PERFORMANCE AND BLOOD PARAMETERS OF FINISHER BROILERS FED GROUNDNUT CAKE UREA-FERMENTED BREWER'S DRIED GRAINS BASED DIETS

J. O. ISIKWENU
Department of Animal Science,
Delta State University, Asaba Campus, Nigeria.

Date submitted 30 January, 2014; date accepted: 29 August, 2014.

Abstract
The implications of replacing groundnut cake (GNC) with urea-fermented brewer's dried grains (BDG) in finisher broiler diets on the blood parameters and performance characteristics were investigated. Urea-fermented brewer's dried grains were used to replace GNC at 0, 25, 50, 75 and 100% levels in finisher broiler diets. Diets were formulated to be isonitrogenous and isocaloric to provide 20% crude protein and 3000 Kcal/Kg metabolizable energy. One hundred and ninety-five 35 days old broiler chicks (Anak breed) were randomly allocated to five treatment groups of 13 chicks per replicate and 39 chicks per treatment and fed *ad libitum* in rearing cakes. At 8 weeks, the means of body weight, daily weight gain, daily feed intake and feed: gain ratio were similar ($P > 0.05$) for all treatment groups. Apart from RBC, WBC, albumin, urea, hydrobicarbonate and creatinine values which were significantly ($P < 0.05$) influenced, all other blood parameters were similar ($P>0.05$). The use of urea-fermented BDG as a replacement for GNC in finisher broiler diets has no adverse health implications as results indicate absence of pathological abnormalities.

Keywords: Urea-fermented BDG, groundnut cake, blood parameters, performance, pathological abnormalities, finisher broiler.

Introduction
The need to produce cheap and quality livestock and poultry feeds is a major step in the desire to make animal protein available and affordable in developing economies. The protein deficit of monogastric animal feed is more critical than caloric inadequacies. Protein sources for poultry feeds are expensive and in most cases directly required by man as food, yet they constitute 30-35% of their diets. The cost of groundnut cake (GNC) which is regularly incorporated into poultry feeds as a plant protein source has continue to rise due to the demand for groundnut and its by-products by man and animal. Brewer's dried grains (BDG) is a cheaper alternative to GNC, is readily available, not directly or indirectly required by man for food and can supply the same quality protein as GNC due to similarity in their amino acid profiles (Aduku, 1993), Table 1. The major limitation to the use of BDG as a source of plant protein is its high fibre content (Ademosun, 1973; Onwudike, 1993; Isikwenu, 2006). Further processing of BDG in order to reduce its fibre content has been carried out by the use of urea-treatment and fermentation Table 2 (Isikwenu *et al.*, 2008), and was successfully used to replace up to 50% of GNC (16.70% of the diet) in broiler starter diets. The health implication of the use of urea-fermented BDG in broiler diets on the final products is important. The constituents of the blood provide valuable information with which to draw inference in clinical and nutritional investigation of the individual. The blood is an important index of physiological, pathological and nutritional status of an organism and as such changes in the constituents of the blood when compared to normal values

could be used to evaluate the metabolic status of an animal (Church *et al.*, 1984). This study was conducted to investigate the effects of replacing GNC with urea-fermented BDG in broiler finisher diets on the performance and blood parameters.

Materials and Methods

Experimental Site: This study was conducted at the Poultry Research Unit of the Department of Animal Science, Delta State University, Asaba Campus. The site has a mean annual rainfall, temperature and relative humidity of 1137mm, 32.7°C and 82% respectively and lies on latitude 5°30` and 5°45` N of the equator and longitude 5°40` and 6°E of the Greenwich Meridian.

Experimental Birds and Management:
A total of one hundred and ninety-five 35 days old broiler chicks (Anak breed) were used in this study. The birds were managed in rearing cages for the finisher period. Feed and water were supplied *ad libitum* while necessary vaccinations and routine medications were administered.

Experimental Design:
The chicks were randomly allotted into five treatment groups on equal weight basis in a completely randomized design. Each treatment group consists of 39 broiler chicks and 13 in each of the three replicates per treatment.

