ASSESSMENT OF THE PERFORMANCE AND BLOOD PARAMETERS OF STARTER BROILERS FED SOYBEAN CHEESE RESIDUE DIETS

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ABSTRACT
A 21-day feeding trial was conducted to evaluate the effect of varied levels of soybean cheese residue (SCR) on the performance and blood profiles of starter broilers. One hundred and ninety-five (195) 7-day old starter broilers were allocated to five diets containing 0%, 5%, 10%, 15% and 20% of SCR. Each treatment had thirty-nine birds, split into three (3) replicates of thirteen (13) birds. Observed results showed final weight, weight gain, daily weight gain and feed conversion ratio (FCR) were statistically significant (P<0.05). Final weight and weight gain ranged between 641.03g-681.03g, and 557.01g-593.03g, respectively. Daily weight gain values ranged from 26.52g to 28.24g, while 2.95 to 3.11 were observed for FCR. Birds on 20%SCR had the worst FCR. No significant difference (P>0.05) was observed for daily feed intake. Observed values for all haematological parameters were statistically significant (P<0.05). Observed values for total protein, albumin, globulin, creatinine and urea were not significant (P>0.05). However, significant differences (P<0.05) were observed for AST and ALT with a range of 62.67iµ/dl to 90.67iµ/dl and 9.66iµ/dl to 12.33iµ/dl, respectively. Performance parameters, such as weight gain (28.24g) showed that starter broilers on the control diet had better weight gain but at numerically higher feed intake. However, similar feed conversion ratio, which is an indicator of economic production, was observed at 10% inclusion of SCR. Therefore, soybean cheese residue can be included in starter broiler diet up to 15%.

Key Words: Performance, blood parameter, starter broiler, soybean cheese residue

INTRODUCTION

Poultry production is one of the most popular animal agriculture enterprises in Nigeria and remains a veritable means of bridging the gap in animal protein needs and supplies, especially in Nigeria. Poultry is also popular because it enjoys a relative advantage of easy management, high turnover, quick returns on capital investment and wide acceptance of its products for human consumption (Haruna and Hamidu, 2004).

Unfortunately, the feeding of poultry is a major problem threatening the survival of the industry. Generally, the prices of conventional protein sources like fish meal, soybean meal (SBM) and groundnut cake have been on the increase thereby affecting poultry farming. For example, the cost of feeding has been put at 60-80% of the total cost of production for intensively reared poultry (Tewe, 1997). Consequently, Hossain *et al.* (2003) advocated harnessing the potentials of good quality and relatively inexpensive feed ingredients as replacement for the more expensive conventional feed ingredients. Maggots from poultry droppings (Atteh and Oyedeji, 1990), housefly-pupa meal (El-Boushy, 1991), poultry offal meal (Udedibie *et al*., 1988), chicken offal meal (Nwokoro,1993), waste products from poultry eviscerating plants (Salami,1997) and shrimp waste meal (Fanimo *et al*.,1996; Rosenfield *et al*., 1997) are some of the unconventional protein sources that have been successfully used to partially or completely replace the expensive conventional protein sources (Ojewola *et al*., 2005).

Muroyama *et al*. (2006) had reported that about 800,000 tonnes of soybean waste is disposed of annually as by product of tofu production in Japan, and that the expense for soybean waste disposal cost around 16 billion yen per annum. Currently, soybean waste (soybean cheese residue) is used as stock feed and fertilizer or dumped in landfill in Japan. According to Muroyama *et al*. (2001), in Japan most of the soybean cheese residue is burnt which results in environmental pollution issues. Other workers reported that discarding of soybean cheese residue as waste is a potential environmental problem because it is highly susceptible to putrefaction (Almaraz *et al.,* 2009; Songo *et al.,* 2012). Obviously, has high moisture content (70% - 80%), which makes it difficult to handle and makes soybean cheese residue expensive to dry by conventional means (Redondo-Cuenca *et al.,* 2008). On the other hand, Soybean cheese residue (SCR) is a relatively inexpensive source of protein that is widely recognized for its high nutritional and excellent functional properties (Cheng and Klmura, 2005).

