Agricultural Journal 2 (1): 64-70, 2007

The Effects on the Blood, Carcass and Organs of Finisher Broilers Fed Groundnut Cake Diets Replaced with Urea-Treated and Fermented Brewer's Dried Grains

J.O. Isikwenu and S.I. Omeje
Department of Animal Science and Fisheries, Delta State University,
Asaba Campus, Nigeria

Abstract: The implications of replacing GNC with urea-treated and fermented BDG in broiler finisher diets on the blood, carcass and organs characteristics was investigated. Urea-treated and fermented BDG was used to replace GNC at 0, 25, 50, 75 and 100% levels in broiler finisher diets. Diets were formulated to be isonitrogenous and isocaloric to supply 20% crude protein and 3000kcal/kg metabolizable energy. One hundred and ninety-five 35 days old broiler chicks of Anak breed were randomly allocated to five equal dietary treatments of 13 chicks per replicate and 39 chicks per treatment and fed *ad libitum* in rearing cages. At the end of the experiment, blood samples were collected from replicates in the treatment groups for analyses. At 8 weeks of age, two birds per treatment fasted overnight were weighed and slaughtered for carcass evaluation. The carcass and organ parameters were not significantly ($p>0.05$) influenced by dietary treatments, except for the neck and breast weights that were significantly ($p<0.05$) affected by dietary treatments. Apart from RBC, WBC, albumin, urea, hydrobicarbonate and creatinine values which were significantly ($p<0.05$) influenced, all other blood parameters were not significantly ($p>0.05$) affected by dietary treatments. The use of urea-treated and fermented BDG is safe as a replacement for GNC in broiler diets as results indicate absence of pathological abnormalities.

Key words: Urea-treated and fermented BDG, groundnut cake, carcass, organs, blood and pathological abnormalities

INTRODUCTION

The need to produce cheap and quality livestock and poultry feeds is the Nutritionist dream and Farmers expectation. Protein sources are the most expensive among feed ingredients in poultry production and 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 cheap, readily available, not directly required by man and can supply same quality protein because of its similar amino acid profile to that of GNC[1]. Table 1 shows the chemical composition of GNC and BDG. The major limitation to the use of BDG as a source of plant protein is its high crude fibre content[2-4]. Further processing of BDG in order to reduce its fibre content was carried out by use of urea-treatment and fermentation. Urea-treated and fermented BDG have been successfully used in broiler starter diets as a replacement for GNC up to 16.70% of the diet without detrimental effects. The health implications of the use of urea-treated and fermented BDG in broiler diets on the final products is important. The constituents of blood provide valuable information with which to draw inference in clinical and nutritional investigations of the individual. The blood is an important index of physiological, pathological and nutritional status of an organism and as such changes in the constituent components of the blood when compared to normal values could be used to evaluate the metabolic status of an animal[5]. This study is aimed at investigating the effects of replacing GNC with urea-treated and fermented BDG in broiler finisher diets on the blood, carcass and organs parameters.

MATERIALS AND METHODS

Urea-treated and fermented BDG (as test ingredient) was used to replace groundnut cake at 0, 25, 50, 75 and 100% levels in broiler finisher diets on protein equivalent basis. The BDG used in this experiment was treated and fermented for 7 days using 2% urea concentration and was prepared by the method of Adeleye[6]. The proximate

Corresponding Author: J.O. Isikwenu, Department of Animal Science and Fisheries, Delta State University, Asaba Campus, Nigeria

Table 1: Chemical composition of groundnut cake and brewer's dried grain

Chemical component	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
TDN	76.00	78.00
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[1]

Table 2: Proximate analysis of test ingredient (urea-treated and fermented BDG)

Parameters %	Treated 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^{-1} (calculated)	5.17	5.14

(urea concentration used was 2%, 20 g urea per litre of water)

compositions of the urea-treated and fermented BDG and the untreated BDG are presented in Table 2.

