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Growth response, hematology and serum biochemistry of finisher broilers fed blended bovine blood plasma and soya bean hull as replacement for fish and soyabean meal

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Target Audience; *Poultry Farmers, Animal Scientists, Nutritionists, Researchers*.

Abstract

A 28-day feeding trial was conducted to investigate the growth response, hematology and serum biochemistry of finisher broiler chickens fed blended bovine blood plasma (BBP) and soyabean hull (SBH) mix. Four diets containing 0, 50, 75% and 100% mixture of bovine blood plasma and soya bean hull (BBP/SBH) coded T_1, T_2, T_3 and T_4 respectively were fed to 120 Anak broiler finisher birds. The birds were divided into 4 groups of 30 broilers per treatment replicated 3 times with 10 birds per replicate. The treatment diets were randomly assigned to the birds in a Completely Randomized Design (CRD). Performance data showed that the test ingredient significantly affected the daily feed intake, feed conversion ratio and daily weight gain of broiler birds. The results showed that hematological values like the Hemoglobin (Hb), Packed cell volume (PCV), Red blood cells (RBC) and white blood cells (WBC) decreased significantly ($P<0.05$) as the levels of BBP/SBH in the diets increases while the mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and clotting time increased proportionally. Serum biochemical parameters like Creatinine and Glucose increased as dietary BBP/SBH mixture increased in the treatment diets. Based on the above result, treatment 3(75%) mixture of BBP/SBH) is recommended to livestock farmers for optimum meat production and for profit maximization.

Keywords*: Performance; Hematology; Serum biochemistry; Finisher broilers; Blended bovine plasma; Soyabean hull.*

Description of Problem

As the global population continues to swell geometrically, especially in the sub-Saharan African (SSA) countries, the animal protein demand and supply gap continues to widen. The poultry industry has been viewed as a valuable sector which can be used to fight against malnutrition and global economic meltdown (1).

Poultry possess several attributes that are advantageous in comparison with other animals and hence the need to enhance its productivity. The greatest constraint to livestock production is the cost of feedstuffs which represents 65 – 70% of the total cost of production (2). The unprecedented rise in the cost of conventional feedstuffs has necessitated the use of unconventional ingredients to cushion the geometrical cost of production (3).

The challenge in broiler production is to reach the target market weight of 2.0-2.8kg in 56 days (4). Meeting these challenges in the Nigerian context will entail the use of

good quality breeds and the incorporation of industrial by-products into the feeding regime of stocks so as to achieve lower cost of production.

Sun-dried bovine plasma (SDBP) and soyabean hull (SBH) are byproducts of the meat processing and soybean oil industry which can be efficiently recycled in the livestock industry. The plasma consists of 78-80% protein (5) and the proteins contained in SDBP are primarily albumins, globulins and most importantly the immunoglobulin gamma (IgG) which is the predominant antibody similar to colostrum in breast milk (6).

Bovine blood plasma contains a diversity of functional proteins such as albumin, immunoglobulins, growth factors, and biologically active peptides (7). Blood products such as bovine blood plasma or red cells have been documented as protein sources with high nutritional value due to their excellent amino acid profile and digestibility, and have been used as ingredients in farm animal diets for many years (8). Therefore, from a nutritive perspective, the improvement in the growth performance of birds fed SDBP may be due to the product being a high quality protein with a good amino acid profile that can support gut development and rapid muscle growth. The presence of immunologically active compounds in blood products such as immunoglobulins, specific blood proteins, and nucleotides have positive effects on weaned pigs and chickens receiving diets containing porcine blood by-products (9). The protein fraction of plasma is highly digestible and plasma also increases digestibility of other ingredients, including fibre (10).

Soya bean hulls are a by-product of soya bean (SB) processing and consist of the SB seed coat. Soybean hulls make up approximately 8% of the whole seed and contain 86% complex carbohydrates ((11). As fed basis, SBH contains 11-12% crude protein, 65-70% total digestible nutrient (TDN), 35-40% crude fibre, 0.49% calcium and 0.9% phosphorus (12). The insoluble carbohydrate fraction of SB hulls consists of approximately 30% pectin, 50% hemicelluloses, and 20% cellulose (12). These compositional characteristics make SB hulls a good source of dietary fiber for livestock.

Considering the fact that the blood plays special role in the transportation of nutrients, removal of metabolic waste products and gases around the body, the need for haemato-biochemical profiles became very necessary in these nutritional studies for assessment and improvement of broiler performance. Combination of bovine blood plasma and soya bean hull may ultimately generate least cost formulated feed which will impact positively on blood profile of domestic animals and hence, the need for an in-depth study on this topic.

