, 3 and 4 while diet 5 slightly increased. Haemoglobin values observed followed the decline trend for diet 1, 2 and 4 while diet 3 and 5 significantly (P<0.05) increased with diet 3 having the highest value. Values of red blood cell were significantly higher in diet 1, 2, 4 and 5 than the observed values at the start of the experiment. Diet 5 was significantly (P<0.05) higher among the treatment while white blood cell values increased significantly in diet 1, 2, 4 and 5. The observed values of MCH increased in diet 1, 3 and 5 and ranged from 36.50pg to 52.00pg with diet 5 having the highest value. MCV values were significantly influenced by dietary treatment having value range of 109fl and 142.90fl with diet 3 having the highest value. Values of lymphocyte were significantly affected (P<0.05) by the dietary treatment with higher values for diet 2, 3, 4 and 5 above the observed values at the start of the experiment with diet 4 having the highest value (81.00%). Neutrophil followed a different trend whereby values obtained in diet 2, 3 and 4 decreased while diet 1 and 5 had higher values compared to values obtained at the beginning of the experiment.

Table 3: Hematological parameters of WAD goats fed on diets containing cassava peels and cassava foliage

Parameters			**Diets**				
At the start of the experiment	1	2	3	4	5	SEM	LOS
Packed Cell Volume (%)	32.00	30.50	29.50	31.00	29.00	0.54	NS
Haemoglobin(g/dl)	10.50	10.60	9.35	10.70	9.90	0.28	NS
Red blood cell(x10^{12}/l)	2.27	2.06	2.81	2.24	2.09	0.12	NS
White blood cell (x10^{9}/l)	20.25	16.40	20.35	23.35	18.70	1.46	NS
MCH(pg	32.95	40.00	43.00	42.35	36.35	1.83	NS
MCHC(g/l)	32.00	40.00	33.40	35.35	32.70	1.41	NS
MCV(fl)	115.35	101.35	116.05	117.45	107.20	2.64	NS
Lymphocyte (%)	75.50	56.00	75.50	76.00	79.00	3.50	NS
Neutrophil (%)	24.00	43.00	23.00	23.00	20.50	3.55	NS
After the experiment							
Packed Cell Volume (%)	29.00^{c}	30.00^{b}	31.50^{a}	28.00^{d}	30.00^{b}	0.39	*
Haemoglobin(g/dl)	9.70^{c}	10.00^{b}	10.30^{a}	9.30^{d}	10.15^{ab}	0.12	*
Red blood cell(x10^{12}/l)	2.66^{bc}	2.68^{b}	2.61^{c}	2.28^{d}	2.84^{a}	0.06	*
White blood cell (x10^{9}/l)	31.10^{a}	24.00^{ab}	19.50^{b}	23.80^{ab}	20.40^{b}	1.55	*
MCH(pg	36.50^{c}	37.30^{c}	52.00^{a}	40.70^{b}	37.00^{c}	1.94	*
MCHC(g/l)	33.40	33.30	33.20	33.20	33.80	0.10	NS
MCV(fl)	109.00^{c}	111.90^{c}	142.90^{a}	122.80^{b}	109.35^{c}	5.62	*

Lymphocyte (%)	63.00^{d}	88.00^{a}	77.00^{c}	81.00^{b}	79.50^{b}	2.74	*
Neutrophil (%)	37.00^{a}	12.00^{c}	22.00^{b}	19.00^{bc}	26.50^{b}	2.85	*

a,b,c,d with different superscripts are significant different

4.2 Serum Biochemistry of WAD Goats Fed Cassava Peel–Cassava Foliage Concentrate Supplement

The result of serum biochemistry of WAD goats cassava peel – cassava foliage concentrate supplement is presented in Table 4. At the start of the experiment serum biochemistry parameters were not significantly influenced (P>0.05) by dietary treatment for total protein, albumin, globulin, creatinine and urea but significant values (P<0.05) were obtained for alanine transaminase and aspartate transaminase. Total protein ranged from 4.15g/dl to 5.15g/dl with diet 4 having higher value. Globulin followed similar values trend in diet 4 while albumin had higher value in diet 5. Values of creatinine ranged from 69.50mol/dl to 110.50mol/dl. Urea followed similar trend as observed for creatinine. Alanine transaminase ranged between 5.50iμ/l and 8.00iμ/l with higher values in diet 5. Aspartate transaminase had the highest values in diet 3(142iμ/l). At the end of the feeding trial, significant values (P<0.05) of serum biochemical profile were obtained for total protein, globulin, creatinine, alanine transaminase and aspartate transaminase while albumin and urea were not significantly influenced (p>0.05) by dietary treatment. Total protein significantly (P<0.05) increased across the treatments values were higher than those at the beginning of the experiments. Observed values ranged between 5.50g/dl and 7.40g/dl with diet 4 having higher values. Globulin ranged from 1.45g/dl to 3.50g/dl with diet 4 having higher value thereby following similar trend of higher value with total protein. Creatinine fell between 57.80mol/dl and 95.30mol/dl. Lower values of creatinine were observed at the end of the experiment than at the beginning of the experiment. Values of alanine transaminase were significantly higher than those recorded at the beginning of the experiment. Observed values of ALT fell between 6.00iμ/l and 16.00iμ/l with diet 1 having the higher value. On the other hand, values obtained for AST at the end of the experiment declined compared to those at the start of the experiment. AST values ranged between 46.25iμ/l and 82.20iμ/l with higher value in diet 4.

