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HAEMATOLOGICAL AND SERUM BIOCHEMICAL PARAMETERS OF BROILER CHICKENS FED DIFFERENT CEREAL GRAIN BY-PRODUCTS

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ABSTRACTS

56 day's feeding trial was conducted to investigate the effects of feeding different cereal grain by-products on the haematological and serum biochemical indices of broiler chickens. One hundred and fifty Amor broiler chickens were randomly allotted to five experimental diets formulated to contain Maize offal, Sorghum offal, Wheat offal, Millet offal and Brewers dried grains at 10 and 15% levels of inclusion for broiler starter and finisher phase respectively. Five treatment groups were replicated three times with ten birds per replicate in a completely randomized design. The result of the experiment showed no significant ($P>0.05$) difference among the haematological values for packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), neutrophils and monocytes. Significant effect of diet was only observed on lymphocyte. Serum biochemical parameters were significantly ($P<0.05$) different in Albumin, Cholesterol and Glucose whose values were however within the normal range for healthy birds. Therefore, it could be concluded that feeding cereal grain by-products to broiler finishers at 15% levels of inclusion has no toxic effect on haematological and serum biochemical indices. This is an indication that broiler chickens fed cereal grain by-products were in good health, nutritionally adequate and in a state of readiness to combat attack by foreign bodies.

Keywords: Broiler Chickens, Haematological, Biochemical, Cereal grain by-product.

INTRODUCTION

One of the major developmental challenges facing most developing countries such as Nigeria is their inability to adequately feed their ever increasing population with the right proportion of animal protein. Maize and soya bean meal which are predominantly used ingredient for energy and protein in poultry feed in Nigeria, is very costly, because of higher demand for it by humans as food and industrial purposes (Bot *et al.,* 2013; Etuk *et al.,* 2013). These dietary ingredients constitute about 50 – 55% of the formulated poultry diet. Besides the high cost of maize as a major component of feed its productivity is low in Nigeria which means it does not meet national demand (Opaluwa *et al.,* 2015). With respect to the present trend of the rising cost of animal feed stuffs all over the world and the geometric increase in human population, greater attention has to be paid to the search for locally available, safe and cheap feed stuffs including the unexploited ones and agro-industrial by-products especially in the developing countries that cannot afford the expensive diet for livestock.

Poultry production is regarded as a means of animal protein, sustainable livelihood and a way of achieving certain level of economic independence (Amos, 2006) but is undergoing a turbulent period (Okorie, 2006), some farmers have closed down and others have been forced to reduce their production capacity due to high cost of feed and feedstuffs (Esonu *et al.,* 2012).The major reason for this scarcity and increased cost of poultry feed has been attributed to increased competition between man and livestock for major feedstuffs (Okorie, 2006).

Blood is used as a means of assessing clinical and nutritional health status of animals in feeding trials and the haematological and serological parameters most commonly used in nutritional studies include Packed Cell Volume (PVC), Red Blood Cell (RBC), White Blood Cell (WBC), Haemoglobin

concentration (HB), Mean Corpuscular Volume (MCV), serum globulin, serum creatinine and cholesterol (Agbede and Aletor, 2003). Measurement of blood parameters provides valuable information for diagnosis of diseases, physiological and nutritional status of an organism, changes in the constituent compound of blood when compared to normal ranges could be used to interpret the metabolic state of an animal as well as quality of feed. Several researches have been carried out on haematological and biochemical parameters of chickens (Isidahomen *et al*., 2011; Alewi *et al.,* 2012) but information on their association with different agro-industrial by-product is scanty. This study was therefore, carried out to investigate the effect of feeding different cereal grain by-products on haematology and serum biochemical indices of broiler chickens.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at Gombe State Ministry of Agriculture in the Poultry Production Unit (PPU) between March and May (2015). Gombe State is located between latitude 9 30 to 12 3^0North and longitude 8 45 to 11 45 East with an altitude of 540m above sea level. It covers an estimated land mass of 20,265km2 and has a population of 1,820,415 inhabitants (Anonymous, 2009). The state has mean maximum monthly temperature of 37^0C, minimum of 120^0C and relative humidity of 94% in august and 10% in December. Rain falls from April to October which ranges between 970.7 mm to 1,142 mm annually with a mean of 1,009.4 mm. Vegetation of the area are savannah grassland (Gombe State Government, 2009). Climatic and adaphic factors favor crop and livestock agriculture.