Five dietary treatments were formulated to be isonitrogenous and isocaloric to provide 20% crude protein and 3000 kcal kg^{-1} metabolizable energy. The diets were adequately furnished with vitamins and minerals. The compositions of the broiler finisher diets are presented in Table 3. One hundred and ninety-five 35 days old broiler chicks of Anak breed were randomly allocated into five equal treatments of 39 chicks each and fed the experimental finisher diets in rearing cages for the 21 days period. Each treatment was replicated thrice with 13 chicks per replicate. Food and water were provided *Ad libitum.*

Blood samples approximately 10 mL 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 EDTA (ethylene diamine tetra-acetic acid) at the end of the experiment. Haematological and serological analyses were carried out using routinely available methods. The Packed Cell Volume ((PCV) was determined by Wintrobes microhaematocrit method, Red Blood Cell count (RBC) and White Blood Cell count (WBC) were by Neubauer haemocytometer and Haemoglobin concentration (Hb) by Cynomethaemoglobin method. The Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Cell Haemoglobin Concentration (MCHC) were computed as outlined by Seal and Erickson[7]. Serological parameters such as total protein was determined by Buiret method, albumin, globulin, urea, glucose (glucose oxidase) and cholesterol were determined by colorimetric methods. Creatinine was determined by kinetic method using alkaline picrate. The serum Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) were analysed according to Enzymatic analysis method of Reitman and Frankel[8]. Electrolytes such 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.

At 8 weeks of age, two birds per treatment group, fasted over night were slaughtered for carcass measurements after the preslaughter were recorded. Organs weighed include heart, liver, pancreas, spleen and gizzard.

Data collected from the experiment were subjected to analysis of variance using SAS[9] package. Duncan's multiple range test[10] was used to assess significance of differences between treatment means.

RESULTS

The results of the carcass quality parameters and organ weights of the broilers slaughtered at 56 days of age are presented in Table 4 and 5. All parameters considered for carcass quality of broilers fed the dietary treatments were not significantly (p>0.05) different in all treatment groups. The cut-up parts were also not significantly (p>0.05) different, except for breast and neck. The breast weight of broilers fed diets with 25 and 50% inclusion levels were significantly (p<0.05) heavier than those of 100% inclusion diet but were similar (p>0.05) to other treatment groups. The neck weight of broilers fed diet with 75% inclusion were similar (p>0.05) to those on 100% inclusion but significantly (p<0.05) heavier than those of 0, 25 and 50% inclusion levels. Most of the organ weights of heart, liver, pancreas, spleen and gizzard (expressed as percentage of dressed weight) were not significantly (p>0.05) different in all treatment groups. The colon and small intestine lengths (expressed in cm per 100 g dressed weight) of broilers fed urea-treated and fermented BDG diets were significantly (p<0.05) higher than those of the control diet. Proventriculus length was only affected at 25% inclusion level which was significantly (p<0.05) lower than the 100% inclusion diet but similar (p>0.05) to the others. Caeca lengths of broilers fed diet with 75% inclusion were significantly (p<0.05) longer than those of 0 and 25% inclusion but similar (p>0.05) to those of 50 and 100% inclusion levels. The

Table 3: Composition of experimental broiler finisher diets

	Dietary treatments				
Ingredients	R_1 (Control)	R_2	R_3	R_4	R_5
Maize (Yellow	58.20	57.18	55.60	54.45	52.85
Groundnut cake	21.50	16.12	10.75	5.38	-
Urea Treated BDG	-	6.30	13.00	19.32	26.00
Fish meal	2.50	2.50	2.50	2.50	2.50
Blood mean	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
Calculated:					
Crude Protein (%)	20.13	20.04	20.06	19.98	19.98
Metabolizable Energy (ME) kcal/kg	3007.50	3002.89	3001.63	3001.49	3002.89
Determined:					
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 I.U; D3, 18000I.U; E. 20 I.U; K, 2.0 mg; B_1, 1.55 mg; B_2, 4.4 mg; B_6, 2.35 mg; B_{12}, 0.013 mg; Biotin, 0.042 mg; Niacin, 23.5 mg; Pantothenic, 6.5 mg; Folic, 0.65 mg; Mn, 75 mg; Zn, 45 mg; Fe, 20 mg, Cu, 5 mg; I, 1.0 mg, Se, 0.01 mg; Co, 0.02 mg; B.H.T.; 90 mg; Ethoxyquin, 33 mg; Choline, 150 mg. Production of Animal Care Services Consult (Nig.) Ltd Lagos

