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RESEARCH ARTICLE

Hematology and Serum Biochemistry of Growing West African Dwarf Goats Fed Cassava Peel with Supplemental Nitrogen Sources

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ABSTRACT

A 60-day feeding trial was conducted with 40 growing West African Dwarf bucks aged 5–7 months with an initial average weight of 5.25 kg ± 0.35 to determine their hematological and serum biochemical parameters. The goats were randomly allocated to five treatments namely: T1 (100% urea-treated cassava peel), T2 (60% untreated cassava peel + 40% cassava foliage), T3 (60% untreated cassava peel + 40% poultry manure), T4 (60% untreated cassava peel + 20% cassava foliage + 20% treated cassava peel), and T5 (60% untreated cassava peel + 20% cassava foliage + 20% poultry manure) in a complete randomized design. Each treatment was split into eight replicates. At the end of the feeding trial, blood samples were collected from four goats per treatment to evaluate the following hematological indices: packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and MCH concentration (MCHC). Serum parameters determined were total protein (g/dL), albumin (g/dL), globulin (g/dL), creatinine (mg/dL), alkaline phosphatase (ALP) (iu/L), alanine transaminase (ALT) (iu/L), aspartate aminotransferase (AST) (iu/L), and urea (iu/L). PCV, RBC and WBC showed significant ($P<0.05$) difference among the treatment groups while other haematological parameters examined showed no significant differences ($P>0.05$). Serum biochemical parameters indicated that total protein ranged from 4.10 to 5.18 g/dL, albumin: 1.90–2.55 g/dL, creatinine: 0.08–1.28 mg/dL, ALP: 53.18–96.95 iu/L, ALT: 138.75–176.50 iu/L, globulin: 2.20–3.03 iu/L, AST: 16.18–17.58 iu/L, and urea: 17.60–23.75 iu/L. All the values obtained for hematological and serum biochemical parameters were within the normal ranges for growing goats. This indicates that feeding of cassava peel with supplemental nitrogen sources had no deleterious effect on the body physiology and health of the animals.

Key words: Hematological, serum biochemistry, West African dwarf goats and urea

INTRODUCTION

Nutrition is the most important consideration in any livestock enterprise. Therefore, the survival of the livestock industry is dependent on the availability of feedstuffs, which are mainly components of human food.[1] The aim of keeping livestock is for the production of high-quality protein. In the rural areas where most of the poor farmers in Africa live, including Nigeria, goats play an important socioeconomic role and form an integral part of the cultural life system of peasantry.[2] Goats are possibly the most distributed domestic livestock; their wide distribution is partially explained by their ability to thrive in environments where vegetation is scarce. Ruminant animals can be fed most only on cassava tuber, but also the stem, leaves, peels, and various by-products of tuber processing such as residues from starch, garri and fufu. Hydrogen cyanide (HCN) toxicity is considered to be a limiting factor in using a high level of cassava leaf in

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the diet of monogastric animals.[3] However, ruminants can neutralize the harmful effect of HCN through the activities of the rumen microbes and can therefore utilize cassava leaves more efficiently. Cassava peels form the bulk of residues from cassava root after post-harvest 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 has not attracted competition by man.[3] At present, these wastes constitute environmental nuisance. These materials could be harvested and harnessed into a dry season feed for ruminant animals which will help to alleviate feed problem.[4] Poultry litter is an agricultural waste from poultry farms in the rural, suburban, and industrial settlements which often constitute health hazard due to inadequate means of disposal, especially when not utilized as fertilizer. Nitrogen content of poultry manure is high.[4] This indicates that offering it to ruminant animals would be a first-rate avenue to turn nutrient in the waste into animal products for human use. Poultry litter is rich in macro- and microminerals such as calcium, potassium, sodium, chlorine, and copper. Protein supplementation cost can be reduced if a portion of the protein comes from non-protein nitrogen (NPN) sources such as urea. It has been noted that blood sampling for the assay of biochemical constituents and hematological traits is frequently employed in nutritional studies. Changes in the constituent composition of blood when compared to normal values could be used to interpret the metabolic state of the animal as well as the quality of feed offered to the animal.[5] Hematological profiles both in human and animal sciences are important indices of the physiological state of the individual.[6] The hematological features have attracted many researchers to look at this profile to make clinical predictions of the health status of a specific animal. The blood constituents change with the advancement of the animal's age and also vary with certain conditions as stress, bacteria/viral infections, and intoxication.[6] Blood with its myriad of constituents provides a valuable medium both for clinical investigations and nutritional evaluation of the organism.[7] The study sought to determine the influence of cassava peel with supplemented nitrogen sources on the hematology and the serum biochemistry of West African dwarf (WAD) goat.