Experimental Diets:
Urea-fermented BDG was produced according to the procedure of Isikwenu *et al*. (2008) and used to replace groundnut cake at 0, 25, 50, 75 and 100% levels in finisher broiler diets on protein equivalent basis. Five diets were formulated to be isonitrogenous and isocaloric to provide 20% crude protein and 3000 Kcal/kg metabolizable energy. Table 2 is the proximate compositions of urea-fermented BDG and the untreated BDG while the compositions of the finisher broiler diets are presented in Table 3.

Measurements:
Mean body weight development, body weight gain, feed intake and mortality were recorded on replicate basis weekly while feed conversion ratio was obtained according to Lambert *et al*, (1936). Blood samples approximately 10ml per bird were collected from replicates in each treatment group through the subclavicular vein under the right wing with sterile needles and syringes into specimen bottles with and without Ethylene Diamine Tetra-Acetic Acid (EDTA). Haematological and Serological analyses were done using routinely available methods. The Packed Cell Volume (PCV) was determined by Wintrobe’s microhaematocrit method, Red Blood Cell Count (RBC) and White Blood Cell Count (WBC) were by Neubauer haemocytometer and haemoglobin concentration (Hb) by cyanomethaemoglobin method. The mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Cell Haemoglobin Concentration (MCHC) were computed as outlined by Seal and Erickson (1979). Serological parameters such as total protein was determined by Buiret method, albumin, globulin, urea, glucose (glucose oxidase) and cholesterol were determined by colorimetric methods.

Table 1: Chemical Composition of Groundnut Cake and Brewer's Dried Grains

Chemical components	GNC	BDG (Untreated)
Crude Protein	45.00	27.90
Ether extract	9.16	7.40
Crude fibre	3.81	11.70
Ash	5.51	4.80
Calcium	0.20	0.30
Phosphorus	0.60	0.88
ME Kcal/kg (swine)	3185.00	2240.00
ME Kcal/kg (poultry)	2530.00	2513.00
Lysine	1.73	0.90
Methionine	0.44	0.60
Cystein	0.72	0.40
Arginine	5.00	1.30
Tryptophan	0.49	0.40

Source: Aduku (1993)

Table 2: Proximate Analysis of Test Ingredient

Parameters %	Urea Fermented BDG	Untreated BDG
Dry matter	88.76	93.34
Crude protein	38.52	24.21
Crude fibre	4.49	11.20
Ether extract	4.87	3.69
Ash	5.99	8.04
Nitrogen-free extract	34.89	46.20
Organic matter	82.77	85.30
Gross energy Kcal/g (Calculated)	5.17	5.14

Source: Isikwenu *et al.* (2008)

Creatinine was determined by kinetic method using alkaline. The Serum Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) were analysed according to enzymatic analysis method by Reitman and Frankel (1957). Electrolytes such as sodium (Na^+) and potassium (K^+) were by flame photometry using atomic emission principles while chlorine (Cl^-) and carbonic acid (HCO_3) were estimated by titration.

Chemical Analysis: The chemical analysis of the proximate compositions of the test ingredient (Table 2) and experimental diets (Table 3) were determined according to the procedure of AOAC (1990).

Table 3: Composition of Experimental Finisher Broiler Diets

Replacement Levels %	Dietary Treatments				
	100 GNC 00UFBDG	75 GNC 25UFBDG	50 GNC 50UFBDG	25 GNC 75UFBDG	00 GNC 100UFBDG
Ingredients					
Maize (Yellow)	58.20	57.18	55.60	54.45	52.85
Groundnut Cake	21.50	16.12	10.75	5.38	-
Urea-Fermented BDG	-	6.30	13.00	19.32	26.00
Fish Meal	2.50	2.50	2.50	2.50	2.50
Blood Meal	3.50	3.50	3.50	3.50	3.50
Wheat offal	5.00	5.00	5.00	5.00	5.00
Rice bran	1.00	1.00	1.00	1.00	1.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Oyster shell	1.50	1.50	1.50	1.50	1.50
Palm Oil	2.60	2.70	2.95	3.15	3.45
Premix (Finisher)*	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50
Methionine	0.20	0.20	0.20	0.20	0.20
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis					
Crude Protein %	20.13	20.04	20.06	19.98	19.98
Crude fibre %	3.27	3.30	3.38	3.41	3.47
Metabolizable Energy Kcal/kg	3007.50	3002.89	3001.63	3001.49	3002.89
Determined analysis (%)					
Dry matter	90.55	91.07	89.95	90.48	88.95
Crude protein	20.29	20.37	20.45	20.54	20.69
Crude fibre	6.85	6.90	7.33	7.36	7.51
Ether extract	2.55	3.07	3.17	3.55	3.65
Ash	9.33	10.12	10.40	11.45	11.45
Nitrogen-free extract	51.53	50.61	48.60	47.58	45.65