Table 4. Carcass quality characteristics of broiler birds fed experimental diets at 56 days

Replacement levels (%)	00UTBDG 100GNC	25UTBDG 75GNC	50UTBDG 50GNC	75UTBDG 25GNC	100UTBDG 00GNC	
	Dietary treatments					
Characteristics	1	2	3	4	5	SEM
Live weight (kg)	2.04±0.21^a	2.00±0.20^a	2.06±0.19^a	1.64±0.10^a	1.8±0.22^a	0.081
Plucked weight (kg)	1.89±0.19^a	1.82±0.18^a	1.81±0.20^a	1.52±0.08^a	1.73±0.20^a	0.075
Dressed weight (kg)	1.68±0.26^a	1.69±0.17^a	1.71±0.13^a	1.49±0.04^a	1.58±0.18^a	0.063
Dressed wt (kg) (%LW)	81.68±4.08^a	84.50±0.05^a	83.01±1.18^a	90.76±3.40^a	85.20±0.18^a	1.307
Eviscerated weight (kg)	1.50±0.23^a	1.48±0.18^a	1.50±0.15^a	1.20±0.12^a	1.33±0.17^a	0.069
Eviscerated wt (kg) (%LW)	73.53±3.68^a	74.00±0.04^a	72.82±0.85^a	73.62±2.40^a	71.51±0.17^a	1.204
Head weight (kg)	0.06±0.01^a	0.05±0.01^a	0.05±0.01^a	0.05±0.01^a	0.05±0.00^a	0.002
Shank weight (kg)	0.09±0.01^a	0.08±0.00^a	0.10±0.02^a	0.10±0.00^a	0.09±0.01^a	0.004
Breast wt (kg) (%PEW)	27.53±1.55^{ab}	28.61±1.69^a	29.15±0.49^a	27.25±0.53^{ab}	24.41±0.27^b	0.656
Back wt (kg) (%PEW)	19.54±0.94^a	21.16±1.16^a	19.52±1.23^a	18.80±0.28^a	21.15 ±2.18^a	0.539
Drumstick Wt (% PEW)	14.35±0.18^a	13.37±1.25^a	15.64±0.83^a	15.04±0.23	15.28±1.9	0.456
Thigh wt (kg) (% PEW)	16.80±0.52^a	16.56±0.41^a	16.55±1.74^a	17.12±0.45^a	17.82±1.15^a	0.368
Wing wt (kg) (%PEW)	12.59±0.78^a	11.53±0.02^a	13.51±1.31^a	12.21±0.76^a	11.80±1.13^a	0.382
Neck wt (kg) (%PEW)	6.98±0.58^b	6.87±0.82^b	7.06±0.35^b	9.21±0.05^a	7.98±0.64^{ab}	0.349

PEW: expressed as percentage of eviscerated weight. LW: Live Weight. Wt: Weight a,b, Means with different superscripts in the same row are significantly different ($p<0.05$)

