HAEMATOLOGICAL INDICES AND SERUM BIOCHEMISTRY OF FINISHER BROILER CHICKENS FED HIGH-QUALITY CASSAVA PEEL MEAL SUPPLEMENTED DIET

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ABSTRACT
This study was aimed at evaluating the haematological indices and serum biochemistry of finisher broiler chickens fed high-quality cassava peel meal. A total of 160-day-old Arbor Acre broiler chicks were sourced from a reputable hatchery in Ibadan, Oyo State. The birds were randomly weighed and assigned into four dietary treatment groups supplemented with HQCP at 150, 200 and 250kg/ton of feed, each replicated four times with ten birds per replicate in a completely randomised design. Results shows that the haematological indices of birds fed high-quality cassava peel meal had significant (P<0.05) differences in Red blood cell (RBC), Packed cell volume (PCV) and Haemoglobin (Hb). Birds fed diet 2(150 kg HQCP/ton) and diet 3 (200kg HQCP/ ton) had the highest values for RBC, PCV and Hb (3.26 x106/mm3, 3.19%, and 13.07g/dl) and (28.0 x106/mm3, 27.67%, and 13.27g/dl), respectively. They are significantly (P<0.05) higher than those of birds on diet1(Control) and diet4(250kg HQCP/ton). However, there were no significant (P>0.05) differences across the treatment groups for white blood cell. The serum biochemistry revealed that total protein of birds fed diet 3 was significantly (P<0.05) higher than those fed diets 1 and diet 4 respectively. The result of the Alanine transaminase (ALT), Aspartate transaminase (AST), alkaline phosphates (ALP), and Bilirubin shows no significant (P>0.05) differences across the treatment groups. The result of the total cholesterol shows that birds fed diets 3 and 4 were not significantly different from each other but they were significantly lower than others. Therefore, cassava peels can replace maize at 150kg – 250kg/ton inclusion level without any detrimental effect on the hematological parameters, and serum biochemical indices of finisher broiler chickens.
Keywords: Serum, Haematology, High-quality Cassava peels, and Broiler

INTRODUCTION

Inadequate protein intake as recommended by Food and Agriculture Organization (FAO, 2016) is more rampant in developing countries which has adverse effects on their citizens. Poultry production is an increasingly important agricultural industry in the world. Poultry meat and eggs account for about 10% of the total amount of all meat, eggs and milk produced in the world each year. However, as beneficial and interesting poultry seems, this sub-sector is bedeviled by high off-farm input prices particularly feed prices. This has made a greater number of poultry farmers to produce below capacity. According to Maize Outlook Reports (2016), findings have shown that the cost of ingredients for the composition of poultry feeds, particularly maize, has increased by 100 percent and invariably affecting the price of poultry products in the market.

Cassava is a major source of calories in developing tropical countries. Cassava peels like most agricultural wastes are made up of mainly polysaccharides which are widespread in nature, they account for an estimated 66% of all global bound carbon (Gardnea and Blackwell, 1974). Cassava peel has crude protein, crude fibre, ether extract and ash ranges of 3.7 to 5.9 g, 10.3 to 31.8 g, 0.0 to 3.3 g and 3.4 to 8.0 g/100 g respectively (FAO, 2012). However, the utilisation of cassava peel is limited by the presence of hydrocyanic acid (HCN) and high fibre, which may cause chronic toxicity in human and livestock particularly when inappropriately processed (Oluremi and Nwosu, 2002; Aro et al., 2010). Fermentation technique has been reported to be of tremendous importance in enhancing the nutrient potentials of cassava products such as protein (Nwafor and Ejulonemu, 2004) and detoxification of anti-nutrients (Oboh and Akindahunsi, 2003). Increasing demands for energy by productive animals increased the importance of sourcing high-quality cassava peel which has been processed to reduce anti- nutritional factors

and improve its nutritional content. Several studies have investigated the performance of broiler chickens fed diets containing high-quality cassava peel, these studies have shown promising results, indicating the high-quality of cassava peel can be a high viable feed ingredient for broiler chickens (Adesehinwa, 2008). High-quality cassava peel is a good source of energy, crude protein and minerals such as calcium and phosphorus. It also contains moderate levels of fibre and essential amino acids. However, the nutrient composition of cassava peel can vary depending on the processing methods used, such as sorting, grading, dewatering, pulverizing and drying.