**Vitamin-mineral premix (optimix) provided the following vitamins and minerals per kg of diet: A, 8000 iu; D_3, 18000 IU; E, 20 IU; K, 2.0mg; B_1, 1.55mg; B_2, 4.4mg; B_6, 2.35mg; B_{12}, 0.013mg; Biotin, 0.042mg; Niacin, 23.5mg; Pantothenic, 6.5mg; Folic, 0.65mg; Mn, 75mg; Zn, 45mg; Fe, 20mg; Cu, 5mg; Iodine, 1.0mg; Se, 0.01mg; Co, 0.02mg; B.H.T, 90mg; Ethoxyquin, 33mg; Choline, 150mg.*
GNC: Groundnut cake. UFBDG: Urea-fermented brewer's dried grains

Statistical Analysis: Data obtained were subjected to analysis of variance and treatment means were compared by Duncan's Multiple Range Test (Duncan, 1955) using SAS package (SAS, 2000).

Results

The results of the body weight development characteristics are presented in Table 4. The mean body weight, weight gain, feed intake and feed conversion ratio were similar ($P > 0.05$) for all treatment groups. The results of the haematological and serological indices are presented in Table 5 and 6. The values of the Packed Cell Volume (PCV), Haemoglobin concentration (Hb), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Cell Haemoglobin Concentration (MCHC) were similar ($P > 0.05$) in all treatment groups. Significant ($P < 0.05$) differences were observed in Red Blood Cell (RBC) Count and White Blood Cell (WBC) count among treatment groups. The PCV values ranging from 24 to 31.5% and the Hb values of 4.05, 4.55, 5.70, 5.30 and 4.80 g/dl though similar ($P > 0.05$) were observed to increase with increasing levels of urea-fermented BDG inclusion. RBC count were similar ($P>0.05$) among finisher broilers fed diets with 0, 50, 75 and 100%

inclusions with values of 1.72, 2.01,1.72 and 1.92 x 10^{12}/l while those of diet with 25% inclusion with value of 1.62 x 10^{12}/l were significantly (P < 0.05) lower than those on 50% inclusion. The WBC count with values ranging from 3.24 to 4.02 x 10^{10}/l showed that finisher broilers fed diets with 50 and 100% inclusions were significantly (P < 0.05) higher than broilers on diet with 25% inclusion but were similar with those diets with 0 and 75% inclusion. The MCV with value range of 139.15 to 181.37 (fl), MCH with value range of 23.49 to 30.53 (pg) and MCHC with value range of 16.84 to 30.53(%) were similar (P > 0.05) in all treatment groups. The MCV and MCH values were generally higher in finisher broilers fed diets containing urea-fermented BDG. Total protein, globulin, glucose, cholesterol, sodium, potassium, chlorine, Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) values were similar (P > 0.05) in all treatment groups of finisher broilers. However, total protein with values of 33.5 – 36.00g/l, globulin with 18.00 – 22.00 g/l and glucose with 8.40 – 9.40 mmol/l tended to slightly increase (P > 0.05) in finisher broilers fed diets with urea-fermented BDG. Sodium with values of 140.50 – 143.50 mmol/l and ALT with values of 12.50 – 14.00 µ/l were slightly lower (P > 0.05) in treatment groups with diets containing urea-fermented BDG. The albumin, urea, hydrobicarbonate and creatinine values were significantly (P < 0.05) influenced by dietary treatments. Finisher broilers fed diets with 25% urea-fermented BDG were significantly (P < 0.05) higher in albumin values than those fed 75% levels but similar (P > 0.05) with those of other dietary levels. The urea values of broilers fed diets with 0 and 100% inclusions were significantly (P < 0.05) higher than those fed diet with 75% inclusion but were similar (P > 0.05) to those on diets with 25 and 50% inclusions. Hydrobicarbonate values showed that broilers fed the control diet were significantly (P < 0.05) higher than those on diets with 25 and 75% inclusions but similar (P > 0.05) to those on diets with 50 and 100% inclusions. It was observed that broilers fed diets containing urea-fermented BDG had hydrobicarbonate values that were generally lower than those fed the control diet. Creatinine values of broilers fed the control diet were significantly (P < 0.05) higher than those fed diets with 50, 75 and 100% inclusion levels but similar (P > 0.05) to those fed diet with 25% inclusion. Creatinine values were found to decrease progressively as the levels of urea-fermented BDG inclusion increased in the diets.