Sources of the Ingredients

Different agro-industrial by-products; maize offal, sorghum offal and millet milling waste were sourced locally around Gombe and its environs, particularly grains milling shops where the products are found in large quantities, while Brewers dried grain also from Gombe locally made beer areas and wheat offal together with Maize, soya beans, Fish meal, Bone meal, Salts, Premix, Methionine and Lysine was obtained from Gombe State market. The offal was not subjected to any form of processing, it was dried and incorporated.

Experimental Birds and their Management

A total of one hundred and fifty (150) unsexed strains of Amor broiler starter weight ranges (98.67 to 101.67g/bird) at second weeks of age were used for this experiment. The chicks were obtained at day-old from reputable hatchery. Before arrival of the chicks, the room was thoroughly swept, washed with detergent and then disinfected with Izal$^{@}$ so as to eliminate disease causing organism present that may be a source of infection to the chicks. After three days when the room was dried, wood shavings was spread on the cemented floor to a depth of about six centimeters (6cm) to serve as an insulator and also absorb moisture from droppings. All brooding equipment were cleaned, washed and disinfected. Five blue-flamed heating kerosene stoves were used as a source of heat, depends on the present temperature of the environments. Fifteen flat feeding trays and plastic drinkers were provided each per replicate for the young chicks in the brooder room. On arrival, chicks were fed commercial broiler starter mash and water containing anti-stress to relieve them of transit stress. All necessary brooding management practices were duly observed. The birds were vaccinated strictly based on the vaccination programmed recommended for the North-East Zone. At the first week of age, they were starved drinking water over night before vaccination, which enable them to drink water containing the vaccine. A vaccine against Newcastle and Gumboro Diseases were administered to maintain them in a good health. All vaccines was administered in clean drinking water and proper sanitation was maintained by regular cleaning of feeding and watering trough, depends on the extent needed during the experimental period. The chicks were switched over from the commercial broilers starter diets to the experimental starter and finisher diets at two and three weeks of ages respectively, which were lasted for the period of 56 days.

Experimental Diets and Design

Experimental diets were formulated using maize offal, sorghum offal, wheat offal, millet offal and brewers dried grains for T1, T2, T3, T4 and T5 respectively. At 2 weeks of age, the birds were randomly weighed and allotted to five (5) dietary treatment groups of 30 birds each and replicated three times with 10 birds per replicate in a Completely Randomized Design. They were fed for the period of eight weeks at both starter and finisher phase. The treatments were designated as T_1, T_2, T_3, T_4 and T_5. The experimental diet is presented in Tables1 and 2.

Table 1. Composition and Calculated Analysis of Experimental Broiler Starter Diets

	Dietary treatments				
Ingredients	**T1 (MO)**	**T2(SO)**	**T3(WO)**	**T4(MIO)**	**T5(BDG)**
Maize	44.43	43.77	46.10	44.77	49.77
Soybean	38.77	39.43	37.10	38.43	33.43
Maize offal	10	_	_	_	_
Sorghum offal	_	10	_	_	_
Wheat offal	_	_	10	_	_
Millet offal	_	_	_	10	_
Brewer dried grain	_	_	_	_	10
Fishmeal	3	3	3	3	3
Bone meal	3	3	3	3	3
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Salts	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated analysis					
Crude protein (%)	23.00	23.80	23.85	23.00	23.00
Crude fibre (%)	3.77	3.32	3.73	3.14	3.82
Ether extracts (%)	9.16	9.58	9.66	9.34	8.98
Calcium (%)	1.08	1.08	1.08	1.08	1.08
Phosphorus (%)	0.50	0.50	0.50	0.50	0.50
ME (Kcal/kg)	3024.40	3041.55	3009.53	3031.37	3003.77