Haematological and serum biochemical studies are very important in diagnosing the structural and functional status of the animal's body (Elagib and Ahmed, 2011). Haematological changes are routinely used to determine various influences of environmental, nutritional and or pathological factors (Graczyk et al., 2003). The objective of this study was therefore to evaluate the effect of different replacement levels of maize with high-quality cassava peel on the haematological parameters and serum biochemistry of broiler chickens.

MATERIALS AND METHODS

Experimental site and Description

This experiment was carried out at the Poultry Unit, Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State. The farm is located at latitude 05^0 29^1 North and longitude 07^0 32^1 East. The farm lies at an altitude of 122m and within the rain-forest zone of south-east Nigeria, which has a bimodal rainfall pattern and total annual rainfall of 2177mm, maximum ambient temperature range of 22 to 36^0C during the hot dry season of the year (November – March) and minimum ambient temperature range of 20^0C-26^0C during the cold rainy season (April-October). The relative humidity ranges from 50-90% depending on the season (NRCRI, 2022).

Test Materials

The major test ingredient is the High-Quality Cassava Peel, a processed cassava peel was produced within 6 to 8h to form a stable product as an animal feed ingredient following the methods of Okike *et al*., (2015), these methods involve a combination of different physical methods such as sorting, grating, dewatering, pulverizing, and drying.

Experimental birds and Management

A total of 200 1-day-old Arbor Acres broiler chicks were sourced from a reputable hatchery in Ibadan, Oyo State. The chicks were brooded for fourteen days on deep litter system using 200-watt electric bulb and charcoal pots. The birds were fed commercial feed during the fourteen days brooding period. Feed and water were supplied *ad libitum*. After the brooding period, one hundred and twenty (n = 160) healthy broiler chicks were individually weighed and randomly assigned to four iso-nitrogenous and iso-caloric experimental dietary treatments each replicated four times with ten birds per replicate in a Completely Randomised Design.

Experimental Diets

The experimental diets were formulated to contain 150, 200, 250 and 522kg/ton of maize with HQCP respectively. Control diet (diet 1) – has maize-based diet with 522kg/t of maize while diet 2, 3, and 4 replaced maize at 150, 200 and 250kg respectively. Each treatment will consist of 40 birds in quadruplicate of 10 birds each.

Design of Study

The design used for this study was a completely randomised design using treatments as the factor of interest. The linear model of the design is:

$Y_{ij} = \mu + T_i + e_{ij}$

Where:

Y_{ij}= individual observation.

μ= population mean

T_{ij}= treatment effect

e_{ij}= Random error assumed to be independently, identically and normal distributed with zero means and constant variance.

Experimental Diet

Table 1. Percentage composition of the experimental diet fed to broiler chickens at the finisher phase (4 - 8 weeks)

Ingredients	Diet 1 (Control)	Diet 2	Diet 3	Diet 4
Maize	52.2	37.2	32.2	27.2
HQCP	-	15	20	25
Wheat bran	7.04	3.5	2.32	1.25
Soya bean meal	17.35	17.35	17.35	17.35
Full fat soya	17.2	20. 7	21.9	23
Soya oil	2.4	2.5	2.5	2.5
Bone meal	2.56	2.56	2.56	2.56
Limestone	0.26	0.26	0.26	0.26
Common Salt	0.37	0.37	0.37	0.37
Lysine	0.18	0.12	0.10	0.07
Methionine	0.19	0.19	0.19	0.19
*Premix	0.25	0.25	0.25	0.25
TOTAL	**100**	**100**	**100**	**100**
Calculated Values				
Crude protein %	19.51	19.51	19.51	19.52
Metabolisable Energy, kcal/kg	3107.35	3106.51	3106.34	3101.97
Crude Fiber, %	3.23	3. 61	3.73	3.92