Table 4: Serum Biochemical Indices of WAD goats fed on cassava peels and cassava foliage

Parameters			**Diets**				
At the start of the experiment	1	2	3	4	5	SEM	LOS
Total Protein (g/dl)	4.85	4.45	4.35	5.15	4.15	0.20	NS
Albumin (g/dl)	2.45	2.05	1.90	2.65	2.35	0.18	NS
Globulin (g/dl)	2.40	2.40	2.45	2.50	1.80	0.18	NS
Creatinine (mol/dl	104.00	110.50	101.00	69.50	98.50	6.04	NS
Urea (mmol/l	6.20	6.90	5.40	3.30	4.35	0.02	NS
ALT (iμ/L)	8.00^{ab}	6.50^{ab}	7.00^{ab}	5.50^{b}	9.00^{ab}	0.48	*
AST (iμ/L	85.50^{b}	122.50^{ab}	142.00^{a}	130.50^{ab}	125.00^{ab}	7.91	*
After the experiment							
Total Protein (g/dl)	6.00^{ab}	5.50^{b}	6.55^{ab}	7.40^{a}	5.85^{ab}	0.26	*
Albumin (g/dl)	3.60	3.80	3.75	3.90	4.05	0.66	NS
Globulin (g/dl)	2.40^{ab}	1.70^{b}	2.80^{ab}	3.50^{a}	1.45^{b}	0.28	*
Creatinine (mol/dl	77.60^{b}	95.30^{a}	57.80^{c}	57.80^{c}	77.60^{b}	5.34	*
Urea (mmol/100ml)	2.59	2.20	2.10	2.50	2.20	0.05	NS
ALT (iμ/L)	16.00^{a}	9.00^{c}	6.50^{d}	6.00^{d}	12.95^{b}	1.30	*
AST (iμ/L	82.20^{b}	66.60^{c}	46.25^{d}	88.20^{a}	58.70^{d}	5.12	*

a,b,c,d with different superscripts are significant different.

V. DISCUSSION

Dry matter content of the supplementary diet was higher ranged between 89.16% and 90.95%. These values were higher than 67.22% to 78.29% reported by [15]. Dry matter values were contrastingly lower than 92.7% to 93.88% reported by [16] for cassava whole plant diets supplemented with poultry manure. Crude protein and the crude fibre were lower than 24.94% to 28.10% and 11.50% to 13.62% reported by [15] for *leucaenia*, *Gricidia* and cassava leaf meal- cassava peel meal based diets. Crude protein values were comparable with 12.55% to 14.56% reported by [17] while ether extract values were lower than 3.50% to 5.15% reported by the same author for WAD for grade levels of *Gmelina arboreal* and cassava peel concentrate fed to WAD sheep. Values of ash obtained in this study were lower than 6.36% to 7.45% reported by [18] for cassava leaf meal concentrate fed to WAD lambs. Observed values for nitrogen free extract ranged from 86.53% and 70.99%. These values are higher than 50.93% to 63.60% reported by [19] for cassava peels and urea multinutrient block

fed to WAD goats. The nitrogen free extract showed the potentials of the diets as an excellent source of fermentable carbohydrates for the animal optimum ruminal activity and ecology. [20] identified cassava based diets (cassava tubers and cassava leaf meals) as potent sources of fermentable carbohydrates and fermentable protein that could promote the activities of the rumen microbes.

