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Growth Performance and Blood Characteristics of Broilers Chicken Fed on Diet Containing Brewer Spent Grain at Finisher Phase

O. A. Anjola, M. A. Adejobi, L. A Tijani

Abstract**—**This study was conducted to investigate the effects of brewer spent grain (BSG) on growth performance and serum biochemistry characteristics of blood of broilers chickens. Three hundred and fifteen (4 weeks old) Oba – Marshall Broilers were used for the experiment. Five experimental diets were formulated with diet 1 (T1) containing 100% soya bean meal as the control, Diet 2, 3, 4 and 5 had BSG as replacement for soya bean meal at 0%, 36%, 57%, 76% and 100% respectively. The birds were allocated into each dietary group in a completely randomized design with 63 chicks in 3 replicates of 21 chicks each. The birds were offered these diets ad libitum from four weeks old to nine weeks old (35 days). Feed intake, body weight, weight gain, and feed conversion ratio (FCR) were assessed. Blood samples were also collected to examine the effect of BSG waste on hematology and serum biochemistry of broilers. Result indicated that BSG did not significantly ($P>0.05$) affect feed intake and weight gain. However, FCR and final weight of finishing broilers differs significantly ($P<0.05$) among treatments. The blood hematology and serum biochemistry indices did not follow a particular trend. Cholesterol concentration reduced with increasing level of BSG in the diet. Hb, RBC, WBC, neutrophils, lymphocytes, heterophiles and MCHC were significant ($P<0.05$) while MHC and MVC were not significantly ($P>0.05$) affected by BSG in diets. serum total protein, albumin, and cholesterol concentration also showed significance ($P<0.05$) difference. Thus, BSG can replace soya bean meal up to 14% in the broiler finisher diet without deleterious effect on the growth, hematology and the serum biochemistry of broiler chicken.

Keywords**—**Broilers, growth performance, hematology, serum biochemistry.

I. Introduction

FOOD remains the most important need for man's existence. In Africa and other developing countries of the world, provision of balanced diet remains a major issue since most sources of protein are either scarce or expensive for the poor population [1], [2]. The availability and affordability of conventional feeds for poultry feeds to commercial and small holder poultry farmers is becoming unnecessarily difficult due to high cost and parallel demand for some of these feedstuffs by man. Therefore, animal science is positioned to reduce the cost of production, having identified that reducing the cost of poultry feeds accounts for a large proportion of production cost. It has been reported that the cost of feeds adjudges for 70-80% of the cost of poultry production [3]. Hence, reducing the cost of production and provision good quality protein for the growing population.

The brewery industry produces a considerable amount of BSG as major waste after the production of burukutu and beer. It account for around 85% of the total by-products produced. Although, BSG contains considerable amount of lignin and cellulose [4]. BSG is readily available in most part of Nigeria and it is inexpensive compared to the conventional protein and energy feedstuffs [5], [6]. This study was conducted to evaluate the effects of replacing soya beam meal with BSG on growth performance, hematology, and serum biochemical characteristics of broilers at finisher stage.

II. Material and Methods

A. Birds Procurement and Management

The experiment was carried out in the Teaching and Research Farm of the Department of Animal Production, Lagos State Polytechnic, Ikorodu, Nigeria. Three hundred and fifteen (315) OBA-MARSHAL broiler were used for the study. The broiler chicks were purchased at day old from a reputable commercial hatchery and were uniformly reared intensively for four weeks. All routine vaccination and medications were adequately carried out. Feed and water given ad libitum done and temperature was adequately monitored

B. Experimental Diets

The composition of the experimental diets is shown on Table I. Wet BSG obtained from the Nigeria brewery Plc. was sundried, milled, weighed and incorporated into broiler finisher diet at 0, 5, 8, 11 and 14% inclusion in diet representing 0%, 36%, 57%, 76% and 100% replacement for soya bean meal.

The birds were weighed at the fourth week and assigned randomly into five dietary treatments groups; T1, T2, T3, T4 and T5. Each group were further divided into three replicates thirty birds each allocated to each using Completely Block Design (CRD).

C. Blood Collection and Evaluation

At the end of the experiment, two birds were selected from each replicates (representing 6 birds per treatment group) for haematological and serum biochemical indices. The selected

O.A. Anjola is with the Department of Animal Production & Fisheries, Lagos State Polytechnic, Ikorodu, Lagos, Nigeria (Phone: +2348051052662, e-mail: oajanjy@gmail.com).
M.A. Adejobi is with the Department of Agricultural Technology, Lagos State Polytechnic, Ikorodu, Lagos, Nigeria (Phone: +2348033484959).
L.A. Tijani is with the Department of Animal Production and Fisheries, Lagos State Polytechnic, Ikorodu, Lagos, Nigeria (Phone: +2348099270118, e-mail: abdulateef_tijani@yahoo.com).

birds were fasted for 24hrs and 8ml of the blood collected from the wing vein of each bird. From the 8ml blood collected, 4ml of the blood were collected into bijon bottle which contain Ethylene Diamine Tetra-Acetic Acid (EDTA) as an anticoagulant.