Table 4: Performance Characteristics of Finisher Broilers Fed Experimental Diets

	Dietary Treatments					
Replacement Level %	100 GNC 00UFBG	75 GNC 25UFBDG	50 GNC 50UFBDG	25 GNC 75UFBDG	00 GNC 100UFBDG	SEM
Parameters						
Mean Body weight(g	2121.82	2008.42	1990.86	1995.06	1998.42	35.33
Weight Gain/Bird/Day (g)	79.28	69.44	56.83	58.45	66.04	1.56
Feed Intake/Bird/Day (g)	103.77	104.99	97.98	102.78	98.39	1.68
Feed: Gain ratio	2.98	3.15	3.40	3.33	3.53	0.14
Mortality (birds/treatment)	3	2	2	3	3	

Means were not significantly (P > 0.05) different. GNC: Groundnut cake. UFBDG: Urea-fermented brewer’s dried grains

Table 5: Haematological Indices of Finisher Broilers Fed Experimental Diets

	Dietary Treatments					
Replacement Levels %	100 GNC 00UFBDG	75 GNC 25UFBDG	50 GNC 50UFBDG	25 GNC 75UFBDG	00 GNC 100UFBDG	SEM
Parameters						
PCV (%)	24.00	27.00	29.50	31.50	28.50	1.20
Hb (g/dl)	4.05	4.55	5.70	5.30	4.80	0.25
RBC (10^{12}/l)	1.72^{ab}	1.62^{b}	2.01^{a}	1.72^{ab}	1.92^{ab}	0.06
WBC (10^{10}/l)	3.61^{ab}	3.24^{b}	4.02^{a}	3.65^{ab}	3.85^{a}	0.10
MCV (fl)	139.15	168.83	146.92	181.37	148.38	6.73
MCH (Pg)	23.49	28.44	28.31	30.53	24.99	1.13
MCHC (%)	16.88	16.86	19.36	16.84	16.85	0.49

a,b, means with different superscript in the same row are significantly different ($P < 0.05$).

Discussion

The similarities in the mean body weights, daily weight gains, feed intake and feed: gain ratio in finisher broilers is an indication that urea-fermented BDG has nutritional content comparable to GNC and therefore can replace completely GNC in the finisher diets. The similarity in weight performance showed that finisher broilers have the ability to tolerate and efficiently utilized the different diets successfully, and this agrees with the results of Uchegbu and Udedibie (1998) and Atteh and Opawande (2000) who found no significant differences in body weight performance when up to 75% untreated BDG replaced maize or GNC in finisher broiler diets. The feed intake values showed that all diets were acceptable to the birds as they ate approximately equal amount of feed. Feed: gain ratio for all treatment groups was similar, indicating that growth rate and feed intake patterns of broilers at this age were not affected by the diets. It implied that the nutrient content of the different diets were adequate for biosynthesis of tissue for growth due to the ability of finisher broilers to handle the fibre content of the diets (Uchegbu and Udedibie, 1998; Atteh and Opawande, 2000; Isikwenu *et al*., 2008). This shows the suitability of urea-fermented BDG as a possible substitute for GNC in finisher broiler diets without adverse effect on efficiency of feed utilization.