MATERIALS AND METHODS

Experimental site

This experiment was conducted at the Sheep and Goat Unit of the Teaching and Research Farm of Kogi State University, Anyigba, Nigeria. Anyigba lies between latitude 7°5'N and 7°21'E of the equator and longitude 7°11'N and 7°32'E of the Greenwich meridian with an altitude of about 420 m above sea level. The zone is characterized by 6–7 months of the average annual rainfall of about 1600 mm, and the daily temperature ranges between 25°C and 35°C.[8]

Experimental feed and treatment

Fresh cassava peels, free from stumps, were collected and grated before being subjected to hydraulic press for dewatering. The dewatered peels were then pulverized and sieved to obtain the coarse mash, which was then sun-dried for 2–3 days before being loaded into bags for feeding animals. Cassava foliage was obtained from Anyigba and environs. The foliage was harvested fresh and sun-dried until the leaves became brittle for milling. Poultry manure was obtained from poultry enterprise that installed the battery cage system and sundried for 5–7 days, to enable easy milling. 100 kg of cassava peels was treated with 4 kg of urea fertilizer dissolved in 100 L of water and sprayed over the cassava peel and pressed to eliminate air while in the container. This was covered with a plastic sheet and ensiled for 21 days before usage for diet formulation.[9] Five supplementary experimental diets were compounded, namely T1 (100% urea-treated cassava peel), T2 (60% untreated cassava peel + 40% cassava foliage), T3 (60% untreated cassava peel + 40% poultry manure), T4 (60% untreated cassava peel + 20% cassava foliage + 20% treated cassava peel), and T5 (60% untreated cassava peel + 20% cassava foliage + 20% poultry manure).

Management of experimental animals

A total of forty (40) WAD bucks of about 5–7 months, with initial weights between average weight of 5.25 kg ± 0.35 were obtained from goat producers within Anyigba town. The goats were treated against

ectoparasites and endoparasites, besides vaccination against peste des petits ruminants.

Experimental diet and method of feeding

The goats were randomly assigned to five treatments groups [Table 1] with eight replicates in a completely randomized design. A 14-day adjustment period was allowed for the goats before data collection commenced. The experimental goats were allowed to graze for about 7 h around the University Teaching and Research Farm, after which, they were fed supplementary ration based on 3% body weight.

Procedure for blood collection

Blood samples were collected at the end of the experiment from four goats per treatment. The animals were bled through the jugular vein in the morning. Specimens for hematological evaluation were collected into ethylenediaminetetraacetic acid (EDTA)-treated sample bottles to prevent coagulation. The hematological indices determined were packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), hemoglobin (Hb), mean corpuscular volume, mean corpuscular hemoglobin (MCH), and MCH concentration (MCHC). Hematological studies were carried out according to Jain (1986).[10] Specimens for biochemical evaluation were collected into sample bottles without EDTA, and the parameters (total protein, albumin, globulin, creatinine, alanine transaminase [ALT], aspartate aminotransferase [AST], and urea) were analyzed using the method described by Ogunsami *et al*.[11]

Statistical analysis

Data collected were subjected to analysis of variance, and significant differences between means were separated using Duncan's multiple range test,[12] with the aid of SPSS Version 17 Computer Software Package.

RESULTS AND DISCUSSION

Proximate composition in (%) of the supplemental diets is presented in Table 2. Dry matter contents ranged between 83.38% and 85.60%. These values were comparable to 83.13–88.21% reported by Onwuka *et al*. (1999)[13] for cassava peel molasses urea multinutrients blocks. Crude protein (CP) contents ranged from 9.95% to 11.89% which is adequate for goat nutrition.[14] Crude fiber (CF) contents were lower than the values reported by Ukanwoko and Ironke.[15] Ether extract (EE) ranged from 3.13% in T1 to 3.99% in T5. These values are lower than 3.02–6.84 reported by Gabriel *et al*.[16] Ash contents ranged between 4.82% and 5.77%. These values are lower than 8.89–11.00% reported by Kalio *et al*.[17] Nitrogen-free extract values ranged between 52.56% and 56.01%. These values were higher than the values reported by Ukanwoko *et al*.[18] The dry matter, CP, CF, EE, and ash values obtained in this study were higher than those reported by Anaeto *et al*.[2] These variations may be attributed to differences in location, plant species, and growth rate of forage plants and processing methods of cassava peels.