PCV values were reduced at the end of the experiment in diet 1, 2 and 4. This might be attributed to concentration of hydrocyaninde present in the dietary component of the experimental diet. The values obtained were nevertheless within the normal range of 22% to 38% reported by [21] for WAD goats and 22% to 27% reported by [22] for Red Sokoto goats. [23] also reported 22% to 38% as normal ranged for healthy goats while [24] noted 22% to 31% as normal PCV ranged for WAD goats. The values of PCV obtained in this study were comparably lower than values reported by [25] but higher than 28.30 to 28.80% reported by [15] also values are higher than 16% to 23% reported by [19] the values of haemoglobin fell between 9.35g/dl and 10.70g/dl these values were within the normal values of 7.15g/dl indicated by [22]; [26] for normally healthy goats. These values suggested absence of anaemic condition occasioned by deficiency of iron and inadequate utilization. [17] reported 6g/dl to 8g/dl for haemoglobin in WAD sheep fed graded levels of *Gmelina arboreal* leaves and cassava peels concentrate under different management system. [15] reported 10% to 11%g/dl for WAD goats fed *leukania, Gliricidia* and cassava leaf meal– cassava peel based diets. Red Blood Cell obtained at the end of the experiment were higher in values than at the beginning of the experiment especially for diet 1, 2 ,4 and 5. This suggests nutritional potential of cassava peels and cassava foliage for haematopoesis. Values of RBC obtained from the study fell below 7 – 10.00 x 10^{12}/l reported by [24] for WAD goats. Also [27] reported 10.4 x 10^{12}/l - 13.2 x 10^{12}/l for WAD goats. [28] indicated that supplementing cassava foliage and cassava peel did not have adverse effects on ruminants that are apparently healthy. This gives credence to higher values of RBC obtained at the end of the experiment. Significant higher values of white blood cell were obtained at the end of the experiment in diet 1, 2, 4 and 5. These values obtained from this study were higher than 7.83 x 10^{3}µl/l – 10.85 x 10^{3} µl reported by [29] for WAD sheep fed cassava peel supplemented with varying proportion of rumen epithelia waste (REW). Values of WBC in this study disagree with declined values at the end of the experiment reported by [29]. Higher values of WBC at the end of this experiment might be attributed to nutritional potential of concentrate supplement fed with the animals as well as efficient utilization of dietary treatment which boosted the immune system of the animals. Significant higher values of MCH for diet 1, 3, and 5 were observed at the end of the experiment. Values obtained from this study were higher than 10.04pg – 11.20pg reported by [17] for WAD sheep fed graded levels of *Gmelina arboreal* leafs and cassava peel concentrate under different management system. These values are higher than 1.90pg – 3.22pg reported by [30] for WAD sheep fed *cajanus–cajan* feed blocks as supplements. However, obtained values of this study are within the normal range reported in the literature. Hence, indicating sufficiency of the concentrate supplement for better physiological status of the animals. Observed values of lymphocyte increased across the treatment over the values observed at the start of the experiment. These values ranged between 47 – 82% reported by [26]. Neutrophil declined across the treatment with diet 1 having higher value above 24% at the start of the experiment. The values were lower than 29.65% and 60.50% reported by [30] but comparable to 22.35% and 28.80% reported by [17]. The values are within the normal range of 30 – 38% reported by Oni *et al* (2017) for WAD goats and 34.0% - 39.1% stated by [31] for Red Sokoto goats.

Serum protein obtained in this study compared favourably with the values stated by [32] for healthy goats. Serum protein values were higher at the end of the experiment were higher than at the start of the experiment this suggest nutritional potential of the experimental diet to boost serum biochemical indices of the animals for better physiological performance. It also gives an indication that animals utilize the diets efficiently without adverse effect on the health status of the animals. Creatinine and urea values declined at the end of the experiment, the values fell comparably within 59.7mmol/l – 134.8mmol/l reported by [33]. This implies that the kidney of the animals function well without during the course of the experiment.

Furthermore, the relatively low values of creatinine and urea at the end of the experiment indicated that the rumen ecology of the animals GIT efficiently utilized the diet leading to urea recycling and nitrogen conservation [34]. Higher values of serum protein at the end of the experiment imply that cassava peel – cassava foliage supplementation can improve immunity in the experimental goats. This indicates animals' defense against infection can be boosted through cassava peel – cassava foliage supplementation as evidence by serum globulin immunological function. ALT and AST were significantly different at the end of the experiment and fell within the normal range for goats (5.38iµ/l– 35.5iµ/l) for ALT and (83.00iµ/L – 135.95iµ/l) for AST according to[32]. This suggests that enzyme concentration is believed to increase the local concentration of inorganic phosphate or to activate the collagen fibre in such a way that they cause deposition of calcium salts[35]. Values of ALT and AST which fell within the range in the literature indicate the potential of dietary supplement to improve bone formation in growing goats. [36] indicated that higher values of AST above the normal range may signal necrosis and myocardial infarction indicating poor quality protein of the diets fed. These imply that values obtained in this study suggest that dietary supplement supply good quality protein to the

animals. [37] opined that ALT and AST test are primarily carried out for the assessment of hepatocellular injuries in animals especially in non – clinical studies. They help to detect hepatocellular necrosis. However, our result from this study for ALT and AST indicated no hepatocellular necrosis in the animals. [38] noted that hepatotoxicity may lead to elevation of the normal values due to inability of the body to excrete it through the bile as a result of the congestion or obstruction of the biliary tract.

VI. CONCLUSION

In conclusion, results obtained from this study showed that feeding cassava peel - cassava foliage concentrate supplements to goats does not seem to pose any deleterious effect on haematology, serum biochemical indices of the animals, rather, it showed its nutritional potentials to improving animals blood components.

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