The PCV, Hb, MCV, MCH and MCHC values of broilers in all treatment groups were similar and comparable with reported normal ranges (Maxwell *et al.*, 1990; Akpodiete *et al.*, 1997; Akpodiete and Ologhobo, 1998; Fanimo *et al.*, 2005; Isikwenu *et al*., 2012). Though the differences were not significant in these indices, values of broilers fed diets containing urea-fermented BDG were generally higher than the control. This means urea-fermented BDG inclusion in the diets of finisher broilers had a positive effect on the blood nutrient composition and levels as indicated by improved values of PCV, Hb, MCH, MCV and MCHC. This similarity and improved values of haematological indices is an index of good physiological, pathological and nutritional status of broilers fed the experimental diets. Similar findings have been reported by Church *et al.* (1984) and Isikwenu *et al*, (2012). The similarity in the red blood cells and white blood cells components between the control and all dietary treatments indicate that the use of urea-fermented BDG in broiler diets has no adverse health implications.

The similarities of the serological indices such as total protein, globulin, glucose, cholesterol, sodium, potassium, chlorine, Aspartate Aminotranferase (AST) and Alanine Aminotransferase (ALT) among the different treatments may be indicative of the adequacy of nutrients contained in the diets. The slightly higher values of serum glucose in finisher broilers fed urea-fermented BDG diets seem to suggest enhanced glucose release from carbohydrate digestion into the blood for energy needs of the birds in urea-fermented BDG based diets. The moderate values of the serum AST and ALT means that the use of urea-fermented BDG in broiler diets did not promote high serum enzyme activities, which is usually associated with hepatocellular damage (liver disease) and toxicity situations as also reported by Lohr (1975), Mitruska and Rawnsley (1977), Cheesbrough (1999) and Akpodiete and Ologhobo (1998b). Apart from treatment with 75% urea-fermented BDG inclusion which was significantly lower than that with 25% inclusion, all treatments were similar, with urea-fermented BDG diets having higher albumin values than the control. This indicates the presence of a healthy functioning liver, since hypoalbuminaemia (low albumin level) is associated with the presence of liver disease. It also indicates a proper protein-energy balance in the diets and absence of parasitic infections (Treacher, 1977; Cheesbrough, 1999).

Table 6: Serological Indices of Finisher Broilers Fed Experimental Diets

	Dietary Treatments					
Replacement Levels %	100 GNC 00UFBDG	75 GNC 25UFBDG	50 GNC 50UFBDG	25 GNC 75UFBDG	00 GNC 100UFBDG	SEM
Parameters						
Total protein (g/l)	33.50	36.00	36.00	33.50	33.50	0.73
Albumin (g/l)	14.50^{ab}	16.00^{a}	15.50^{ab}	13.50^{b}	15.50^{ab}	0.37
Globulin (g/l)	19.00	20.00	20.50	22.00	18.00	0.69
Glucose (mmol/l)	8.40	9.15	8.70	9.40	8.85	0.15
Urea (mmol/l)	2.65^{a}	2.40^{ab}	2.35^{ab}	2.05^{b}	2.85^{a}	0.10
Cholesterol (mmol/l)	2.88	2.86	3.23	2.92	2.93	0.07
Sodium Na^{+} (mmol//l)	143.50	140.50	141.00	141.00	140.50	0.99
Potassium K^{+} (mmol/l)	4.20	3.70	4.15	4.20	3.55	0.13
Chlorine Cl^{-} (mmol/l)	100.00	96.50	99.50	101.00	102.00	0.83
HCO_3 (mmol/l)	26.00^{a}	21.50^{ab}	24.00^{ab}	21.00^{b}	24.00^{ab}	0.69
Creatinine (µmol/l)	21.35^{a}	18.15^{ab}	16.15^{b}	15.85^{b}	15.00^{b}	0.86
AST (µ/l)	102.50	107.00	104.50	100.00	100.00	1.33
ALT (µ/l)	14.00	13.00	12.50	13.00	13.50	0.68

a,b, means with different superscript in the same row are significantly different ($P < 0.05$).