Table 5: Organ weight of broiler birds fed experimental diets at 56 days

Replacement levels (%)	00UTBDG 100GNC	25UTBDG 75GNC	50UTBDG 50GNC	75UTBDG 25GNC	100UTBDG 00GNC	
	Dietary treatments					
Characteristics	1	2	3	4	5	SEM
Heart weight (g) (%PDW)	0.45±0.01^a	0.56±0.08^a	0.46±0.05^a	0.52±0.03^a	0.51±0.02^a	0.019
Liver weight (g) (%PDW)	1.83±0.28^a	2.12±0.51^a	1.61±0.03^a	2.02±0.05^a	1.92±0.22^a	0.110
Pancrease weight (g)	0.165±0.04^a	0.185±0.04^a	0.185±0.02^a	0.210±0.00^a	0.190±0.00^a	0.009
Spleen wt (g) (%PDW)	0.135±0.02^a	0.200±0.01	0.125±0.02^a	0.170±0.04^a	0.175±0.02^a	0.012
Gizzard weight (without lining) (g) (%PDW)	2.71±0.11^a	2.99±0.30^a	2.67±0.50^a	3.70±0.43^a	3.21±0.37^a	0.176
Colon length cm (cm/100g dressed wt)	1.59±0.02^b	1.84±0.02^a	1.72±0.01^a	2.05±0.04^a	1.82±0.01^a	0.024
Small Intestine lenght cm (cm 100 g^{-1} dressed wt)	9.20±0.39^b	10.19±0.12^a	10.13±0.24^a	10.28±0.24^a	10.59±0.23^a	0.201
Proventriculus lenght cm (cm/100g dressed wt)	0.292±0.01^{ab}	0.269±0.00^b	0.292±0.00^{ab}	0.302±0.00^{ab}	0.304±0.02^a	0.005
Caeca lenght cm (cm 100 g^{-1} DW)	1.12±0.02^b	1.03±0.02^c	1.19±0.04	1.27±0.01^a	1.20±0.03^{ab}	0.029

a,b,c Means with different superscripts in the same row are significantly different ($p<0.05$). PDW: expressed as percentage of dressed weight. DW: Dressed weight results of the haematological and serological indices are presented in Table 6 and 7. There were no significant ($p>0.05$) differences among broilers fed the dietary treatments in Packed Cell Volume (PCV), Haemoglobin concentration (Hb), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) values. Significant ($p<0.05$) differences were observed in Red Blood Cell count (RBC) and White Blood Cell count (WBC) values among treatments. The PVC with values ranging from 24 to 31.5% though not different ($p>0.05$) were observed to increase with increasing levels of urea-treated BDG inclusion, except for 100% inclusion that was slightly lower than 50 and 75% inclusions. The Hb with values of 4.05, 4.55, 5.70, 5.30 and 4.80 g dL^{-1} though not different ($p>0.05$) were found to increase generally with the inclusion of urea-treated BDG. Red blood cells count were similar ($p>0.05$) among 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 white blood cells count with values ranging from 3.24 to 4.02×10^{10} L^{-1}) showed broilers fed diets with 50 and 100% inclusions were significantly ($p<0.05$) higher than broilers on diet with 25% inclusion but were similar ($p>0.05$) with those on 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 not significantly ($p>0.05$) different among broilers fed the dietary treatments. The MCV and MCH values were generally higher in broilers fed diets containing urea-treated BDG. Total protein, globulin, glucose, cholesterol, sodium, potassium, chlorine, Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) values were not significantly ($p>0.05$) different among broilers fed the different diets. However, total protein with values of 33.5-36.00 g L^{-1}, globulin with 18.00-22.00 g L^{-1} and glucose with 8.40-9.40 mmol L^{-1} tended to be slightly higher ($p>0.05$) in broilers fed diets with urea-treated BDG. Sodium with 140.50-143.50 mmol L^{-1} and ALT with values of 12.50-14.00 μ L^{-1} showed values slightly lower ($p>0.05$) for urea-treated BDG diets. The albumin, urea, hydrobicarbonate and creatinine values were significantly ($p<0.05$) affected by dietary treatments. The albumin

