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Some Serum Metabolites and Haematological Parameters of Pullet Chicks Fed Cassava Root Products (CRPs)

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Abstract: Blood biochemistry is routinely used in veterinary medicine to evaluate the health status of animals and poultry. The experiment was designed to evaluate serum metabolites and haematological parameters of pullet chicks fed cassava root products (CRPs). Diet 1 contained 100% maize and served as the control diet (CD). Diets 2, 3 and 4 contained 50% unpeeled cassava chip (UCC), unpeeled cassava pellet (UCP) and unpeeled cassava grit (UCG), respectively, while diets 5, 6 and 7 contained 100% of respective cassava products. There were three replicates of 10 birds each in a completely randomized design. At the seventh week, blood samples were carefully collected from three birds from each replicate for haematological indices and serum metabolites. Results on haematological indices showed that values recorded were not adversely ($p < 0.05$) affected by dietary treatments. Birds fed CD had packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) values that were similar ($p > 0.05$) to values recorded by birds fed cassava based diets. The respective values ranged from 18.50% to 24.50%, 11.30 g/dL to 12.75 g/dL, 2.43 × 10^6/mm^3 to 3.69 × 10^6/mm^3, 32.96 µmg to 50.87 µmg and 44.65% to 63.41%. Serum glucose and thiocyanate were significantly ($p < 0.05$) affected by inclusion of CRPs. Serum thiocyanate of birds fed the CD (0.14 mg/dL) was lower ($p < 0.05$) than values recorded for those fed 50% and 100% UCC, UCP and UCG (2.33 and 2.56, 2.25 and 2.47, 2.19 and 2.38 mg/dL, respectively). Also values of serum glucose of birds fed 100% UCC, UCP and UCG (181.52, 179.64 and 173.24 mg/dL, respectively) were higher ($p < 0.05$) than CD. However, serum protein and its fractions were not affected. Conclusively, haematological indices were not adversely affected by dietary treatment, but serum glucose and thiocyanate were affected.

Key words: Cassava pellet, cassava grit, pullet chicks, serum glucose, thiocyanate.

1. Introduction

The blood contains a myriad of metabolites and other constituents, which provide a valuable medium for clinical investigation and nutritional status for human beings and animals. The haematological indices are index and reflection of the effects of dietary treatments on the animals in term of the type and amount of feed ingested and were available for the animal to meet its physiological, biochemical and metabolical necessities [1]. Avian blood differs in cells' characteristics from their mammalian counterpart [2]. Several factors including physiological [3], environmental conditions [4], diet contents [5], water and feed restriction [6], fasting [7], age [8], administration of drugs [9],

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anti-aflatoxin premixes [10] and continuous supplementations of vitamin E [11] affect the blood profiles of healthy birds. It had been reported that biochemical changes as a result of toxins have effects on haematological parameters [12]. The effects of both raw and processed defatted *Terminolia catuppa* seed meal based diet on haematological and urinary parameters of albino rats have been reported in literature [13].

Dietary components have measurable effects on blood components; hence, blood constituents are widely used in nutritional evaluation and survey of animals [14]. Esonu *et al.* [15] had reported that the physiological response of the animal to its internal and external environment, which includes feed and feeding, is reflected in the haematology. The haematological indices include white blood cell (WBC), haemoglobin (Hb), red blood cell (RBC) and packed cell volume (PCV).

The presence of cyanide in cassava has caused a global scare as to safety of cassava and its products for human and animal consumption [16]. The cyanide ion is rapidly absorbed from the gastrointestinal tract [17]. Ingestion of cassava can trigger several toxic manifestations due to the release of HCN from cassava cyanogenic glycosides. The toxicity of cassava is due to the release of HCN *in vivo* which is a potent cytotoxin exerting a wide range of biological effects which include inhibition of tissue respiration, terminal oxidase of the mitochondrial respiratory [18]. It also inhibits a number of other enzymes like catalase, superoxide dismutase and nitrate reductase [19].

Acute and sub acute toxic effects of cyanide can vary from events like convulsions, screaming, vomiting, coma and death. However, Balagopalan *et al*. [19] stated that the incidence of acute poisoning from consumption of cassava is relatively low and that chronic intake of cassava can lead to toxic condition. Sub lethal doses of cyanide cause increase in blood glucose and lactic acid [20]. Haematological indices and blood biochemistry are routinely used in veterinary medicine to evaluate the health status of animals and poultry [21]. Nutrition, especially, dietary protein intake is known to affect the live weight and haematological parameters of animals [22]. The influence of diets on haematological variables was also established by Makinde *et al.* [23] and Otesile *et al.* [24].

This study evaluated effects of cassava on haematological parameters and some serum metabolites of fed pullet chicks.