*Vitamin-Mineral premix; (Bio-mix) provided per Kg the following: Vitamin A500iu Vitamin D_3,888000iu; Vitamin E, l2,000mg; Vitamin K_3, l5,000mg; Vitamin B_1, 1000mg; B_2, 2000mg; Vitamin B_6, 1500mg; Niacin, l200mg; Pantorhenic acid, 2000mg; Biotin, 1000mg, Vitamin B_{12}. 3000mg; Folic acid1500mg; Choline Chloride; 60,000mg, Manganese, l0,000mg Iron, l500mg; Zinc, 800mg; Copper 400rng; Iodine, 80mg; Cobalt 40mg; Selenium, 8000mg.

Table 2: Composition and Calculated Analysis of Experimental Broiler Finisher Diets

	Dietary treatments				
Ingredients	T1 (MO)	T2(SO)	T3(WO)	T4(MIO)	T5(BDG)
Maize	48.77	43.43	51.27	49.20	56.77
Soybean	30.43	35.77	27.93	29.93	22.43
Maize offal	15	_	_	_	_
Sorghum offal	_	15	_	_	_
Wheat offal	_	_	15	_	_
Millet offal	_	_	_	15	_
Brewer dried grain	_	_	_	_	15
Fishmeal	2	2	2	2	2
Bone meal	3	3	3	3	3
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated analysis					
Crude protein (%)	20.00	20.30	20.00	20.00	20.00
Crude fibre (%)	4.52	3.89	4.31	3.51	4.51
Ether extracts (%)	7.85	9.09	8.01	8.12	7.58
Calcium (%)	1.08	1.08	1.08	1.08	1.08
Phosphorus (%)	0.50	0.50	0.50	0.50	0.50
ME (Kcal/kg)	3019.33	3026.26	3068.93	3029.74	3010.84

*Vitamin-Mineral premix; (Bio-mix) provided per Kg the following: Vitamin A500iu Vitamin D_3,888000iu; Vitamin E, l2,000mg; Vitamin K_3, l5,000mg; Vitamin B_1, 1000mg; B_2, 2000mg; Vitamin B_6, 1500mg; Niacin, l200mg; Pantorhenic acid, 2000mg; Biotin, 1000mg, Vitamin B_{12}. 3000mg; Folic acid1500mg; Choline Chloride; 60,000mg, Manganese, l0,000mg Iron, l500mg; Zinc, 800mg; Copper 400rng; Iodine, 80mg; Cobalt 40mg; Selenium, 8000mg.

Blood Sample Collection and Analysis

At the end of the experiment, three (3) birds were randomly selected from each replicate pen for haematological and biochemical parameters. About 4 ml of blood samples each for haematological and biochemical analysis was collected from the wing vein using a sterile disposable needle and syringe. The blood samples for haematological assay were collected in ethylene diamine tetra acetic acid (EDTA) treated tubes.

Blood samples for biochemical analysis, were collected into EDTA–free test tubes and allowed to clot for serum separation. Serum was separated from the plasma by centrifugation of the blood at 4000 rpm for 15 minutes and thereafter quickly taken to the laboratory for analyses. The haematology and blood chemistry analyses were carried out according to the procedure of Ochei and Kolhatkar (2000). Erythrocytic indices (mean corpuscular haemoglobin concentration -MCHC), mean corpuscular haemoglobin (MCH) and mean corpuscular volume - MCV) were calculated using the formulae of Jain (1986) as follows:

$$\text{MCHC (\%)} = \frac{\text{Hb(g/dl) x100}}{\text{PCV (\%)}}$$

$$\text{MCH (fl)} = \frac{\text{Hb(g/dl) x10}}{\text{RBC (x10}^6\text{UL)}}$$

$$\text{MCV(pg)} = \frac{\text{PCV (\%) x 10}}{\text{RBC (10}^6\text{)}}$$

Statistical Analysis

All data generated from the experiment was subjected to one way analysis of variance (ANOVA) using Completely Randomised Design according to Steel and Torrie (1980). Significance differences among treatment means was compared using Duncan's Multiple Range Test (Duncan, 1955).