In the face of the current global feed crisis due to high cost of feed ingredients, one of the approaches is the use of alternative feed ingredients that can partly or wholly replace their conventional counterparts in poultry feed production. It is also important that these cheap potential alternative feedstuffs such as SCR do not compromise the performance and health of the target animals (poultry). The feeding trial sought to evaluate the performance, haematology and serum biochemistry of starter broilers fed varying levels of soybean cheese residue.

MATERIALS AND METHODS

The feeding trial was conducted in the Poultry Unit of the Livestock Teaching and Research Farm of Kogi State University Anyigba. Anyigba is situated between Latitude 7° 15' and 7° 29'N of the equator and Longitude 7° 11' and 7° 32' E of the Greenwich meridian and with an average altitude of 420metres above the sea level. Anyigba town falls within the tropical wet and dry climate region of the Guinea savanna, with average annual rainfall of 1600mm and daily temperature range of about 25 °C - 35 °C (Ifatimehin *et al.*, 2006).

Experimental Diets

SCR was obtained wet from soybean cheese vendors and sundried. The dried SCR was milled to break up the lumps before incorporation in the diets. Five experimental diets were formulated to include SCR at 0% (control), 5%, 10%, 15% and 20% as presented in Table 1.

Table 1: Gross Composition of Experimental Diets Containing Soybean Cheese Residue for Starter Broilers (%)

			SCR		
Ingredient	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)
Maize	46.00	43.00	40.00	37.00	34.00
Soybean full fat	39.00	37.00	35.00	33.00	31.00
Soybean Cheese Residue	0	5.00	10.00	15.00	20.00
Maize offal	8.65	8.65	8.65	8.65	8.65
Bone meal	3.50	3.50	3.50	3.50	3.50
Fish meal	2.15	2.15	2.15	2.15	2.15
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
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
Calculated analysis (%)					
Crude protein	22.05	22.08	22.11	22.14	22.17
Ether extract	9.17	9.29	9.41	9.53	9.65
Crude fibre	3.54	3.89	4.20	4.52	4.84
Calcium	1.45	1.45	1.45	1.45	1.45
Phosphorus	0.97	0.97	0.97	0.97	0.97
Lysine	1.16	1.11	1.07	1.02	0.97
Methionine	0.39	0.36	0.36	0.35	0.34
Cysteine	1.20	1.16	1.11	1.08	1.02
*ME Kcal/kg	3156.19	3047.95	2938.99	2830.03	2721.07

* ME value for soybean cheese residue is not added

Experimental birds and design

One hundred and ninety-five (195) 7-day old unsexed Cobbs broiler chicks were used for the experiment. The birds were allotted to five (5) diets (0%SCR, 5%SCR, 10%SCR, 15%SCR and 20%SCR). Each dietary group had thirty-nine (39) birds, with each group split into three (3) replicates of thirteen (13) birds. The feeding trial duration was twenty-one (21) days. The birds were weighed at the beginning of the feeding trial, weekly and at end of the study. The initial weight was subtracted from the final weight to determine the weight gain of the birds. Feed intake was determined by offering weighed quantity of feed daily and weighing leftover weekly to obtain the weekly feed intake. Weekly feed intake was divided by seven (7) to obtain the daily feed intake. Feed conversion ratio (FCR) was computed by dividing average daily feed consumed (intake) by average daily weight gain.

At the end of the feeding trial (21 days, i.e., at 28 days old), blood samples were collected from randomly picked birds in the various replicates representing each treatment, through the wing web using sterile disposable needles and syringes. The blood samples were collected into well labeled bottles containing ethylene diamine tetra acetic acid (EDTA) anti-coagulant for haematological profile evaluation. Another set of bottles without anticoagulant were used to collect another set of blood samples for evaluation of serum metabolites. Haematological parameters evaluated were packed cell volume (PCV), red blood cell count (RBC), white blood cell count (WBC), haemoglobin (Hb), neutrophils, lymphocytes, mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), and mean corpuscular haemoglobin (MCH). Serum biochemical parameters evaluated were total protein, globulin, creatinine, albumin, urea, aspartate amino transferase (AST) and alanine amino transferase (ALT).