The samples were stored in 20^0C for 3hrs and were analysed using the method of [7] for packed cell volume (PCV), hemoglobin concentration (Hb), red blood cell count (RBC), white blood cell count (WBC), neutrophiles, lymphocytes, mean corpuscular volume (MCV), mean corpuscular heamoglobin (MCH) and mean Corpuscular Heamoglobin concentration (MCHC). And also for serum analysis, the remaining 4ml blood samples were collected into bottle vial bottles which do not contain anticoagulant, serum was separated by centrifugation at 2000 rbm at 10mins. Protein concentration (g/dl) and Albumin concentration (g/dl) were determined using the method of [8]. Creatinine (mmol/l) using the method of [9], Globulin (g/dl) as described by [10] and cholesterol concentration (g/dl) by the method of [11]

D.Data Collection and Analysis

Data on feed intake, body weight were collected weekly. From the primary data collected, FCR was deducted by dividing feed consumed by weight gained. Body weight gain was calculated as the differences between two successive weights in grams.

All data collected were subjected to analysis of variance test and all significant means were separated with Turkey test using Assistat software version 7.7 beta developed by [12].

TABLE I
GROSS COMPOSITION OF BROILER FINISHER DIET

	T1	T2	T3	T4	T5
Maize	55.0	55.0	55.0	55.0	55.0
BSG	-	5	8.0	11.0	14.0
Soya meal	14.0	9.0	6.0	3.0	-
Groundnut cake	12.2	12.2	12.2	12.2	12.2
Palm kernel cake	4.0	4.0	4.0	4.0	4.0
Palm Oil	3.0	3.0	3.0	3.0	3.0
Fishmeal (72%)	5.0	5.0	5.0	5.0	5.0
Lysine	0.1	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1	0.1
Limestone	5.6	5.6	5.6	5.6	5.6
Bone meal	0.5	0.5	0.5	0.5	0.5
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Metabolisable Energy	3224.2	3206.70	3196.20	3185.70	3175.7
Crude Protein	20.63	19.98	19.59	19.20	18.81

TABLE II
PROXIMATE COMPOSITION OF SOYA BEAM MEAL AND BREWER DRIED GRAIN MEAL

Variables	SBM	BDG	SEM
Dry Matter	98.60	95.91	0.95
Crude Protein	38.01.	25.00	4.59
Crude Fibre	12.86	19.88	2.48
Crude Fat	14.64	9.20	1.92
Ash	12.00	19.01	2.48

TABLE III
PERFORMANCE CHARACTERISTICS OF BROILERS FED DIFFERENT LEVELS OF BREWER'S SPENT GRAIN AS REPLACEMENT FOR SOYA MEAL AT FINISHER PHASE

Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Initial weight (g/bird)	702.74	703.27	702.76	701.01	701.60	0.19
Average feed consumption (g/bird/day)	3008.98	2991.64	2989.12	2950.9	3002.06	4.50
Average weight gain (g/bird/day	38.98	37.14	37.19	36.98	37.01	0.17
FCR	2.21	2.30	2.30	2.28	2.32	0.01
Final live weight (g/bird)	2067.04^{a}	2003.17^{bc}	2004.41^{b}	1995.31^{c}	1996.95^{bc}	6.05

abc=means with difference superscript on the same row differ significantly ($p<0.05$)

TABLE IV
HEMATOLOGICAL CHARACTERISTICS OF BROILER FED DIFFERENT LEVELS OF BREWER'S SPENT GRAIN AS REPLACEMENT FOR SOYA MEAL AT FINISHER PHASE

Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
HB(g/dl)	10.80^{ab}	11.18^{ab}	10.01^{bc}	11.83^{a}	9.12^{b}	0.21
PVC (%)	30.20^{b}	29.95^{b}	33.01^{a}	26.98^{c}	27.81^{c}	0.47
WBC($x10^3/\mu L$))	29.16^{a}	28.86^{b}	19.94^{d}	19.97^{d}	22.48^{c}	0.92
RBC($x10^3/\mu L$)	2.18^{c}	2.69^{a}	2.10^{c}	1.99^{d}	2.49^{b}	0.06
MCV(fl)	117.98	120.10	118.87	115.99	121.01	0.39
MCH(pg)	38.90	42.23	38.58	38.55	44.02	0.50
MCHC(g/dl)	40.20^{c}	44.51^{b}	34.69^{d}	44.38^{b}	50.02^{a}	1.14
Heterophils ($X10^3$ /μL)	4.70	5.00	4.58	5.25	5.11	0.06
LYM (($X10^3$ /μL)	11.33^{c}	17.63^{a}	11.69^{bc}	13.30^{b}	12.93^{bc}	0.47

abc=means with difference superscript on the same row differ significantly ($p<0.05$)