**Each 2.5Kg contains: Vitamin A=12,000,000i.u, Vitamin D_3 =2, 500,000i.u, Vitamin E=30,000mg, Vitamin K_3=2,000mg,Vitamin B_1 =2,250mg, Vitamin B_2 =6,000mg ,Vitamin B_6=4500mg, Vitamin B_{12} =15mcg, Niacin =40,000mg, Pantothenic Acid=15,000mg, Folic Acid =1,500mg, Biotin =50mcg, Choline Chloride =300,000mg, Manganese =80,000mg, Zinc =50,000mg, Iron =20,000mg, Copper =5000mg, Iodine =1000mg, Selenium =200mg, Cobalt =500mg, Antioxidant =125,000mg*

Data Collection

The data were collected on the response parameters during the study, they include;

Blood collection procedure

For the hematological and serum biochemistry analysis, an initial 2mL of blood was collected through the wing vein into a labelled sterile vacutainer tube containing ethylene-diamine-tetra-acetic (EDTA) as anti-coagulant which was used for hematological analysis. Another 2mls of blood was collected into labelled sterile sample bottles without EDTA which was used for the serum biochemical analysis. The Red Blood Cells (RBC), White Blood Cells (WBC), Hemoglobin (Hb) and Packed Cell Volume (PCV) were determined, while the serum biochemical indices that were considered includes; total protein, globulin, albumin, plasma protein, creatinine and urea.

Data Analysis

The data generated were subjected to Analysis of Variance (ANOVA) technique as described by (Steel and Torrie, 1980). Differences between treatment means were further separated using Duncan Multiple Range Test (DMRT) as described by (Duncan, 1980). Statistical computations were done using IBM SPSS (20th Edition).

Results

Haematological indices of finisher broiler chicken fed high-quality cassava peel meal.

The result of the haematological indices of finisher broiler fed HQCP is presented in table 2. The result showed that there were significant ($P<0.05$) differences across the haematological parameters such as the Packed Cell Volume (PCV), Red Blood Cell (RBC), Haemoglobin (Hb) except for White Blood Cell (WBC). The Red Blood cell (RBC) and Packed cell volume (PCV) showed the same level of significances where broiler chickens fed diet 2 and 3 were not significantly ($P>0.05$) different from each other but they were significantly ($P<0.05$) higher than those fed Diet 1 and 3 respectively. The result of the Haemoglobin (Hb) showed that broiler chickens fed diet 3 were significantly ($P<0.05$) higher than those fed diets 1 and 4.

Table 2: Haematological indices of finisher broiler fed high-quality cassava peel

Treatment	Diet 1	Diet 2	Diet 3	Diet 4	SEM
RBC $x10^6/mm^3$	2.81^b	3.26^a	3.19^a	2.63^b	0.09
PCV (%)	24.67^b	28.00^a	27.67^a	23.33^b	0.67
Hb g/dL	12.33^b	13.07^{ab}	13.27^a	11.03^c	0.28
WBC $x10^3/mm^3$	19.83	20.25	20.46	18.78	0.29
Platelets $x10^3/mm^3$	214.00	219.33	218.67	218.00	1.42

[abc] Means within the rows with different superscripts differ significantly P<0.05; SEM- Standard error of the mean; RBC: Red blood cell; PCV: Packed cell volume; Hb: Haemoglobin; WBC: White blood cell.

The result of the serum biochemistry of broiler chickens fed HQCP is presented in table 3. The result of the total protein showed that broiler chickens fed diet 3 were significantly (P<0.05) higher than those fed diet1 and 4 respectively. The result of the Total Cholesterol showed that broiler chickens fed diet 1 were significantly (P<0.05) higher than those fed diet 3 and 4. The result of the Alanine transaminase (ALT), Aspartate transaminase (AST), Alkaline phosphates (ALP), and Bilirubin shows that there were no significant (P>0.05) differences across the treatment groups.