Statistical analysis

All data obtained were subjected to Analysis Of Variance (ANOVA) using Statistical Package for Social Sciences (SPSS) version 16. Duncan's Multiple Range Test was used to separate significantly different ($P < 0.05$) means, using the same SPSS Statistical Software.

RESULTS

The performance of broilers fed graded levels of Soyabean cheese reidue is presented in Table 2.

Table 2: Performance of Starter Broiler Fed Soybean cheese residue (SCR) Diets

			SCR				
Parameter	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)	SEM	LOS
Initial weight (g)	88.00	85.00	83.00	84.00	84.00	3.12	NS
Final weight (g)	681.03[a]	656.41[ab]	652.47[b]	653.85[b]	641.03[b]	13.20	*
Weight gain (g)	593.03[a]	571.27[b]	569.56[b]	569.85[b]	557.01[c]	5.21	*
Daily weight gain (g)	28.24[a]	27.20[ab]	27.12[ab]	27.14[ab]	26.52[b]	0.58	*
Daily feed intake (g)	82.14	80.13	80.01	80.50	82.50	2.10	NS
Feed conversion ratio	2.95[a]	2.95[a]	2.95[a]	2.97[ab]	3.11[b]	0.35	*

abc: Means with different superscripts along the same row show significant difference at p<0.05, SEM: Standard error of the mean, LOS: Level of significance, NS: Not significant at p>0.05, *: Significant at p<0.05.

Final weight, weight gain, daily weight gain and feed conversion ratio were significantly affected (P<0.05) by treatments. Final weight ranged from 641.03g- 681.03g. A range of 557.01g-593.03g was recorded for weight gain. Daily weight gain ranged from 26.52g-28.24g. While 2.95-3.11 was recorded for feed conversion ratio. Diet with 20%SCR had the worst FCR. Daily feed intake was statistically not significant (P> 0.05).

The haematological parameters of starter broilers fed Soybean cheese residue based diets are presented in Table 3. Observed values for PCV, Hb, RBC, MCH, MCHC, MCV, WBC, neutrophils and lymphocytes were significant (P<0.05). PCV, Hb, RBC, MCH, MCHC, MCV, WBC, neutrophils and lymphocytes values ranged from 29.00% (0%SCR)-30.67% (5%SCR), 9.60g/dl (0%SCR)-10.20g/dl (5%SCR), 2.08×10^{12}/l (10%SCR)-2.17×10^{12}/l (0% and 20%SCR), 44.47pg (0%SCR)-48.97pg (10%SCR), 33.23%-33.63%, 205×10^{9}/l-231.33×10^{9}/l, 133.50fl-143.53fl, 2.33% (0%SCR)-4.00% (5%SCR), 96.00% (5%SCR)-97.67% (0%SCR) respectively.

The serum biochemical profile of broilers fed graded levels of Soybean cheese residue is presented in Table 4. Observed values show that total protein, albumin, globulin, creatinine and urea levels were not statistically significant (P>0.05) across the treatments. However, total protein ranged from 3.00g/dl (15%SCR)-3.69g/dl (10%SCR). A range of 1.33g/dl-1.79g/dl was recorded for the albumin. Globulin, creatinine and urea ranged from 1.47g/dl-2.01g/dl, 0.44mg/dl-0.65mg/dl, and 1.50mg/dl - 2.45mg/dl, respectively.

AST and ALT, were significant ($P < 0.05$), both increased from 62.67iµ/dl-90.67iµ/dl and 9.66iµ/dl-12.33iµ/dl, respectively as the level of SCR in the diets increased.