The haematological indices of experimental goats fed urea treated cassava peels enriched with supplemental nitrogen is presented in Table 3. Hematological parameters such as PCV, RBC, and WBC measured were significantly different ($P < 0.05$) across the treatments. The PCV values ranged from 29.05 to 32.00% across the treatments. The values for PCV were significantly ($P < 0.05$) different; the observed value fell within the

Table 1: Gross composition (%) of experimental diets

Ingredients	T1	T2	T3	T4	T5
Cassava peel meal+urea	100	-	-	20	-
Untreated cassava peel meal		60	60	60	60
Poultry manure	-	-	40	-	20
Cassava foliage	-	40	-	20	20
Total	100	100	100	100	100

Table 2: Proximate composition of supplementary diets

Nutrients (%)	T1	T2	T3	T4	T5
Dry matter	85.60	83.23	83.63	84.40	82.38
Crude protein	9.95	11.85	11.09	10.70	10.89
Crude fibre	10.95	10.25	10.62	10.15	9.68
Ether extract	3.13	3.25	3.52	3.20	2.95
Ash	5.55	5.25	5.77	5.15	4.85
Nitrogen-free extract	56.01	52.56	52.63	55.63	55.87

T1=100% urea-treated cassava peel, T2=60% untreated cassava peel+40% cassava foliage, T3=60% untreated cassava peel+40% poultry manure, T4=60% untreated cassava peel+20% cassava foliage+20% urea-treated cassava peel, T5=60% untreated cassava peel+20% cassava foliage+20% poultry manure

Table 3: Hematology of West African Dwarf goats fed cassava peel with supplemental nitrogen sources

Parameters	T1	T2	T3	T4	T5	SEM	LOS
Packed cell volume (%)	29.25^{b}	29.50^{b}	32.00^{a}	30.50^{ab}	31.50^{ab}	0.17	*
Hemoglobin (g/dl)	10.00	9.98	10.80	10.60	10.88	0.13	NS
Red blood cell ($\times10^{6}$/mm)	2.47^{b}	2.19^{c}	2.47^{b}	2.58^{b}	6.87^{a}	0.15	*
White blood cell ($\times10^{3}$/mm)	13.93^{c}	15.45^{a}	14.35^{b}	13.35^{c}	14.43^{b}	0.13	*
Mean corpuscular hemoglobin (Pg)	41.50	45.25	44.25	41.75	46.00	0.33	NS
Mean corpuscular hemoglobin concentration (g/l)	34.12	33.65	33.78	35.28	34.38	0.17	NS
Neutrophil (%)	34.75	34.25	39.50	22.25	32.00	0.20	NS
Lymphocyte (%)	70.25	65.25	60.00	75.00	67.50	0.29	NS
Monocyte (%)	0.00	0.50	0.25	0.25	0.00	0.14	NS
Eosinophil (%)	0.00	0.00	0.25	0.25	0.25	0.42	NS
Basophil (%)	0.00	0.00	0.00	0.00	0.25	0.17	NS

^{a,b,c}Means with significant superscript on the same row differ significantly (P<0.05). *Significant (P<0.05), SEM: Standard error of mean, LOS: Level of significance, NS: Not significant (P>0.05). T1=100% urea-treated cassava peel, T2=60% untreated cassava peel+40% cassava foliage, T3=60% untreated cassava peel+40% poultry manure. T4=60% untreated cassava peel+20% cassava foliage+20% urea-treated cassava peel, T5=60% untreated cassava peel+20% cassava foliage+20% poultry manure

Table 4: Serum biochemistry of West African Dwarf goats fed cassava peel with supplemental nitrogen

Parameters	T1	T2	T3	T4	T5	SEM	LOS
Total protein (g/dL)	5.18^{a}	4.53^{ab}	5.03^{ab}	5.15^{a}	4.10^{b}	0.20	*
Albumin (g/dL)	2.55^{a}	1.93^{b}	2.23^{ab}	2.13^{ab}	1.90^{b}	0.08	*
Globulin (g/dL)	2.63	2.60	2.80	3.03	2.20	0.08	NS
Creatinine (mg/dL)	1.10^{ab}	0.08^{ab}	0.93^{ab}	0.88^{ab}	1.28^{a}	0.07	*
ALP (iu/L)	68.78^{ab}	53.18^{b}	80.63^{ab}	96.95^{a}	65.15^{ab}	0.07	*
AST (iu/L)	17.58	16.18	17.38	16.95	17.00	0.73	NS
ALT (iu/L)	172.75^{b}	176.50^{a}	140.75^{d}	156.75^{c}	138.75^{c}	0.20	*
Urea (mg/dL)	23.75	18.13	17.60	17.98	19.05	0.95	NS