RESULT AND DISCUSSION

H**aematological parameters**

There was no significant ($p>0.05$) difference observed across the treatment diets in haematological parameters except white blood cells (WBC). Lymphocyte shows significant ($p<0.05$) difference among the treatment means. It is a component of WBC known to appear when an antigen and antibodies react, a strategy for combating disease infection by chickens (Adeyemo and Longe, 2007). Thought, significant ($p<0.05$) difference observed but the ranges in this study is within the normal ranged of 55 to 60% values reported by Swenson (1999). This is an indication that broiler chickens fed test diet were in good health and in a state of readiness to combat attack by foreign bodies as described by Anon (1980).

The values of packed cell volume (PVC), Red blood cell (RBC) and Haemoglobin concentration (Hb) obtained in the present study were not significantly influenced by the treatment diet among the groups. They all fall within the reference range of (24.9 to 45%, 2-4.0 x 10^6/mm^3 and 7-13g/dL respectively) Mitruka and Rawnsley (1977) for broiler chickens. Iheukwumere and Herbert (2003) also reported normal range of 29.0 to 38% and 6.0 to 13g\dl for PCV and Hb respectively. However, the values obtained in this study were considered adequate for broiler chickens, indicating that birds are in good condition of health with normal functioning of body system. Adeyemo and Longe (2007) pointed out that the purpose of investigating blood when unconventional feed ingredients is used was to observed its (test material) effects on the haematological parameters so as to predict the health status of the animals.

Table 3. Haematological Parameters of Broiler Chickens Fed Different Cereal Grain By-Products.

	Dietary treatments					
Parameters	**T1(MO)**	**T2(SO)**	**T3(WO)**	**T4(MIO)**	**T5(BDG)**	**SEM**
Hematological indices						
PCV (%)	22.16	21.29	19.27	20.09	18.85	1.80^{NS}
R B C ($\times10^6$/mm^3)	2.80	2.52	2.10	2.19	2.10	1.03^{NS}
WBC ($\times10^3$/mm^3)	20.17	21.33	18.30	23.47	23.25	3.09^{NS}
Neutrophils (%)	8.49	9.76	6.20	9.26	10.07	2.13^{NS}
Monocytes (%)	20.20	21.54	17.26	17.14	16.61	3.13^{NS}
Lymphocytes (%)	55.17^{b}	57.37^{ab}	55.22^{b}	58.21^{ab}	59.21^{a}	0.97^{*}
MCV (*fl*)	110.76	108.80	112.15	111.76	113.18	2.06^{NS}
MCH (*pg*)	47.21	47.32	49.24	51.17	48.53	2.32^{NS}
MCHC (*g/dl*)	30.24	30.20	27.27	28.24	26.24	2.17^{NS}

a, b, c = Means with different superscripts on the same row are significantly different * = Significant ($p<0.05$), NS = Not significant ($p>0.05$), SEM = Standard Error of means PCV = Pack cell volume, RBC = Red blood cell, WBC = White blood cell, MCV = Mean corpuscular volume, MCH = Mean corpuscular haemoglobin, MCHC = Mean corpuscular haemoglobin concentration, MO = Maize offal, SO = Sorghum offal, WO = Wheat offal, MIO = Millet offal, BDG = Brewers dried grains.