AST-Aspartate aminotransferase, ALT-Alanine aminotransferase

Serum total protein and albumin levels in this study are an indication of good quality dietary protein and this agrees with the findings of Eggum (1986). The similarity of blood urea content in most diets is indicative of a normal protein synthesis and absorption for finisher broilers fed the different dietary treatments. Since serum urea is a function of protein quality and high urea level is an indication of low quality protein, this result further confirms the suitability of urea-fermented BDG as a plant protein source in finisher broiler diets and values of this study agree with those of Ross *et al.* (1978), Chandra *et al*. (1983), Maxwell *et al.* (1990) and Akpodiete and Ologhobo (1998b). The serum creatinine levels of broilers were found to be significantly lower in the urea-fermented BDG diets except in the 25% inclusion level and the decrease was progressive as the level of urea-fermented BDG increased in the diets. This could mean that feeding urea-fermented BDG in broiler diets may cause a reduction in serum creatinine level in broilers, which is an indication of good kidney and overall renal function, as high creatinine level in the blood is associated with kidney and renal failures (Cheesbrough, 1999). Although, low serum creatinine is implicated in muscle wasting disease, the differences in this study are not serious enough to be associated with muscle wasting disease, rather serum creatinine levels are proportional to the muscle mass of an individual (Cheesbrough, 1999) and this agrees with the slightly lower muscle mass of the eviscerated weight of finisher broilers fed urea-fermented BDG diets. Serum creatinine values obtained in this experiment are within the approximate reference range and those reported by Mitruska and Rawnsley (1977) and Fanimo *et al.* (2005). Finisher broilers fed urea-fermented BDG diets had lower hydrobicarbonate content in the blood.

Conclusion

Based on the similar results obtained from the weight performance, it is concluded that urea-fermented BDG can be used to replace the entire GNC (26% of the diet) as a plant protein source in finisher broiler diets. The similarity of results of the haematological and serological indices is indicative of the absence of pathological abnormalities such as liver and kidney failures and toxicity. It is, therefore, safe to use urea-fermented BDG at recommended concentration and levels to replace GNC in finisher broiler diets without any health implications for the consumers of such poultry products.

References

Ademosun, A. A. (1973). Evaluation of brewer's dried grains in diets of growing chickens. *British Poultry Science*, 14:463-468

Aduku, A. O. (1993). Tropical feedstuffs Analysis Table. Faculty of Agriculture, Department of Animal Science, Ahmadu Bello University, Samaru-Zaria, Nigeria.

Akpodiete, O. J. Ologhobo, A. D., Ayoade, O. G. (1997). Replacement value of maggot meal for fish meal in broiler chicken diets. *Proceedings of 2nd Annual Conference of Animal Science Association of Nigeria*, Ikeja-Lagos pp 64-76.

Akpodiete, O. J. and Ologhobo, A.D. (1998a). The nutritive value of maggot meal in broiler chicks I. Performance characteristics. *Proceedings of 3rd Annual Conference of Animal Science Association of Nigeria*, Ikeja-Lagos. pp. 38-40.

Akpodiete, O. J. and Ologhobo, A. D. (1998b). The nutritive value of maggot meal in broiler chicks II. Nutrient retention, haematology and serum chemistry. *Proceedings of 3rd Annual Conference of Animal Science Association of Nigeria*, Ikeja-Lagos pp. 41-42.

AOAC (1990). Association of Official Analytical Chemists. Official Method of Analysis, 15th Edition, Washington, D.C.

Atteh, J.O. and Opawande. F.E. (2000). Replacement of brewer's dried grains for groundnut cake in broiler finisher diets. *Proceedings of 25th Nigerian Society for Animal Production Conference,* Umudike, Nigeria. pp. 165-168.