Materials and Methods

Location of the experiment

The experiment was conducted at the Teaching and Research farm of the Imo State Polytechnic, Umuagwo, in Ohaji/Egbema Local Government Area of Imo State, Nigeria. The climatic data of the area showed that the average annual rainfall ranges between (2000-2500mm) while the relative humidity ranges between (70-80%). The soil is sandy loamy and slightly acidic (13).

Experimental Birds and Design

One hundred and twenty (120) day old Anak broiler strains were procured from a commercial hatchery in Ibadan, Oyo State, Nigeria, certified to be healthy. The broiler birds were fed with commercial starter broiler ration for 4 weeks during which

adequate prophylactic and routine measures were ensured. Thereafter, birds were divided into 4 treatment groups of 30 birds each in a Completely Randomized Design (CRD) experiment. Each treatment was replicated three times. The birds were raised on a deep litter system of production. Optimum routine management practices were observed. Feed and water were provided *ad-libitum.*

Table 1: Ingredient composition of experimental diets (For 100kg feed)

	Dietary levels of BBP +SBH mixture			
Ingredients	T_1	T_2	T_3	T_4
Maize	50.00	50.00	50.00	50.00
Soya bean meal	13.00	6.50	3.25	0.00
Fish meal	2.00	1.00	0.50	0.00
SDBP + SBH Mix	0.00	7.50	11.25	15.00
Rice meal	18.30	18.30	18.30	18.30
Palm Kernel Cake	12.00	12.00	12.00	12.00
Bone meal	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25
Vit premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Total	100	100	100	100
Crude protein	21.44	18.71	17.00	16.00
ME (Kcal/kg)	3144	2968	2881	2793
Energy/protein ratio	147	159	169	175

Feed preparation and feeding

Fresh blood was hygienically collected from cattle certified fit by veterinary officials at Government Abattoir in Owerri Municipal Council of Imo State. The cattle were starved overnight, slaughtered and the blood collected with anti-coagulant in a bucket. The blood collected was subjected to high pressure by stirring with a centrifugation machine for separation of the serum from the plasma. The plasma collected was boiled for about 40 minutes and then sun-dried. The dried blood was then milled. The milled blood sample was then mixed with soya bean hull at the ratio of 3:2 and analyzed for its proximate composition as described by (14) and presented in Table 1. Four treatment diets were formulated (table 1). Treatment 1 served as the control and contained no SDBP and SBH meal mixture while diets 2, 3 and 4 contained graded levels of SDBP + SBH at 50%, 75% and 100% respectively.

Table 2: Proximate composition of BBP + SBH Mix (%)

Parameter	Composition (%)
Dry matter	93.50
Crude protein	51.37
Ash	7.97
Ether extract	2.11
Crude fibre	7.05
Nitrogen free extract	32.05
ME (Kcal/kg)	3104

ME = Metabolizable energy calculated; ME (Kcal/kg) = 37 x %CP + 81.8 X %EE + 35.5 X %NFE (Pauzenga, 1985) (15).

Table 3: Performance characteristics of broiler finishers on varying levels of BBP and SBH mixture.

Parameter	Dietary levels of BBP +SBH mixture				
	T_1	T_2	T_3	T_4	SEM
Initial Live weight(g)	717.30	716.00	730.70	750.70	9.32
Final weight (g)	2211.30	2182.00	2336.70	2241.70	3.88
Av. total Wt.gain(g)	1494	1466	1606	1491	35.88
Av.daily Wt.gain(g)	53.36^a	52.35^a	57.36^b	53.25^a	1.28
Feed conversion ratio	2.06^a	2.01^a	1.74^b	2.01^a	0.10
Total feed intake g)	3080^a	2940^b	2800^c	2996^b	68.03
Av. daily feed intake	110^b	100^c	105^a	107^a	2.43
Cost of 25kg feed(N)	2515^a	2502^b	2491^c	2471.88^d	5.59

*^{abc}Mean values along the row having different superscripts differ significantly at (P< 0.05) level (LSD). SEM=Standard error of means.

Collection of Blood Samples

At the end of the 4 weeks feeding trial, blood samples were collected from the jugular vein of 3 birds per replicate using hypodermic syringe into a set of sterilized glass tubes with Ethylene Diamine Tetraacetic Acid (EDTA) for determination of hematological parameters while glass tubes without anticoagulant were used for serum biochemical evaluation (16). The parameters investigated in the hematology estimates include hemoglobin (Hb), red blood cells (RBC), packed cell volume (PCV), white blood cells (WBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and clotting time (CT). The parameters investigated in the serum biochemistry estimate include urea, creatinine, glucose, cholesterol, total protein, albumin and globulin.