Table 6: Haematological indices of broiler birds fed experimental diets

Replacement levels (%)	00UTBDG 100GNC	25UTBDG 75GNC	50UTBDG 50GNC	75UTBDG 25GNC	100UTBDG 00GNC	
	Dietary treatments					
Characteristics	1	2	3	4	5	SEM
PCV (%)	24.00±1.00^{a}	27.00±1.00^{a}	29.50±5.50^{a}	31.50±0.0.50^{a}	28.50±0.50^{a}	1.197
Hb (g dL^{-1})	4.05±0.15^{a}	4.55±0.15^{a}	5.70±0.60^{a}	5.30±0.90^{a}	4.80±0.10^{a}	0.253
RBC (10^{12} L^{-1})	1.72±0.04^{ab}	1.62±0.15^{b}	2.01±0.04^{a}	1 .72±0.14^{ab}	1.92±0.06^{ab}	0.058
WBC (10^{10} L^{-1})	3.61±0.08^{ab}	3.24±0.29^{b}	4.02±0.10^{a}	3.65±0.07^{ab}	3.85±0.13^{a}	0.102
MCV (fl)	139.15±2.50^{a}	168.83±21.52^{a}	146.92±6.07^{a}	181.37±17.23^{a}	148.38±1.90^{a}	6.725
MCH (pg)	23.49±0.32^{a}	28.44±3.51^{a}	28.31±2.30^{a}	30.53±2.75^{a}	24.99± 0.24^{a}	1.134
MCHC (%)	16.88±0.08^{a}	16.86±0.07^{a}	19.36±2.40^{a}	16.84±0.08^{a}	16.85±0.06^{a}	0.486

a,b, Means with different superscripts in the same row are significantly different ($p<0.05$) AST-Aspartate aminotranferase, ALT-Alanine aminotransferase

Table 7: Serological indices of broiler birds fed experimental diets

Replacement levels (%)	00UTBDG 100GNC	25UTBDG 75GNC	50UTBDG 50GNC	75UTBDG 25GNC	100UTBDG 00GNC	
	Dietary treatments					
Characteristics	1	2	3	4	5	SEM
Total protein (g L^{-1})	33.50±2.50^{a}	36.00±1.00^{a}	36.00±3.00^{a}	33.50±0.50^{a}	33.50±0.50^{a}	0.734
Albumin (g L^{-1})	14.50±0.50^{a}	16.00±1.00^{a}	15.50±0.50^{ab}	13.50±0.50^{b}	15.50±0.50^{ab}	0.365
Globulin (g L^{-1})	19.00±2.00^{a}	20.00±0.00^{a}	20.50±2.50^{a}	22.00±1.00^{a}	18.00±1.00^{a}	0.690
Glucose (mmol L^{-1})	8.40±0.30^{a}	9.15±0.25^{a}	8.70±0.50^{a}	9.40±0.20^{a}	8.85±0.05^{a}	0.153
Urea (mmol L^{-1})	2.65±0.15^{a}	2.40±0.00^{ab}	2.35±0.05^{ab}	2.05±0.25^{b}	2.85±0.05^{a}	0.101
Cholesterol (mmol L^{-1})	2.88±0.18^{a}	2.86±0.17^{a}	3.23±0.00^{a}	2.92±0.18^{a}	2.93±0.14^{a}	0.067
Sodium Na^{+} (mmol L^{-1})	143.50±0.50^{a}	140.50±2.50^{a}	141.00±4.00^{a}	141.00±3.00^{a}	140.50± 2.50^{a}	0.989
Potassium K^{+} (mmol L^{-1})	4.20±0.20^{a}	3.70±0.10^{a}	4.15±0.35^{a}	4.20±0.40^{a}	3.55±0.05^{a}	0.127
Chlorine Cl^{-} (mmol L^{-1})	100.00±0.00^{a}	96.50±1.50^{a}	99.50±2.50^{a}	101.00±1.00^{a}	102.00±2.00^{a}	0.827
$HC0^{-}_{3}$ (mmol L^{-1})	26.00±0.00^{a}	21.50±1.50^{b}	24.00±1.00^{ab}	21.00±1.00^{b}	24.00±0.00^{ab}	0.694
Creatinine (μmol L^{-1})	21.35±0.45^{a}	18.15±0.05^{ab}	16.15±0.25^{b}	15.85±2.25^{b}	15.00±1.40^{b}	0.858
AST (μ L^{-1})	102.50±0.50^{a}	107.00±5.00^{a}	104.50±1.50^{a}	100.00±4.90^{a}	100.00±0.00^{a}	1.332
ALT (μ L^{-1})	14.00±0.00^{a}	13.00±3.00^{a}	12.50±0.50^{a}	13.00±2.00^{a}	3.50± 2.50^{a}	0.680

