



HAEMATOLOGICAL AND SERUM BIOCHEMICAL INDICES OF BROILER CHICKENS FED DIETARY LEVELS OF SWEET POTATO PEEL MEAL

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ABSTRACT

The experiment was conducted to evaluate the blood haematology and serum biochemical indices of broiler chicken fed graded levels of potato peel meal (SPPM) as replacement for maize. The treatment consisted of five diets formulated using SPPM to replace maize at 0, 25, 50, 75 and 100% in diets 1, 2, 3, 4 and 5 respectively in both starter (23%CP) and finisher (20%CP) phases. Two hundred and twenty five one week old broiler chicks were allotted to the five diets in four replicates of fifteen chick each in a completely randomized design (CRD). The feeding trial lasted for six weeks with feed and water given *ad libitum*. At the end of week six, blood samples were collected from three birds in each replicate and subjected to laboratory analysis for both haematology and serum biochemistry. Results obtained indicated that, all the serum biochemical indices were not statistically ($P>0.05$) affected by the dietary treatment except percentage Haematocrit (HCT) which was affected significantly ($P<0.05$) by the diets with values ranging from 21.07-28.67%. Similarly, all the blood haematology parameters were not significantly ($P>0.05$) affected by the substitution levels of SPPM to maize. Both the serum biochemistry and haematology were within normal values which indicated that the birds were healthy and their meats were safe for consumption. It was concluded that feeding broiler birds with SPPM and maize based diets has no deleterious effects on their haematology and serum biochemistry indices as well as their general health. Therefore, substituting conventional maize with sweet potato peel meal is recommended and further studies on other poultry species are encouraged.

Keywords: Haematology, Serum, Biochemistry, Broiler chicken

INTRODUCTION

Poultry production is a very important integral part of the agricultural sector of developing countries. The Nigerian poultry industry comprises about 180 million birds, SAHEL (2015). Nigeria has the second largest chicken population in Africa, after South Africa producing 650,000 tonnes of eggs and 300,000 tonnes of poultry meat in 2013 (FAOSTAT, 2018). Poultry plays significant role in the provision of animal protein required by man to meet his daily protein requirement. Animal proteins are of high biological value than those of plants and are important for healthy living. Poultry production is an important source of income due to its monetary turn over (Ajala *et al.*, 2007). In Nigeria, the demand for protein of animal origin has by far outstripped its supply due to the rapid population growth. Nigeria, with a population of over 200 million (PRB, 2010) and poultry population of more than 150 million (Abubakar, 1998), will require a substantial improvement in poultry production to meet the basic minimum dietary protein needs of its people. Blood is a vital tissue in the circulatory system, transporting nutrients and oxygen to all cells and removing carbon-dioxide and other waste products. High percentage of the blood tissue consists of plasma and serum (Akinfala *et al.*, 2007). The serum level of metabolite particularly of protein, packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), white blood cell (WBC), urea, creatinine, glucose