Table 3: Haematology of Starter Broilers Fed Soybean Cheese Residue (SCR) Diets

	SCR					
Parameter	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)	SEM
Packed cell volume (%)	29.00^{b}	30.67^{a}	29.33^{b}	29.33^{b}	29.67^{b}	0.29
Haemoglobin (g/dl)	9.60^{bc}	10.20^{a}	10.13^{a}	9.77^{b}	9.87^{b}	0.11
Red blood cell ($\times 10^{12}$/l)	2.17^{a}	2.14^{a}	2.08^{b}	2.12^{ab}	2.17^{a}	0.02
Mean corpuscular haemoglobin (pg)	44.47^{d}	47.70^{b}	48.97^{a}	46.00^{c}	45.40^{cd}	0.66
Mean corpuscular haemoglobin concentration (%)	33.33^{c}	33.23^{c}	33.63^{a}	33.40^{b}	33.23^{c}	0.06
Mean corpuscular volume (fl)	133.50^{b}	143.53^{a}	139.33^{ab}	138.07^{ab}	136.43^{ab}	1.21
White blood cell ($\times 10^{9}$/l)	221.00^{ab}	205.00^{c}	216.00^{b}	231.33^{a}	218.67^{b}	2.61
Neutrophils (%)	2.33^{c}	4.00^{a}	3.00^{b}	3.67^{ab}	2.67^{bc}	0.34
Lymphocytes (%)	97.67^{a}	96.00^{b}	97.00^{a}	96.33^{b}	97.33^{a}	0.34

abc: Means with different superscripts along the same row show significant difference at $p<0.05$, SEM: Standard error of the mean, LOS: Level of significance, NS: Not significant at $p>0.05$, *: Significant at $p<0.05$.

Table 4: Serum Biochemistry of Starter Broilers Fed Soyabean Cheese Residue (SCR) Diets

	SCR						
Parameter	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)	SEM	LO
Total Protein (g/dl)	3.62	3.69	3.21	3.00	3.12	0.78	NS
Albumin (g/dl)	1.61	1.79	1.38	1.33	1.65	0.28	NS
Globulin (g/dl)	2.01	1.90	1.83	1.67	1.47	0.56	NS
Creatinine (mg/dl)	0.44	0.49	0.52	0.61	0.65	0.11	NS
Aspartate transferase (iµ/dl)	62.67^{d}	65.67^{c}	70.67^{b}	77.00^{b}	90.67^{a}	3.45	*
Alanine transfarase (iµ/dl)	9.66^{b}	11.00^{a}	11.00^{a}	11.33^{a}	12.33^{a}	1.64	*
Urea (mg/dl)	1.50	1.62	2.27	2.37	2.45	0.98	NS

abc: Means with different superscripts along the same row show significant difference at $p<0.05$, SEM: Standard error of the mean, LOS: Level of significance, NS: Not significant at $p>0.05$, *: Significant at $p<0.05$.

Discussion

The observed final weight of birds across treatments at 28 days is higher than 530g to 540g reported by Abimiku *et al*. (2017), 582.89 ± 10.96 and 578.78 ± 10.96 (Iyaode *et al.*, 2020) for similar age of broilers. Zakaria *et al.* (2010) reported a range of 458g - 659g for starter broilers, while Hooge *et al.* (2010) observed a range of 509g to 710g for enzyme supplemented diets. Live weight and daily weight gain of birds in all the groups seem adequate for their age. The observed feed intake across the treatments may suggest that SCR inclusion did not depress appetite, as all the diets were acceptable and palatable to the birds. The observed FCR were poorer than 1.82-2.54 for different strains of starter broilers reported by Abdullah *et al.* (2010). The values indicate that SCR inclusion in the diet did not compromise the ability of the birds to utilize the diets for growth, especially at 0 - 15% inclusion.