a,b, Means with different superscripts in the same row are significantly different ($p<0.05$) AST-Aspartate aminotranferase ALT-Alanine aminotransferase value of 13.50-16.00 g L^{-1} showed that broilers fed diet with 25% inclusion had significantly ($p<0.05$) higher albumin than those of 75% inclusion but were similar ($p>0.05$) with those of other diets. The urea values of 2.05-2.85 mmol L^{-1} showed that 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 of 21.00-26.00 mmol L^{-1} 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-treated BDG had lower hydrobicarbonate values than those fed the control diet. The creatinine values of 15.00-21.35 μmol L^{-1} showed that broilers fed the control diet were significantly ($p<0.05$) higher than those fed diets with 50,75 and 100% inclusion levels but were similar ($p>0.05$) to those fed diets with 25% inclusion. Creatinine values were found to decrease progressively as the levels of urea-treated and fermented BDG inclusion increased in the diets.

DISCUSSION

The carcass quality parameters in Table 4 for broilers at 56 days were similar in all dietary treatments. Since the carcass measurements were similar for all treatment groups, it can be inferred that urea-treated and fermented BDG and GNC are similar nutritionally and capable of tissue synthesis in a comparable rate in finishing broilers under the same environment. The similarity of the cut-up parts indicate that nutrient content of the diets were similar and supported growth at comparable rate. The values of these measurements agree with those of Boardbent *et al.*[10] and Akpodiete *et al.*[12]. The similarity of the breast weights for treatments with 0, 25, 50 and 75% replacement levels agree with the performance of other cut-up parts but the poor performance of breast weight by 100% replacement level, means that nutrients for tissue synthesis of breast muscles were inadequate or tissue synthesis of breast muscles was delayed at that level of replacement. The neck weights indicate that urea-treated and fermented BDG incorporation seem to encourage the development of neck muscles. The organ weights were not different and this confirm the fact that the use of urea-treated and fermented BDG do not cause toxicity or abnormal metabolic activities in broiler organs and is therefore, safe for use in broiler finisher production. The values of organ weights of this study are similar to those reported by Akpodiete *et al.*[13] and Fanimo *et al.*[14]. The significant increase in length of the Gastro Intestinal Tracts (GIT) of broilers fed urea-treated and fermented BDG diets, resulted from a modification of their GIT to enable them accommodate their more bulky rations and this is supported by antecedent reports of Savory and Gentle[15,16], Hetland and Svihus[17] and Hetland *et al* .,[18,19].

The haematological parameters of PCV, Hb, MCV, MCH and MCHC in Table 6. For broilers fed the different dietary treatments showed no significant differences and the values obtained are comparable with reported normal ranges by several workers[12,13,20-23]. It was observed that though differences were not significant in these indices, values of broilers fed diets containing urea-treated and fermented BDG were generally higher than the control and therefore can only be attributed to the presence of urea-treated BDG inclusion in the diets. This means urea-treated BDG inclusion in the diets of 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 the blood parameters is an index of good physiological, pathological and nutritional status of broilers fed both GNC and urea-treated BDG based diets. Similar results have been reported by Church *et al.*[5]. The similarity in the red blood cells and white blood cells components between the control and all dietary treatments indicate the use of urea-treated BDG in broiler diets is safe.