TABLE V
SERUM BIOCHEMICAL PARAMETERS OF BROILER FINISHER FED GRADED BREWER'S SPENT GRAIN MEAL

Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Total Protein (g/dl)	3.57^{a}	2.97^{b}	1.92^{d}	2.98^{b}	2.01^{c}	0.14
Cholesterol (mg/dl)	3.72^{a}	3.48^{b}	3.06^{c}	3.10^{c}	2.82^{d}	0.07
Globulin (g/dl)	3.90^{a}	2.58^{e}	3.57^{b}	2.93^{d}	3.10^{c}	0.11
Albumin (g/dl)	1.98^{a}	1.86^{c}	1.93^{b}	1.78^{d}	1.64^{e}	0.03
Creatinine (mmol/l)	41.17	46.53	39.50	45.01	47.82	0.71

abc=means with difference superscript on the same row differ significantly ($p<0.05$).

III. RESULT & DISCUSSION

Table I showed the gross composition and calculated analysis of experimental diets on fed basis. All diets were formulated to meet the dietary requirement of broiler at finisher phase. Diet 1 contains soya bean meal without replacement as the control diet, Diet 2, 3 and 4 contains BSG at different replacement values for soya bean meal. Diet 4 contains BSG as complete replacement for soya bean meal. All other ingredients were similar along all diets (treatments). The calculated crude protein (%) and metabolisable energy (kcal/kg) decreased with increasing level of BSG inclusion in the experimental diets.

Proximate composition of soya bean meal and BSG is indicated on Table II. Crude Protein of BSG obtained in this

study did not significantly (p> 0.05) differ from those documented by [13] who evaluated the crude protein content (DM basis) of BSG to be 26%.

The performance characteristics of broiler fed on different levels of brewer's dried grain as replacement for soya bean meal at finisher phase is shown on Table III. There were no significant (p> 0.05) differences on initial weight, average feed consumption g/bird/day and average gain g/bird/day. The feed consumption showed that all experimental diets were well consumed by the birds. However, the highest feed consumption was recorded in diet containing soya bean meal (T1) followed by diet containing total replacement of BDG for SBM (T5). This indicates that the inclusion of brewer dried grain in this study may not have affected the palatability of the feed. [14], [15] had earlier reported that moderate concentration of insoluble fibre in poultry diet do not affect feed consumption. It has been noted that older bird utilise fibre in diet than the younger ones due to the physiological development of the gastro intestinal tract and increased microbial activity [16], [17]. Also, high consumption of T5 may not be unconnected with increased viscosity and size of the GIT as reported by [18]. Feed consumed to weight gain was lower for birds in T1 (2.30) while the highest was recorded for those on T4 (2.32). This may be due to the availability of soluble nutrients in the soya bean meal based diet than in diets containing BSG. Feed to weight gain and final weight of birds were significantly (P<0.05) affected by BSG based diets. Dietary fibre content modifies the intestinal length, reduces weight of organs and also increase rate of passage of digesta through the digestive tract [19]. Solubility of the fiber and its physiochemical content determines the effects of dietary fibre on digestion and nutrient utility [20], [21].

Table IV showed the hematological characteristics of broiler fed different levels of brewer dried grain as replacement for soya meal at finisher phase. Hematological parameters are important indicator of the functional and health status of an animal exposed to suspected challenge [22]. The blood hematology values fall within the normal ranges reported for broiler chicken [23]. Hb, RBC, PCV, WBC count, MCHC, and lymphocytes were significantly (P<0.05) influenced by BSG in the diets. The values did not follow a particular pattern. Physiological condition and diseases of individual animal contribute to the hematology values [24], [25].

Serum biochemistry in Table V indicated that total protein, Albumin, cholesterol and globulin differs significantly among the diets. The values obtained in this study of serum protein (1.92-3.57g/dl) are relatively lower than those (4.55 to 6.46 g/dl) reported by [26]. The serum protein value of the diet I this experiment reduced with increasing level of BSG in diet. The blood cholesterol (2.82-3.72g/dl) however falls within the range (3.10-3.64g/dl) reported by [27] and 2.93-4.27g/dl by [27]. In this study, the cholesterol decreases as the level of BSG in diet increase, this is an indication of high fibre in BSG based diets. Soluble fibres have been reported to reduce total and LDL cholesterol in blood by related quantity [28]. The highest globulin (3.90g/dl) recorded birds fed on diet 1(100% SBM) may be an indication of poor nutritional status of which may be due to poor protein synthesis in bird fed on BSG diets. Malnutrition and immune defects has been attributed to contribute to globulin reduction [29], [30]. Serum protein is an indicator of protein quality which shows that soya bean meal possesses higher quality protein than BSG.

IV. Conclusion

The result of this study confirmed that the BSG meal can be used as partial replacement of soya bean meal in the diet of finishing broiler without any deleterious effect on the growth performance, hematology and serum biochemistry.

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