etc. are good indicators of the metabolite of the ingested feed on one hand and the state of body cells, tissues and organs on the other hand. According to Adeniji and Ogunmodede (2006) nutritional deficiency, organic breakdown or penetrations of foreign materials are known to alter blood composition. Therefore, blood chemistry among others is employed as useful indices in appraising nutritional status of the animals. Blood consists of red and white blood cells and the platelets suspended in a plasma liquid medium. Blood functions include, transport of oxygen, food materials, metabolic waste, maintenance of acid- base and water balance and body temperature (Murray *et al.*, 2000). Avian haematological studies are always performed for research purposes in other to evaluate the effects of rearing techniques (Vergel *et al.*, 1984: Cerolini *et al.*, 1986), feeding regimes (Frachini *et al.*, 1988), environmental condition and toxicity levels. Values of haemoglobin (HB), packed cell volume (PCV), and red blood cells (RBC) can be used for diagnostic purposes. In general, blood volume of poultry is between 80-100 ml/kg body weight red blood cell (RBC) or erythrocytes count falls within 2.5-3.2 ($\times 10^6/\text{mm}^3$) (Akimmutimi *et al.*, 2004, Igene and Olody, 2004, Swenson, 2004). Other haematological studies indicate, haemoglobin concentration (90g/l) and white blood cell or leucocytes count 20-30($\times 10^9$). Packed cell volume (PCV) values of chicken ranges from 28-40% or 10- 21ml/kg body weight (Mitruka and Rowsley, 1977: Akimmutimi *et al.* 2004). Similar report on avian haematology indicates a range of 29.00-38.90% packed cell volume, 93-118g/dl haemoglobin, 2.70-3.40($\times 10^9/\text{l}$) red blood cell count, and 11.60- 17.30 ($\times 10^6/\text{l}$) white blood count for broiler chicken. While, those for cockerel are 30.43% PCV, 117.8g/l haemoglobin, $3.81 \times 10^9/\text{l}$ RBC and $12.15 \times 10^6/\text{l}$ WBC (Kwari *et al.*, 2004: Omoikhoje *et al.*, 2004: Ameen *et al.*, 2007: Iyayi *et al.*, 2008). Similarly, Swenson, (1993) reported erythrocytes ranges of MCV (115-254g/l), MCHC (21-23g/l) and MCH (25-27mg/dl) are useful in measuring the size and HB content of erythrocytes or in diagnosing diseases, toxicity level and anemia.

MATERIALS AND METHODS

Study Area

The study was conducted at the Abubakar Tafawa Balewa University Teaching and Research Farm Bauchi between March and April, 2024. Bauchi town is located on Latitudes $10^{\circ}22'N$ and $11^{\circ}55'N$ and Longitudes $09^{\circ}48'E$ and $10^{\circ}10'E$ respectively (Anon., 2018). Bauchi State occupies a total land area of 49,119 km^2 representing about 5.3% of Nigeria's land mass and is located between Latitudes $9^{\circ}3'$ and $12^{\circ}3'$ North and Longitudes $8^{\circ}50'$ and $11^{\circ}0'$ East (Anon., 2020). Bauchi State is bordered by seven states, Kano and Jigawa to the North, Taraba and Plateau to the South, Gombe and Yobe to the East and Kaduna to the West. Bauchi climate is characterized by a well-defined rainy season (June – October) and dry season (November – May). The total mean annual rainfall in the state is 700-900 mm for the Northern zone, 690-1031 mm for central zone and 900 – 1300 mm for the western zone (BASDP, 2023). The mean temperature ranges between 19.15°C . The highest temperature is observed in the months of March, April and May, while the lowest is in the months of January and December every year. Highest relative humidity of 99% is observed in August and the lowest of 57% in February (Anonymous, 1999).

Experimental Diets

Five (5) diets were formulated for both starter (23%CP) and finisher (20%CP) phases (Tables 1 and 2) in which SPPM replaced maize at 0, 25, 50, 75 and 100% levels as diets 1, 2, 3, 4 and 5 respectively. Other ingredients used the diets include, wheat offal, full fat soya beans (FFSB), fishmeal, bone meal, limestone, common salt, palm oil, lysine, methionine and



mineral-vitamin premix. Percentage composition and calculated analysis of the experimental diets for starter and finisher phases are presented in Tables 1 and 2.

Table 1: Compositions (%) of Starter Diets Containing Graded Level of Sweet Potato Peel Meal as Replacement for Maize (1– 3 weeks)

Ingredients	T ₁ (0%)	T ₂ (25%)	T ₃ (50%)	T ₄ (75%)	T ₅ (100%)
Maize	45.00	33.75	22.50	11.25	0.00
SPPM	0.00	11.25	22.50	33.75	45.00
FFSB	36.50	36.50	36.50	36.50	36.50
Wheat offal	9.50	9.50	9.50	9.50	9.50
Fish meal	4.00	4.00	4.00	4.00	4.00
Palm oil	1.00	1.00	1.00	1.00	1.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude protein	23.00	23.00	23.00	23.00	23.00
Crude fibre (%)	3.73	5.67	7.59	9.53	11.46
ME (Kcal/kg)	2986.70	2891.02	2795.35	2799.67	2804.00

SPPM = Sweet Potato Peel Meal, FFSBM = Full Fat Soya Bean, ME = Metabolizable Energy.