Chandra, M., Singh, B., Soni, G.L. and Ahuja, S. P. (1983). Real biochemical changes produced in broilers by high protein, high calcium, urea-containing and Vitamin A deficient diets. *Avian Diseases*, 28:1-6.

Cheesbrough, M. (1999). District Laboratory Practice in Tropical Countries. *Cambridge University Press*, Edinburg Building, Cambridge, U.K.

Church, J. P., Young, C.W., Kelsay, J.L. and Kim, W.W. (1984). Relationship among dietary constituents and specific serum clinical components of subjects eating self selected diets. *American Journal of Clinical Nutrition*, 40:1338-1344.

Duncan, D.B. (1955). Multiple Range and Multiple F-Tests. *Biometrics*, 11:1-42.

Eggum, B. O. (1986). Blood urea measurement as a technique for assessing protein quality. *British Journal of Nutrition*, 4:983-988.

Fanimo, A.O., Bamgbose, A. M., Abiola, M.O., Adediran, M. and Olaniyan, A.I. (2005). Carcass yield and blood parameters of broiler chicken fed melon husk diets supplemented with yeast. *Proceedings of 1st Nigerian International Poultry Summit (NIPS)*, Ota Ogun State, Nigeria. pp:60-63.

Isikwenu, J. O., (2006). The use of urea-treated and fermented brewer's dried grains in poultry diets. *Ph.D Thesis*, Department of Animal Science, Delta State University, Abraka, Asaba Campus.

Isikwenu, J. O., Omeje, S.I., Okagbare, G.O. and Akpodiete, O.J. (2008). Effect of replacing groundnut cake with urea-fermented brewer's dried grains in broiler chicks diets. *Animal Research International*, 5(1): 795-800.

Isikwenu, J.O., Udeh, I. and Ifie, I. (2012). Haematological response, performance and economic analysis of cockerel chicks fed enzyme supplemented brewer's dried grains groundnut cake based diets. *Pakistan Journal of Nutrition* 11(6):541-546.

Lambert, W.V. Ellis, N.R. Block, W. H. and Titus, H.W. (1936). The role of nutrition in genetic research. *The American Society for Animal Production*, 29:236. http://jas.fass.org/cgi /reprint/1936b/1/236-a.

Lohr, J.E. (1975). Fatty liver and kidney syndrome in New Zealand chickens. *New Zealand Veterinary Journal*, 23:163-187.

Maxwell, M. H., Robertson, W. Spence, S. and McCorquodale, C. C. (1990). Comparison of haematological values in restricted and *ad libitum* fed domestic fowls: Red Blood Cell Characteristics. *British Poultry Science*, 31:407-413.

Mitruska, B.M. and Rawnsley, H.M. (1977). Clinical, Biochemical and Haematological Reference Values in Normal Experimental Animal. Mason Publishing Inc, USA.

Onwudike, O. C. (1993). Energy and protein requirements of broiler chicks in the humid tropics. *Tropical Animal Production Investigation*. 18:39-44.

Reitman, S. and Frankel, S. (1957). A colorimeter method for determination of serum glutamic exaloacetic and serum glutamic pyruvic transaminases. *American Journal of Clinical Pathology*, 28:56-63.

Rose, J. G., Christic, G. Halliday, W.G. and Jones, R. M. (1978). Haematological and Chemistry. Comparison values for clinical pathology in poultry. *Veterinary Record* 102:29-31.

SAS Institute (2000). Statistical Analysis Systems *User's Guide*, Cary, N.C. USA pp:949.

Seal, U. S and Erickson, A.W. (1979). Haematology, blood chemistry and protein polymorphism in the white tailed doer. *Comparative Biochemistry and Physiology*. 39:695.

Treacher, R.J. (1977). Dietary protein levels and blood composition of dairy cattle. *British Society for Animal Production Occasional Publication*, 1:133-142.

Uchegbu, M. C. and Udedibie, A. B. I. (1998). Maize/sorghum-based dried brewer's grains in broiler finisher diets. *Nigerian Journal of Animal Production*. 25(1 & 2): 13-16.