Serum Biochemical Indices

The result obtained for serum biochemical indices shows no significant (p>0.05) difference across the dietary treatment in total protein, creatinine and urea except for the albumin, cholesterol and glucose which were significantly (p<0.05) different. Total protein value range observed in this experiment was agreed with the value 30.31 to 39.53mg/dl reported by Mitruka and Rawnsley (1977). However, the values indicated nutritional adequacy of the test material in respect of protein hence, high serum protein and albumin values are reflection of better quality and amount of protein in the diets (Eggum, 1970). Serum creatinine values were not significantly (p>0.05) different among the treatment groups. Iyayi and Tewe (1998) reported that insignificant values of creatinine across the dietary treatments are an indication of quality protein supplied. Nworgu (2004) reported that the level of creatinine measures the degree of muscles wastage, higher level shows low quality or protein supplied in the feed. Urea was found to be insignificant among the dietary treatment indicating nutritional adequacy of the diet, since is not above the references range. Thought significant (p<0.05) difference observed in albumin among the groups, the means value recorded are within the references range. Variation could be resulted from different sources of the test materials considered across the treatment groups. Adeyemi *et al.* (2000) stated that correlation exist between total protein and Albumin content of the diet. Bamgbose *et al.* (2003) reported that total protein and albumin are indicators of the total protein reserves in an animal. Similarly, Ewulola and Egbunike (2008) observed that albumin indicate adequacy in quality and quantity of the dietary protein whereas value less than the normal physiological value indicate hypo albuminemia.

The serum cholesterol values obtained were within the reference range of 115± 29 to 152 ± 2.0 mg/dl (Leville *et al.*, 1957) for non-laying bird. Though insignificant (p>0.05) difference observed, the above reason attests to the facts that test ingredient has advantage of low cholesterol deposit there by reduced the incidence of coronary heart disease in humans consumed these products. Madubuike and Ekenyen (2006) reported the conscious of people in reducing the cholesterol content of the animal protein. Glucose range of 10.15 – 14.67mmol/l recorded in the present study was within the range of 125 – 200 IU/L reported by Anon (1980) and Jain (1986). Blood glucose which is the end product of carbohydrate digestion is directly used to provide energy for the body. However, excess is being converted and stored in the form of glycogen in the liver and muscles, and for fat, protein and other biosynthesis. Flurharty and Loenrch (1996) reported that high energy did not have any detrimental effects on the health of the animals, but rather it increases the growth rate in the tropics. According to Mayes (1996), continuous supply of glucose is necessary as a source of energy especially for the nervous system and the erythrocytes. The findings of Melluzzi *et al.* (1991) showed that, low blood glucose could be an indication of in adequate intake or incipient problem with ketosis. Therefore, the glucose level in the experimental diet can support the need for broiler production.

Table 4. Serum Biochemical Indices of Broiler Chickens Fed Different Agro-Industrial By-Products.

	Dietary treatments					
Parameters	**T1(MO)**	**T2(SO)**	**T3(WO)**	**T4(MIO)**	**T5(BDG)**	**SEM**
Biochemical indices						
Total protein *(mg/dl)*	36.93	35.18	31.98	33.36	30.99	4.35^{NS}
Albumin (*g/dl)*	21.29^{a}	18.44^{b}	16.91^{b}	17.07^{b}	16.89^{b}	0.71^{*}
Cholesterol *(mg/dl)*	137.46^{b}	139.18^{ab}	143.73^{a}	140.64^{ab}	145.13^{a}	1.17^{*}
Creatinine (*umol/l*)	55.93	57.74	60.40	58.83	60.58	2.58^{NS}
Urea *(mmol/l)*	1.23	1.52	1.77	1.82	2.23	1.03^{NS}
Glucose (*mmol/l*)	14.67^{a}	13.92^{a}	10.28^{b}	12.97^{ab}	10.15^{b}	1.11*

a, b, c = Means with different superscripts on the same row are significantly different * = Significant (p<0.05), NS = Not significant (p>0.05), SEM = Standard Error of means, MO = Maize offal, SO = Sorghum offal, WO = Wheat offal, MIO = Millet offal, BDG = Brewers dried grains.

CONCLUSION AND RECOMMENDATION

In conclusion, the result of the study showed that feeding cereal grain by-products at 10 and 15% levels of inclusion to starter and finisher broiler chickens respectively has no toxic effect on haematological and serum biochemical indices. This is an indication that broiler chickens fed cereal grain by-products were in good health, nutritionally adequate and in a state of readiness to combat attack by foreign bodies.

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