Table 4: Hematological parameters of broiler finishers on mixture of BBP and SBH based diets.

	Dietary levels of BBP +SBH Mixture					
Parameters	T_1	T_2	T_3	T_4	Ref. Value	SEM
Hb (g/dl)	11.33^a	11.00^a	10.40^b	10.07^b	7-13	0.65
PVC (%)	33.83^a	33.00^b	31.70^b	30.20^c	22-35	1.82
RBC (10^{-6})	5.10^a	4.80^b	4.40^b	2.77^a	4.2-4.84	1.17
WBC ($x10^3$)	3.70	3.50	3.40	3.20	4.07-4.32	0.25
MCV (ft)	29.50^c	30.00^b	30.50^a	30.50^a	29-35	0.50
MCH (pg)	33.73^c	34.50^a	34.70^a	4.50^a	30-40	0.49
MCHC (pg)	31.10	31.50	31.40	31.40	32.41-33.37	0.20
CT (sec)	35.00^b	36.00^b	36.20^b	40.20^a	32-39	2.60

*^{abc}Mean values on the same row having different superscript(s) are significantly different (P<0.05).
SEM=Standard error of means; Hb=Haemoglobin; PVC =Packed cell volume; RBC= Red blood cell; WBC=White blood cell; MCV=Mean corpuscular volume; MCH=Mean corpuscular haemoglobin; MCHC=Mean corpuscular haemoglobin concentration; CT=Clotting time.
Ref. Value=Reference value from Wikivet chicken hematology, (2012) (33).

Statistical analysis

Data obtained were statistically analyzed by One-way Analysis of Variance (ANOVA) (17) as appropriate for a completely randomized design using the General linear Model (GLM) procedure of SPSS version 20 (18) while differences in treatment means were separated using Duncan's Multiple Range Test from the same software package.

Results and Discussion

The nutritive assessment and performance characteristics of the experimental finisher broilers on BBP and soyabean hull mixture are shown in tables 1and 2 respectively. The crude protein content (CP) of BBP and SBH mixture is 51.37%, while values of 2.11%, 6.50%, 7.05%, 7.97%, and 32.05% were obtained for fat, moisture, fiber, ash, and soluble carbohydrate (NFE) respectively.

The test ingredients (SDBP + SBH mix) significantly affected the daily feed intake, feed conversion ratio and daily weight gain of broiler birds. The average daily feed intake of birds on the control diet was highest compared with the values of birds placed on plasma/soyabean hull mix diets. According to (19), blood meal is unpalatable in nature and the insoluble carbohydrate fraction of SB hulls appeared to have reduced the palatability and appetite of the broiler chickens. T_3 (75%) promoted the highest average daily weight gain of 57.36g followed by $T_1 > T_4 > T_2$ respectively. This finding aligns with (20) and (21) that blood meal can replace 50-100% of fish meal and 50% of soyabean meal in broiler finisher rations. The best feed conversion ratio was obtained from T_3 (1.74) while the poorest value of 2.06 was recorded in the control diet and this disagrees with (22) who asserted that inclusion of blood meal up to 15% reduced rate of growth and decreased efficiency of feed conversion. On the economy of production, T_1 (Control diet) promoted the highest feed cost/kg of ₦2515 which is statistically different ($P<0.05$) from BBP/SBH based diets. Feed cost of the diet reduced significantly ($P<0.05$) as dietary levels of blended bovine mixture increased progressively.

Table 5: Serum biochemical variables of broiler finishers on mixture of BBP and SBH based diets

	Dietary levels of BBP + SBH mixture					
Parameters	T_1	T_2	T_3	T_4	Ref. Value	SEM
Urea (Hg/ml)	2.60^a	2.40^a	1.77^b	1.50^b	4.46-4.54	0.33
Creatinine (mg/dl)	2.10^d	2.40^c	2.80^b	3.10^b	0.88-0.95	0.40
Glucose (mg/dl)	47.50^b	49.50^b	52.00^a	53.30^b	44.10-45.50	0.90
Cholesterol (mg/dl)	39.20^a	38.20^a	35.30^b	34.97^b	31.30-32.4	2.12
Totalprotein(mg/dl)	4.50^a	4.25^a	3.85^b	3.50^b	4-4.50	3.10
Albumin (g/dl)	3.05^a	3.00^a	2.85^a	2.70^b	2.8-3.00	1.15
Globulin (g/dl)	1.45^a	1.25^a	1.00^b	0.80^b	0.7-1.00	1.90

*^{abc}Mean values on the same row having different superscript(s) are significantly different ($P<0.05$).
SEM=Standard error of means; Ref. Value=Reference value from Wikivet chicken biochemistry, (2012).