Table 3: Serum profile of finisher broiler fed high-quality cassava peel

Treatment	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Total protein g/dL	3.16^c	3.50^{ab}	3.60^a	3.35^{bc}	0.06
ALT µ/L	36.00	34.00	34.67	33.67	0.60
AST µ /L	41.00	41.67	44.00	43.00	0.69
ALP µ /L	63.00	64.00	61.00	59.67	0.97
Bilirubin mg/kg	0.58	0.56	0.56	0.56	0.01
Total. Cholesterol mg/dL	104.83^a	99.83^{ab}	97.87^b	95.97^b	1.22

[abc] Means within the rows with different superscripts differ significantly P<0.05; SEM- Standard error of the mean ALT: Alanine transaminase; AST: Aspartate transaminase; ALP: Alkaline Phosphatase

DISCUSSION

Blood parameters are good indicators of physiological, pathological and nutritional status of an animal and changes in haematological parameters have the potential of being used to elucidate the impact of nutritional factors and they are also related to health status which are of diagnostic importance in clinical evaluation of the state of health (Ganong, 1999). The values obtained are within the normal range of RBC for chickens of 2.5-3.5x10^6 μ L (Bounous and Stedman, 2000). The highest value recorded in diet 2 and diet 3 suggest that inclusions level of high-quality cassava peels improves RBC production in finisher broiler. The PCV values obtained from the experimental diets were within the physiological range of 23% - 33% as stated by Godwin *et al.* (1992); Onyishi *et al.* (2017) and Oyewole *et al.* (2018) for healthy birds. This implies that the inclusion of high-quality cassava peel in the diet of the birds did not cause any health impairment. The result of the WBC showed that values obtained are within the minimum range for broiler chickens as reported by Mitruka and Rawnsley (1997). WBC is essential component of the blood necessary for defense against infectious disease, and for immune system and Higher values above normal range may indicate pathogenic disease. The results for haemoglobin (Hb) concentration showed that the highest value of 13.27 g/dL was recorded in diet 3, while 12.33 g/dL, 13.07 g/dL, and 11.03 g/dL were recorded in diet 1, diet 2, and 4 respectively. The results agreed with the findings of (Iweala and Obioha, 2009) who observed that high minerals and vitamin content of feed materials like leaves stimulate the synthesis of Hb leading to its increase in the blood. The results equally fall within the normal range of Hb values for chickens of 7-13 g/dL. The significant variation in red blood cell, packed cell volume and haemoglobin indicates that the high-quality cassava peels had an effect on erythropoiesis and transportation of oxygen, chemicals and nutrients essential for life.

The results of the serum profile showed an increased level of total protein which signifies beneficial synergistic effect of phenolic and flavonoids on protein metabolism. According to (Harr, 2002), serum total protein values of broilers tend to be lower than those of mammals, ranging from 25.00 to 45.00 g/l. Among numerous factors that influence the concentration of serum proteins, age plays an

important role in the physiology. Quality and quantity of protein intake have been reported to influence total protein, albumin and globulin of serum (Onifade and Tewe, 1993). Therefore, the results obtained in this study indicated that the experimental diets were not deficient with respect to protein quality and quantity. In this study, serum cholesterol decreased linearly across the treatments. High-quality cassava peel had been reported to exert hypocholesterolemic effect in several species (Gashi *et al*., 2018). Serum enzymes particularly AST and ALT are vital markers of various organs and tissue disorders arising from toxicity or disease conditions and are therefore used to assess or monitor the health status of different organs and tissues with the animal's body.

CONCLUSION

High-quality cassava peels can replace maize at 15 – 25kg/100kg of feed inclusion level without any detrimental effect on the haematological parameters and serum biochemical indices of broiler finisher chickens.

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