Table 2: Compositions (%) of Finisher Diets Containing Graded Levels of Sweet Potato Peel Meal as Replacement for Mazie (3 – 6 weeks)

Ingredients	T ₁ (0%)	T ₂ (25%)	T ₃ (50%)	T ₄ (75%)	T ₅ (100%)
Maize	51.20	38.40	25.60	12.80	0.00
SPPM	0.00	12.80	25.60	38.40	51.20
FFSB	25.60	25.60	25.60	25.60	25.60
Wheat offal	14.00	14.00	14.00	14.00	14.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Palm oil	1.00	1.00	1.00	1.00	1.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude prot. (%)	20.00	20.00	20.00	20.00	20.00
Crude fibre (%)	2.24	2.24	2.24	2.24	2.24
ME (Kcal/kg)	2868.10	2809.24	2800.38	2791.53	2782.67

SPPM = Sweet Potato Peel Meal, FFSBM = Full Fat Soya Bean, ME = Metabolizable Energy.



Experimental Birds and their Management

Two hundred and twenty-five (225) one week old broiler chicks were randomly allotted to the five diets in three replicates of 15 chicks each in a completely randomized design. Experimental feeds and water were given *ad libitum* and the feeding trial lasted for six weeks.

Data Collection

At the end of the feeding trial, blood samples were collected from broiler birds selected randomly from each replicate to obtain blood haematology and serum biochemistry. The blood samples were collected in levelled sample bottles containing EDTA and without EDTA for laboratory analysis to obtain data on blood haematology and serum biochemistry.

Data Analysis

All data collected were subjected to analysis of variance (ANOVA) using SPSS (2.0) and significantly different treatment means were separated using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The results of haematology and serum biochemistry parameters are presented in Tables 3 and 4. The results showed that, all haematological parameters were not significantly ($P>0.05$) affected by the dietary treatments only on Haematocrit percentage (HTC%) which was affected significantly ($P<0.05$) by the dietary treatments with values ranging from 21.07 to 28.67. The result further indicated that, serum biochemistry did not show any statistical significance except in percentage Bilirubin which was affected significantly ($P<0.01$) by the diets types with values ranging from 7.04 to 11.04. Both the haematological parameters and serum biochemical indices were within normal ranges of healthy birds as reported by Merck Veterinary Manual (1979), Jain (1993) and Swenson (1993). This indicated that the birds were healthy and showed that SPPM is safe for feeding broiler chicken. Serum chemistry is routinely used to detect abnormalities in physiological processes and pathology of organs in domestic animal. Total protein (TP) and its fractions (albumin and globulin) supply the information required to interpret the protein quality of the feed, occurrence of dehydration, infections, immune diseases, and inflammatory responses. The non-significant effect observed in this study agreed with the findings of Mozafari *et al.* (2013) who found no significant difference on broiler chickens fed almost similar dietary treatments. Values obtained on PCV was higher than values of 34.53 – 30.08% reported by Aikpitany *et al.* (2020) when broiler chickens were fed soya bean based diets and similar to the result obtained by Kpanja *et al.* (2020) for broiler chickens fed diets containing graded levels of Irish Potato Peel Meal. White blood cell count did not agree with the report ($15.25 - 16.77 \times 10^3/\text{mm}^3$) of Diarra *et al.* (2012) when fed broiler chickens yam/sweet potato peel/maize mixture based diets. This also agreed with the findings of Mozafari *et al.* (2013) when fed different levels of edible potato/maize based diets to broiler chickens on serum metabolite and immune system.