2. Materials and Methods

2.1 Diet Formulation and Management of Birds

Cassava chip, pellets and grit were prepared according to Mosobalaje and Tewe [25]. These cassava root products (CRPs) were used to formulate seven experimental diets for pullet chicks. Diet 1 was 100% maize and served as the control diet (CD). Replacement of maize with 50% unpeeled cassava chip (UCC), unpeeled cassava pellet (UCP) and unpeeled cassava grit (UCG) constituted diets 2, 3 and 4, while 100% replacement formed diets 5, 6 and 7, respectively. Diets were formulated to be balanced for all nutrients. Gross composition of the experimental diets is presented in Table 1. Two hundred and ten Bovan brown from a commercial hatchery in Ibadan were used. Thirty birds were randomly allocated to each of the seven experimental diets and there were three replicates of 10 birds per replicate. Birds were provided with experimental feed and water *ad libitum*.

2.2 Blood Analysis

At eight weeks of age, three birds per replicate were randomly selected and blood was carefully collected through wing vein into labeled ethylene diamine tetra acetic acid (EDTA) bottles for estimation of haematological parameters while blood samples for serum metabolites were collected into a plain bottle and allowed clot and serum decanted after centrifugation.

Table 1 Gross composition of the experimental chick diets.

Ingredients (%)	100%	50% Substitution			100% Substitution		
	Maize diet 1	UCC diet 2	UCP diet 3	UCG diet 4	UCC diet 5	UCP diet 6	UCG diet 7
Maize	44.50	22.50	22.50	22.50	-	-	-
Cassava	-	22.50	22.50	22.50	47.00	47.00	47.00
Toasted soya	19.00	24.50	24.50	24.50	29.00	29.00	29.00
Palm kernel cake	7.20	4.7	4.7	4.7	-	-	-
Wheat offal	11.00	7.50	7.50	7.50	4.70	4.70	4.70
Groundnut cake	10.00	10.00	10.00	10.00	11.00	11.00	11.00
Fish meal (72%)	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Oyster shell	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DL Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20
L-lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Crude value (kcal/kg ME)	2,875.36	2,875.46	2,875.37	2,875.67	2,875.47	2,875.47	2,875.47
Calculated protein (%)	20.39	20.13	20.13	20.13	20.55	20.55	20.55

UCC = unpeeled cassava chip; UCP = unpeeled cassava pellet; UCG = unpeeled cassava grit.

*Premix content per kg: vitamin A 12,500,000.00 I.U., vitamin D_3 2,500,000.00 I.U., vitamin E 40,000.00 mg, vitamin K_3 2,000.00 mg, vitamin B_1 3,000.00 mg, vitamin B_2 5,500.00 mg, niacin 55,000.00 mg, calcium pantothenate 11,500.00 mg, vitamin B_6 5,000.00 mg, vitamin B_{12} 25.00 mg, folic acid 1,000.00 mg, biotin 80.00 mg, C holine chloride 500,000.00 mg, manganese 120,000.00 mg, iron 100,000.00 mg, zinc 80,000.00 mg, copper 8,500.00 mg, iodine 1,500.00 mg, cobalt 300.00 mg, selenium 120.00 mg, anti-oxidant 120,000.00 mg.

The following parameters were assayed for haematological indices: PCV, Hb, RBC, WBC, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC). Serum glucose, serum thiocyanate, total proteins (albumin and globulins) were determined for serum metabolites. PCV, Hb concentration, RBC, total protein, MCV, MCH and MCHC were assayed using the procedure of Schalm [26]. Serum total proteins (albumin and globulins) were determined using the method of Bonder and Mead [27]. Aspartate amino transferase (AST) and alanines amino transferase (ALT) were analyzed using a method described by Ackers [28]. Serum thiocyanate was determined according to Tewe [29].

2.3 Statistical Analysis

All the data obtained in the study were analyzed according to the procedure of the Statistical Analysis System [30]. Differences noticed in the means were separated using Duncan's multiple range test [31].

3. Results and Discussion

Results on haematological indices and serum metabolites are shown in Tables 2 and 3, respectively. All haematological parameters investigated were not adversely ($p < 0.05$) affected by dietary treatments. Birds fed CD had numeric higher values for PCV, Hb and RBC and lower values for MCH and MCHC but WBC did not follow any trend. The respective values ranged from 18.50%, to 24.50%, 11.30 g/dL to 12.75 g/dL, 2.43 × 10^6/mm^3 to 3.69 × 10^6/mm^3, 32.96 µmg to 50.87 µmg, 44.65% to 63.41% and 3.70 × 10^6/mm^3 to 8.10 × 10^6/mm^3, while MCV ranged between 81.41 μm^3 and 108.30 μm^3.

Serum thiocyanate of birds fed CRP based diets was significantly ($p < 0.05$) higher than the CDs (0.14

Table 2 Haematological indices of chicks on experimental diets.