The result of this study showed some level of influence of the treatment diets on hematological and serum biochemical parameters (Tables 2 and 3). Hematological values including hemoglobin, packed cell volume, red blood cells and white blood cells

decreased significantly ($P<0.05$) as the level of bovine blood plasma and soyabean hull increases across treatment group while mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC) increased proportionally above the control groups.

Reduction in the concentrations of erythrocytic parameters (such as PCV, RBC counts and Hb concentration) and an increase in mean corpuscular volume are indications of macrocytic (regenerative) anaemia (poor nutrient utilization) emanating from increased destruction and subsequently enhanced erythropoiesis at the liver, spleen and kidneys (23). Many blood metabolites like magnesium, Iron and copper which would have helped in building the haemoglobin load of the blood were apparently of low concentration in the blood cells and accounts for the low erythrocytic values.

This similar hematological trend was observed by (24) in an experiment on finisher broilers fed sorghum offal meal as dietary supplement. Blood clotting time (BCT) decreased marginally as dietary BBP/SBH increased in the treatment diets. T_1 (control) has the least BCT while the highest value was recorded by T_4 (100% total replacement). Reduced BCT is an index of the presence of blood clotting factors like prothrombin, fibrinogen, fibrinogen stabilizing factor, calcium and vitamin K (25). Nevertheless, in this study, all the haematological values were within the normal range (26).

Serum biochemical parameters like creatinine and glucose increased as dietary BBP/SBH mixture increased in the diets. Sufficient glucose level in the blood is an indication of stable homeostasis as optimum energy (metabolizable energy) is needed by the body to carry out its metabolic functions (27).

Birds on T_3 and T_4 showed no significant difference ($P>0.05$) in globulin and glucose. Birds in T_1 and T_2 showed similar values in globulin while birds on T_1 showed significant differences ($P<0.05$) when compared with other treatments means. Albumin and globulin are plasma proteins and their normal concentration in the blood enhances growth and development of body tissues. It appears that increase in the dietary level of the mixture of SDBP/SBH did not optimize the activity of microbial flora and better gut health and hence the reduction of the plasma proteins as dietary treatment increased proportionally (28).

Total serum cholesterol (TC) for finisher broilers were significantly influenced ($P<0.05$) by dietary BBP and SBH mix with values ranging between 34.97 and 39.20mg/dl. The control diet (T_1) recorded the highest value of TC (39.20mg/dl) while T_4 recorded the least value of 34.97mg/dl respectively. This implies that incorporation of high levels of BBP and SBH mix could be used to reduce the serum cholesterol for broiler birds. Cholesterol is synthesized from fats consumed and endogenously synthesized within the cells. A high level of cholesterol is an indication of a high risk of cardiovascular disease (22).

Birds on T_3 and T_4 showed no significant difference ($P>0.05$) in urea when compared with other treatments means while the creatinine values for birds on T_4 and T_3 were the highest and significantly different ($P<0.05$) when compared with T_1 and T_2. The significant difference and increased creatinine value as the inclusion level of SDBP and SBH mix increased suggests depletion of tissue creatinine phosphate which is produced as a result of energy production by skeletal muscles and this can adversely affect the muscle mass (29).

According to (5), inclusion rates of

spray-dried plasma products in research trials with pigs have ranged from 2 to 25%. However, in poultry nutrition the inclusion rate has ranged from 0.25 to 4%. Dose-dependent studies have been conducted to determine the optimal inclusion rate of spray-dried porcine plasma (30). The optimal inclusion level in pigs has been reported to range between 4 and 8% (31). In this study, based on past research work on bovine plasma, and in consideration of its combination with SBH which is a new innovation in broiler nutrition, it appears that the level of inclusion seems to be too high above the tolerable range for broiler birds. Bovine blood plasma contains a diversity of functional proteins such as albumins, immunoglobulins, growth factors, and biologically active peptides (7 and 31). 10 and 32 reported that the protein fraction of plasma is highly digestible and that plasma also increases digestibility of other ingredients including fibre. The result of the present study however, disagrees with the above findings since the expectation was that the high fibre fraction of soya bean hull would have been diluted by the bovine blood plasma despite the concentration of the hull in the mix, hence, BBP does not digest fibre judging from the result of this study.

Conclusion and Applicationss

1. The study has shown that BBP/SBH based diets can be tolerated by finisher broiler chickens but however, not at very high levels.
2. At moderate level of inclusion of this mixture, haematological and biochemical parameters were within optimal levels for optimum productivity of stocks.
3. Based on the above result, treatment 3 (75%) mixture of BBP/SBH) is recommended to livestock farmers for optimum meat production and for profit maximization.

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