^{a,b,c}Means with significant superscript on the same row differ significantly (P<0.05). *Significant (P<0.05), SEM: Standard error of mean, LOS: Level of significance, NS: Not significant (P>0.05), ALT: Alanine aminotransferase, AST: Aspartate aminotransferase, ALP: Alkaline phosphatase. T1=100% urea treated cassava peel, T2=60% untreated cassava peel+40% cassava foliage, T3=60% untreated cassava peel+40% poultry manure, T4=60% untreated cassava peel+20% cassava foliage+20% urea treated cassava peel, T5=60% untreated cassava peel+20% cassava foliage+20% poultry manure

range of 22–38% as reported by Oni *et al.*[19] and Merck[20] for normal healthy animals. These values are equally similar to the values as reported by Daramola *et al*.[21] The Hb values obtained in this study ranged between 9.98 and 10.88 (g/dL) across the treatments; these values indicated the absence of microcytic and hypochromic anemia occasioned by iron deficiency or its improper utilization for the formation of Hb.[22] However, the values fell within the range for normal and healthy grower goats as reported by Njidda *et al.*[23] The RBC values ranged between 2.19 ($\times10^{6}$ mm) and 6.87 ($\times10^{6}$ mm) across the treatments. RBC values were highest in T5 (with a diet containing untreated cassava peel + cassava foliage and poultry manure). The highest RBC value obtained in treatment 5 shows the nutritional quality of cassava peels, cassava leaves, and poultry manure diet when fed to WAD goats. The WBC values of 13.35 ($\times10^{3}$ mm) to 15.45 ($\times10^{3}$ mm) recorded in this experiment were within the range of 6.8–20.1 ($\times10^{3}$ mm) as reported by Opara *et al*.[24] These values obtained for WBC were equally comparable to the values as reported by Bawala *et al*.[25] The values of MCH and MCHC are within the normal ranges as reported by Njidda *et al.*[23] MCH and MCHC ranged from 41.25 in T1 to 46.00 in T5 and 33.25 in T2 to 35.28 in T4, respectively, and were not significantly different (P > 0.05). Njidda *et al.*[23] reported that MCH and MCHC are used in diagnosing anemic condition. The highest neutrophils' value (39.50%) was obtained in T3 (with diet containing 60% untreated cassava peel and 40% poultry manure). This value fell within the normal ranges as reported by Njidda *et al.*[23] for growing goats. Lymphocyte values fell within 60–75% as reported by Tambuwal and Agele[26] for lymphocytes and 17–52% and 36.4% for neutrophils as reported by the same authors, respectively. These values are suggestive of a well-developed immune system in the WAD goats

with such number of immune cells to proffer good health (Daramola *et al.*)[21] The result also implies that a decrease in neutrophils is associated with an increase in lymphocytes and vice versa.[27]

Serum biochemical analysis

The serum biochemical indices of WAD goat fed cassava peel enriched with supplemental nitrogen are presented in Table 4. All the parameters measured were significantly different ($P < 0.05$) except for globulin, ALT, and urea. The value for total protein and globulin ranged between 4.10–5.18 (g/dl) and 2.20–3.03 (g/dl), respectively, and were significantly ($P < 0.0.05$) different with T1 and T4 having significantly higher values. These observed values fell within the range as reported by Opara *et al*.[24] Creatinine had significant ($P < 0.05$) highest value of 1.28 mg/dl in T5 and lowest value of 0.80 mg/dl in T4. AST and AST ranged from 16.18–17.58 (iu/L) to 138.75– 176.50 (iu/L), respectively, and were significantly different. The value of creatinine obtained in this study was significantly ($P < 0.05$) different across the treatments. However, T5 had significantly ($P < 0.05$) higher value of 1.28 than other treatments. AST value obtained in this study ranged between 16.18 and 17.58 across the treatments, with T1 having the highest value. These values are however within the value range reported by Oni *et al*.[19] AST values ranged between 138.75 (T1) to 176.50 (T2), with T2 having significantly ($P < 0.05$) higher value. The values of total protein, albumin, globulin, and urea obtained in this study agree with the report of Bawala *et al*.[25] There were no signs of physiological stress on the animals in the experimental groups as the obtained values of blood urea were comparable with the values obtained by Oloche *et al*.[28]

CONCLUSION

This study revealed that cassava peel enriched with supplemental nitrogen as both energy and protein sources posed no negative effects on the body physiology of the experimental animals, so far, the values obtained in this study fall within the normal range for healthy ruminant animals. Based on the result obtained from this study, the use of NPN sources such as urea nitrogen, cassava foliage, and poultry manure did not pose any adverse effect on the health status of the animals. Therefore, NPN should be given adequate consideration in the diet of ruminant animals, especially goats. Higher inclusion level could equally be investigated vis-a-vis the physiological response of animals to the inclusion levels.

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