Packed cell volume improved in SCR groups, and are close to 28.75 - 29.33% reported by Iyaode *et al*. (2020) for starter broilers, an indication that the birds' health was not compromised despite the inclusion of SCR in the diet. Packed cell volume is a vehicle for the transport of oxygen and absorbed nutrients (Isaac *et al*., 2013). Adequate PCV may indicate normal transportation of absorbed nutrients and oxygen. Haemoglobin (Hb) values fall within the range of 9.43g/dl - 10.50g/dl (Iyaode *et al*., 2020) reported for normal healthy starter broilers. Haemoglobin is directly involved in the transport of oxygen and carbon dioxide**.** Any drop in this ability of Hb affects the wellbeing of the birds. Observed Hb values for the birds are adequate for oxygen and carbon dioxide transport. The RBC values obtained in the study were lower than 2.46×10^{12}l and 2.48×10^{12}l reported for cobbs and abor acre starter broilers respectively at 4 weeks (Iyaode, *et al.*, 2020) in the same environment. Observed values in the SCR groups did not indicate impairment of haematopoiesis even at 20% SCR. This may indicate that SCR contains sufficient minerals and vitamins required for red blood synthesis. The MCH values obtained in the study are close to 42.44pg - 48.19pg (Iyaode *et al*., 2020) observed for starter broilers in the same environment. The MCHC values are close to 33.55 - 34.18% observed by Iyaode *et al*. (2020). Values observed in this study are within normal range for healthy birds and did not suggest anaemia. The MCV, which is an expression of the average volume of individual red blood cell, increased due to SCR inclusion in the diet. The values obtained were close to 126.43fl to 138.65fl for starter broilers (Iyaode *et al*., 2020). However, the observed MCV values are within the range of 97.07fl - 166.45fl reported by Ameen *et al.* (2007) for healthy birds. This is an indication that the iron intake from the diets by the birds was sufficient.

In addition, the SCR did not impair normal bone marrow function of the birds. White blood cell values though significantly different ($P<0.05$) among treatments did not follow a particular trend, but are similar to 206.15×10^9/l to 232.82×10^9/l observed in 4 week old broilers by Iyaode *et al*. (2020) in Anyigba. This may indicate the diets were adequate in terms of furnishing the birds with sufficient minerals and vitamins for white blood cell synthesis necessary for defense of the birds against infection. The neutrophils and lymphocytes values obtained in the study though differed but do not indicate that SCR inclusion in the diet had negative effects on the innate immunity of the birds.

Observed serum total protein values showed that the birds did not suffer any adverse effect due to protein deficiency of SCR diets; that is, the protein quality and quantity of all diets were adequate and similar. Serum albumin values fell within the range 1.20g/dl - 2.00g/dl observed by Wallace (2010) for healthy birds. Globulin values are within range reported by Mitruka and Rawnsley (1977) for healthy birds. Creatinine ($P>0.05$) appeared to increase with increase in SCR in the diet. Nonetheless, observed values are within the ranges of 0.51mg/dl to 2.54mg/dl and 0.66mg/dl to 1.73mg/dl reported by Ebegbulem (2018) and Adeyemo and Sani (2013) respectively for healthy birds. This implies that the nutrient obtained from the diets were adequate, thus the birds were not surviving at the expense of the body reserve or suffering from muscle wastage and renal distress. Higher levels of creatinine is an indicator of muscle wastage and renal distress; which implies that the animal is surviving at the expense of the body reserve which result to weight loss and kidney failure (Ebenebe *et al.,* 2012). Serum urea values also increased with increase in SCR level but fell within 2.00mg/dl - 4.61mg/dl (Wallace, 2010) for broilers. Serum urea is an indicator for determining the absorption and utilization of protein by birds. The lower the value of urea, the better the utilization of dietary protein. Observed values did not therefore indicate poor utilization of experimental dietary protein neither do they indicate renal failure, because they are similar. Values of AST and ALT steadily increased with increase in the inclusion level of SCR. However, observed values of AST and ALT are within ranges for healthy chicks (Mitruka and Rawnsley, 1977). AST activities take care of inflammatory and degeneration lesion of the liver. Low values of AST and ALT may indicate liver disease/damage and high cases of AST and ALT would indicate both liver and kidney disease/damage (Gao *et al.,* 2008).

CONCLUSION AND RECOMMENDATION

Performance parameters such as weight gain showed that starter broilers fed the control diet had superior gains but at numerically higher feed intake. However, similar feed conversion ratio (to the control), which is an indicator of economic production, was observed even at 15% inclusion of SCR. Therefore, soybean cheese residue could be included in the diet of starter broilers up to 10% for better profitability. Furthermore, soybean cheese residue showed no deleterious effect on the health and physiology of the birds.

Based on the observations recorded in this feeding trial 15% inclusion of soybean cheese residue is recommended in the diet of starter broilers due to similarity of feed conversion ratio with the control

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