The non-significance of differences of the serological indices in Table 7 such as total protein, globulin, glucose, cholesterol, sodium, potassium, chlorine, Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) among the different dietary treatments may be indicative of the adequacy of nutrients contained in the diets. The slightly higher values of serum glucose in broilers fed diets containing urea-treated BDG seen to suggest an encouragement of glucose release from carbohydrate digestion into the blood for energy needs of the birds by urea-treated BGD based diets. The moderate values of the serum AST and ALT means that the use of urea-treated BDG in broiler diets does not promote high serum enzyme activities, which is usually associated with hepatocellular damage (liver disease) and toxicity situations as also reported by Lohr[24], Mitruska and Rawnsley[20], Cheesbrough[25] and Akpodiete *et al.*[12,13]. Apart from treatment with 75% treated BDG inclusion which was significantly lower than that with 25% inclusion, all treatments were similar with the urea-treated BDG diets having higher albumin values than the control. This indicate the presence of a healthy functioning liver, since hypoalbuminaemia (low albumin level) is associated with the presence of liver disease. It also indicate a proper protein-energy balance in the diets and absence of parasitic infections[25,26]. The serum total protein and albumn levels in this study are an indication of good quality dietary protein and this agrees with the findings of Eggum[27]. The similarity of blood urea content between most diets is indicative of a normal protein synthesis and absorption for 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[28], this result further confirm the suitability of urea-treated BDG as a plant protein source in broiler diets and values agree with those of Ross *et al.*[21], Chandra *et al* .[28], Maxwell *et al.*[22] and Akpodiete *et al.*[12,23]. The serum creatinine levels of broilers was found to be significantly lower in the urea-treated BDG diets except in the 25% inclusion level and the decrease was progressive as the level of urea-treated BDG increased in the diets. This could mean that feeding urea-treated BDG in broiler diets may cause a reduction in serum creatinine level in broilers, which is an indication of a good kidney and overall renal function, as high creatinine level in the blood is associated with kidney and renal failures[25]. 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[25] and this agrees with the slightly lower muscle mass of the eviscerated weights of broilers fed urea-treated BDG diets. Serum creatinine values obtained in this study are within the approximate reference range and agree with those reported by Mitruska and Rawnley[20] and Fanimo *et al.*[14]. It was observed that broilers fed diets with urea-treated BDG had lower hydrobicarbonate content in the blood.

CONCLUSION

Based on the similarity of results obtained from carcass quality characteristics and organ weights, the use of urea-treated and fermented BDG in broiler diets at recommended inclusion levels is advocated. 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-treated and fermented BDG at recommended concentration and levels to replace GNC in broiler diets without any health implications for the consumer of such poultry products.

REFERENCES

1. Aduku, A.O., 1993. Tropical feedstuffs analysis table. Faculty of Agriculture, Department of Animal Science, Ahmadu Bello University, Samaru-Zara Nigeria.
2. Onwudike, O.C., 1993. Energy and protein requirements of broiler chicks in the humid tropics. Tropical Anim. Prod. Invest, 8: 39-44.
3. Ademuson, A.A., 1973. Evaluation of brewer's dried grains in diets of growing chickens. Brit. Poult. Sci., 14: 463-468.
4. Richardson, C.E., A.B. Watts and E.A. Epps, 1958. The effect of added fibre with or without fat in a practical broiler ration. Poult. Sci., pp: 37-1278.
5. Church, J. P., C.W. Young, J.L. Kelsay and W.W. Kim, 1984. Relationship among dietary constituents and specific serum clinical components of subjects eating self selected diets. Am. J. Clin. Nutr., 40: 1338-1344.
6. Adeleye, I.O.A., 1988. Treatment of low quality roughages and agronomic residues for livestock feeding: Their technology, applicability and adaptability to local conditions. Invited paper presented at the workshop on Alternative Formulation of Livestock feeds in Nigeria, University of Ibadans, Ibadan Nigeria.
7. Seal, U.S. and A.W. Erickson, 1979. Haematology, blood chemistry and protein polymorphisms in the white tailed doer. Comp. Biochem. Physio., pp: 39:695.
8. Reitman, S. and S. Frankel, 1957. A colorimeter method for determination of serum glutamic exaloacetic and serum glutamic pyruvic transaminases. Am. J. Clin. Path., 28: 56-63.
9. SAS Institute, 2000. Statistical Analysis systems. User's Guide, Cary, N. C., USA, pp: 949.
10. Duncan, D.B., 1955. Multiple range and multiple F-tests. Biometrics, 11: 1-42.
11. Broadbent, L.A., B.J. Wilson and C. Fisher, 1981. The composition of the broiler chicken at 56 days of age, output, components and chemical composition. Brit. Poult. Sci., 22: 385-390.
12. Akpodiete, O.J. and A.D. Ologhobo, 1998a. The Nutritive Value of Maggot Meal in Broiler Chicks I. Performance Characteristics. Proc. 3rd Ann. Conf. Anim. Sci. Assoc. Nigeria. Ikeja-Lagos pp: 38-40.
13. Akpodiete, O.J., A.D. Ologhobo and O.G. Ayoade, 1997. Replacement Value of Maggot Meal for Fish Meal in Broiler Chicken Diets. Proc. 2nd Ann. Conf. Anim. Sci. Assoc. Nigeria. Ikeja-Lagos, pp: 64-76.
14. Fanimo, A.O., A.M. Bamgbose, M.O. Abiola, M. Adediran and A.I. Olaniyan, 2005. Carcass yield and blood parameters of broiler chicken fed melon hust diets supplemented with yeast. Proc. 1st Nigeria International Poultry Summit (NIPS), Ota, Ogun State, Nigeria. pp: 60-63.