Table 3: Haematological Indices of Broiler Chickens Fed Dietary Levels of Sweet Potato Peel Meal

Parameters	T1(0%)	T2(25%)	T3(50%)	T4(75%)	T5(100%)	SEM	Norma Range
WBC ^{109/mm³}	5.37	3.09	3.74	5.53	4.97	0.62 ^{NS}	-
RBC ^{109/mm³}	3.81	2.56	2.71	3.57	3.47	0.60 ^{NS}	50-3.50x10 ⁶ /μl
MCV ^(FL)	89.20	84.57	90.47	86.57	95.50	5.54 ^{NS}	-
MCH ^(PG)	40.00	57.87	64.30	49.57	45.07	10.35 ^{NS}	-
MCHC ^(g/dl)	34.77	44.13	51.00	37.17	37.53	5.92 ^{NS}	-
HCT%	24.07 ^{ab}	28.40 ^a	28.67 ^a	21.07 ^b	27.30 ^a	1.78 [*]	36-54%
PCV%	40.33	36.00	37.63	35.67	37.67	2.07 ^{NS}	22-35
HB ^(g/dl)	13.43	11.97	12.53	11.87	12.50	0.69 ^{NS}	7-13
PLET ^{x10⁹}	244.33	173.33	173.33	175.33	224.33	24.92 ^{NS}	-
NEUT (%)	54.67	60.33	48.00	58.67	56.00	6.22 ^{NS}	-
LYMP(%)	39.33	34.33	42.00	34.67	36.00	6.71 ^{NS}	-
MONO(%)	4.00	4.00	7.67	4.33	7.00	2.85 ^{NS}	-
EOSINO (%)	1.33	1.33	1.67	1.33	1.00	0.83 ^{NS}	-
BASO (%)	0.67	0.00	0.67	1.00	0.00	0.33 ^{NS}	-

a, b, c = Means within the same row bearing different superscripts differ significantly, ***= highly significant (P<0.001), *= significant (P<0.05), SEM= Standard Error of the Mean NS = Not significant (P>0.05), WBC = White Blood Cells, RBC = Red Blood Cells, MCV = Mean Corpuscular Haemoglobin concentration, HCT = Haematocrit, PCV = Park Cells Volume, HB = Haemoglobin, PLET = Platelet, NEUT Neutrophil, LYMP = Lymphocyte, MONO = Monocytes, EOSINO = Eosinophil, BASO = Basophil.

Table 4: Serum Biochemical Indices of Broiler Chickens Fed Dietary Levels of Sweet potato Peel Meal

Parameters	T1(0%)	T2(25%)	T3(50%)	T4(75%)	T5(100%)	SEM	NORMAL RANGE
Glucose %	14.83	15.00	15.70	14.63	16.10	0.62 ^{NS}	4.00-10.00
Albumin %	2.54	3.50	3.37	3.33	3.97	0.31 ^{NS}	2.80-4.00
Protein%	7.50	7.50	6.34	7.60	6.90	0.36 ^{NS}	6.20-8.00
Bilirubin%	8.07 ^{bc}	10.03 ^{ab}	9.53 ^{ab}	7.04 ^c	11.04 ^a	0.65 ^{xx}	0.00- 17
Urea %	3.03	3.57	4.50	4.83	6.13	0.91 ^{NS}	1.70-9.10
Conjugate Biliru. %	3.47	2.77	3.77	3.30	3.57	0.33 ^{NS}	0.00-4.60
Cholesterol %	4.06	4.10	4.69	3.94	4.08	0.44 ^{NS}	0.00-5.17

a, b, c = Means within the same row bearing different superscripts differ significantly. ***= highly significant (P<0.001), *= significant (P<0.05), SEM= Standard Error of the Mean NS= Not Significant (P>0.05).

CONCLUSION AND RECOMMENDATION

Based on the findings of this study, it can be concluded that Sweet potato peel meal can completely (100%) replace maize in the diets of broiler chicken with no adverse effects on haematological and serum biochemical parameters of broiler chicken, it is therefore recommended in the study area.

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