Components (%)	100%	50% Substitution			100% Substitution			
	Maize diet 1	UCC diet 2	UCP diet 3	UCG diet 4	UCC diet 5	UCP diet 6	UCG diet 7	± SEM
PCV (%)	24.50	18.50	19.50	20.50	20.50	18.50	21.50	1.31
Hb (g/dL)	12.15	11.45	11.30	12.65	12.80	11.65	11.95	0.40
RBC ($\times 10^6$/mm^3)	3.69	2.57	3.93	3.50	2.93	2.43	2.84	0.34
MCH (µmg)	32.96	40.83	34.25	36.97	44.94	48.14	50.87	7.34
MCHC (%)	49.65	61.91	57.96	61.81	55.83	63.41	60.52	3.50
WBC ($\times 10^6$/mm^3)	6.40	7.65	8.10	5.70	4.75	3.70	6.50	1.02
MCV (µm^3)	99.95	90.18	81.41	89.26	90.61	96.17	108.30	5.92

UCC = unpeeled cassava chip; UCP = unpeeled cassava pellet; UCG = unpeeled cassava grit; PCV = packed cell volume; Hb = haemoglobin; RBC = red blood cell; MCH = mean corpuscular haemoglobin; MCHC = mean corpuscular haemoglobin concentration; WBC = white blood cell; MCV = mean corpuscular volume.

Table 3 Serum metabolites of pullet chicks on experimental diets.

Components (%)	100%	50% Substitution			100% Substitution			
	Maize diet 1	UCC diet 2	UCP diet 3	UCG diet 4	UCC diet 5	UCP diet 6	UCG diet 7	± SEM
Glucose (mg/dL)	125.44^{b}	164.24^{ab}	153.32^{ab}	163.81^{ab}	181.52^{a}	179.64^{a}	173.24^{a}	8.33
Total protein (g/dL)	10.10	9.80	9.35	9.25	9.60	9.60	8.20	0.54
Albumin (%)	2.85	2.45	2.95	2.65	3.05	2.55	2.90	0.25
Globulin (%)	7.25	7.05	6.90	6.60	6.55	7.05	6.30	0.23
Albumin globulin ratio	0.39	0.35	0.39	0.4	0.47	0.36	0.45	0.03
Thiocyanate (mg/dL)	0.14^{c}	2.33^{ab}	2.25^{ab}	2.19^{b}	2.56^{a}	2.47^{a}	2.38^{ab}	0.24

UCC = unpeeled cassava chip; UCP = unpeeled cassava pellet; UCG = unpeeled cassava grit.
^{abc} in the same row with the same superscript are not significantly different ($p > 0.05$).

mg/dL). Birds fed 50% (2.33, 2.25 and 2.19 mg/dL) and 100% (2.56, 2.47 and 2.38 mg/dL) chip, pellet and grit, respectively, had similar values. Blood glucose values of birds fed 100% cassava chip, pellet and grit based diets (181.52, 179.64 and 173.24 mg/dL, respectively) were higher ($p < 0.05$) than the CDs (125.44 mg/dL). However, birds fed 50% cassava based diets were similar ($p < 0.05$) to those on 100% CRP based diets and CD. Total protein, albumin, globulin and albumin:globulin were not significantly ($p > 0.05$) affected by cassava inclusion in the diets. Heamotological indices were not adversely affected by dietary treatments. Feed intake of chicks reduced and hence dietary intake of cyanide from cassava was very small to cause any adverse effect in the pullet chicks. Olajide [32] reported that haematological parameters of broiler fed soaked cocoyam were not significantly affected. However, values obtained for Hb, WBC, MCV and globulins were higher than values reported by Aderemi [33]. WBC values were lower than values reported by Mitruska and Rawnsley [34] for adult chicken. This might probably account for susceptibility of chicks to diseases compared to adult birds.

Higher blood glucose reported in the study was due to effects of cyanide on glucose metabolism. Isom *et al*. [20] studied effect of sub lethal doses of cyanide on the metabolism of glucose in mice. He found that cyanide caused an increase in blood glucose and lactic acid levels and decrease in the adenosine triphosphate/adenosine diphosphate (ATP/ADP) ratio indicating a shift from aerobic to anaerobic metabolism. EFSA [35] also stated that cyanides apparently activate glycogenolysis and shunts glucose to the pentose phosphate pathway decreasing the rate of glycolysis and inhibiting the tricarboxylic acid cycle. Blood thiocyanate increased with increase in cassava inclusion level in the diet due to conversion of

cyanide to thiocyanide *in vivo*. The principal pathway of cyanide metabolism is the conversion to thiocyanate, catalyzed by either rhodanase (thiosulfate sulphur transferase) or by β mercaptopryustate sulphur transferase [18]. Detoxification of hydrogen cyanide to thiocyanate reduces toxicity in 200 folds [19].

4. Conclusions

The followings are the conclusions drawn from the study:

(1) Haematology indices were not adversely affected by experimental treatments;

(2) Serum glucose of birds fed cassava based diets was higher ($p < 0.05$) than the CD;

(3) Dietary treatment significantly affected serum thiocyanate as it increased with increase in cassava inclusion in the diet;

(4) Total protein and its fraction (globulin and albumin) were not affected by dietary treatments.

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