15. Savory, C.J. and K.J. Gentle, 1976a. Effects of dietary dilution with fibre on the food intake and gut dimension of Japanese Quail. Brit. Poult. Sci., 17: 560-570.
16. Savory, C.J. and K.J. Gentle, 1976b. Changes in food intake and gut size in Japanese Quail in response to manipulation of dietary fibre content. Brit. Poult. Sci., 17: 571-580.
17. Hetland, H. and B. Svihus, 2001. Effect of oat hulls on performance, gut capacity and feed passage time in broiler chicken. Brit. Poult. Sci., 42: 354-361.
18. Hetland, H., B. Svilus and V. Olaisen, 2002. Effect of feeding whole cereals on performance, starch digestibility and duodenal particle size distribution in broiler chickens. Brit. Poult. Sci., 43: 416-423.
19. Hetland, H., B. Svilus and A. Krogdahl, 2003. Effect of oat hulls and wood shavings on digestion in broilers and layers fed diets based on whole or ground wheat. Brit. Poult. Sci., 44: 275-282.
20. Mitruska, B.M. and H.M. Rawnsley, 1977. Clinical, Biochemical and haematological reference values in normal experimental animals. Mason Publishing, USA, Inc.
21. Ross, J.G., G. Christic, W.G. Halliday and R.M. Jones, 1978. Haematological and blood chemistry. Comparison values for clinical pathology in poultry. Vet. Record, 102: 29-31.
22. Maxwell, M.H., W. Robertson, S. Spence and C.C. McCorquodale, 1990. Comparison of haematological values in restricted and *ad libitum* fed domestic fowls: Red blood cell characteristics. Brit. Poult. Sci., 31: 407-413.
23. Akpodiete, O.J. and A.D. Ologhobo, 1998b. The Nutritive Value of Maggot Meal in Broiler Chicks Ii. Nutrient Retention, Haematology and Serum Chemistry. Proc. 3rd Ann. Conf. Anim. Sci. Assoc. Nigeria. Ikeja- Lagos, pp: 41-42.
24. Lohr, J.E., 1975. Fatty liver and kidney syndrome in New Zealand chickens. N. Z. Vet. J., 23: 163-187.
25. Cheesbrough, M., 1999. District Laboratory Practice in Tropical Countries. Ed. Cambrige Univ. Press. Edinburg Building, Cambridge, U.K.
26. Treacher, R.J., 1977. Dietary protein levels and blood composition of dairy cattle. Brit. Soc. Anim. Prod. Occa. Publ., 1: 133-142.
27. Eggum, B.O., 1980. Blood urea measurement as a technique for assessing protein quality. Brit. H. Nutr., 4: 983-988.
28. Chandra, M., B. Singh, G.L. Soni and S.P. Ahuja, 1983. Real biochemical changes produced in broilers by high protein, high calcium, urea-containing and vitamin A deficient diets. Avian Disease, 28: 1-6.