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Assessment of carcass yield, organ weights and haematological indices of broiler finisher chickens fed urea plus methionine treated and fermented sorghum beer residue

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Target Audience: *On-Farm feed millers, Poultry farmer, Animal nutritionist, Researchers*

Abstract

The carcass yield, organ weights and haematological indices of finished broiler chickens fed urea plus methionine supplemented and re- fermented sorghum beer residue (RSBR) were investigated after a 4-week finisher period. Three hundred (300) 28days broiler birds were randomly allocated to 15 pens (20 birds per pen) for the finishing period. They were fed diets containing RSBR at graded levels of 0, 25, 50, 75 and 100 %. At day 56th, three birds from each pen were selected for blood sampling and carcass analysis. The dressing percentage of birds on 50% RSBR diet was significantly higher (P < 0.05) compared to others. The breast weight percentage for birds on the control was observed to be highest significantly (P<0.05) while that for birds on 100% RSBR was lowest (P<0.05). The thigh percentage of birds on control and 50% RSBR diets were similar but significantly (P<0.05) higher than those of birds on other diets. Heart and gizzard percentages of birds on 100% RSBR diet were significantly higher (P < 0.05) than those on control and other diets. The packed cell volume and haemoglobin concentrations of birds fed on all RSBR supplemented diets were within normal ranges but were significantly higher (P < 0.05) than those of birds fed control diet. This study indicated that up to 75% RSBR can adequately support carcass yield, and organ weights without detrimental effect on finisher broiler chickens.

Key word: *Broilers, groundnut cake, re-fermented sorghum beer residue, carcass yield, haemotological indices, fermentation.*

Description of Problem

Today, broiler chicken production is among one of the fastest means of producing animal protein because of their short generation interval (1). However, the cost of production of broiler meat has remained high due to high cost of feed. The feed deficit situation is further compounded with the advent of Covid-19 pandemic that has impacted negatively to national economies. Groundnut cake (GNC) has been used as a protein supplement in broiler diets but its price has continued to increase in our markets (2). This has engineered the need for alternative feed ingredients as protein supplements.

Sorghum beer residue (SBR) is a possible alternative to groundnut cake (GNC) because of its nutritional qualities that are comparable to GNC. SBR is cheap and readily available and contributes to the protein, amino acids and energy content of formulated feeds. Although its nutritional qualities have been evaluated in the diets of

broilers and growing chickens with some success (3) and (4), it's maximum utilization as a plant protein source have been limited by its high fibre content (5). The need to further recycle SBR through the process of fermentation in order to reduce its fibre content, obtain a high protein biomass and interesting amino acid composition by treatment with urea-nitrogen and methionine (sulfur) is imperative. Treatment of various fibrous materials with urea, sulfur or nitrogen plus sulfur have been found to improve their nutritional qualities (6). Urea and Methionine have been recommended for use as sources of nitrogen and sulfur for ruminant animals respectively by (7). Therefore, the objective of this study was to subject SBR into a second stage fermentation after pretreatment with urea grade fertilizer plus methionine and the assessment of its dietary effects on carcass yield, organ weights and blood characteristics when fed to finisher chickens.

Materials and Methods

Experimental site

The experiment was carried out at the Poultry Production Unit, College of Agriculture and Animal Science, Mando, Kaduna-Nigeria (11^0 10' N, $07^0$38'E with elevation of 632m above sea level. An average rainfall of 1200mm with 95% falling between April and October. The temperature varies between 26 -35 ^{o}c. The humidity at harmattan period is 21 and 27% at the wet season. Mando is Located in the Northern Guinea savannah Zone of Nigeria **(Nigeria Google Satellite Maps, 2015).**

Fermentation of sorghum beer residue for On-farm feeding

The inoculation of sorghum beer residue prior to fermentation was carried out as described by (8). SBR was moistened with water at a ratio of 1:5 (w/w). SBR was treated with urea and methionine concentrations at a ratio of 1.5: 0.37 % (9). The quantities of urea and methionine were first dissolved in the water containing the inoculum before wetting the substrate (SBR).

The quantities of methionine, urea, SBR, water and inoculum used and the process of fermentation carried out was as described by (9). The fermented product (RSBR) was sundried for 7days on concrete floor and samples taken for proximate analysis according to (10) for proximate analysis–at the Department of Animal Science, Ahmadu Bello University, Zaria. The amino acid profiles of the SBR and RSBR protein biomass produced were determined using methods described by (11). The results are as shown in Table 1.

Feeding Trial

The carcass yield, organ weights and blood characteristics were evaluated in a 4-weeks feeding trial where urea plus methionine supplemented and fermented SBR (as a test ingredient) was used to replace groundnut cake (GNC) at 0, 25, 50, 75 and 100% levels on protein equivalent basis during the finisher phases. The diets were least-cost formulated in order to meet the recommended nutrients requirements for finisher broiler birds by (12). The ingredient composition of the broiler finisher diet is shown in Table~~s~~ 2.

A total of three hundred (300) broiler birds were randomly allocated to 15 pens in groups of 20 birds per pen. Each dietary group was replicated three times. The diets were randomly allocated to the pens of broilers on concrete flooring; each pen measuring 3.5 by 7.0m. Wood shaving was used as bedding materials. All the test rations were iso-nitrogenous and iso-caloric. The finisher diet was formulated to have 20% CP. The respective groups of chickens were fed the finisher diet (Table 1) for 4 weeks.

All birds were provided with feed and water *ad libitum.* Weighed quantity of feed was given daily and leftover feeds were collected and weighed. At the end of the broiler finisher phase (4-weeks), three birds from each pen whose weights were equal or close to the mean weight of the birds in the pen were selected. The sampled birds were sacrificed for carcass analysis. The selected birds were slaughtered by severing the neck with a sharp knife and allowed to bleed. They were then de-feathered and eviscerated. The breast, thigh, back, neck, wings, legs, head, liver, heart, gizzard, pancreas and the abdominal fat were weighed and expressed as percentages of the live weights. Intestinal lengths were measured in centimeters. The dressed weights were taken and the dressing percentages computed. Similarly, from the 3-birds selected and sacrificed for carcass analysis blood samples were collected for haematological assay. 2mls of blood from each bird was collected into bottle treated with ethylene diamine tetra acetic acid (EDTA). The bottles were labelled accordingly and taken for haematological evaluation at the Veterinary Clinical Pathology Laboratory, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria. Blood samples were analyzed within 6 hours of collection for haematocrit or packed cell volume (PCV), haemoglobin (Hb) according to the methods described by (13). Packed cell volume (PCV) was measured as micro haematocrit with 75 x 16mm capillary tubes filled to 2/ng level with blood and centrifuged at 3000 rpm for 5 minutes. Haemoglobin concentration (g/dl) was also calculated. The total serum protein (TP) was determined by the Goldberger refractometer to obtain concentration (g/dl) per blood sample.

Data analysis

Data collected were subjected to Analysis of variance procedure. (ANOVA-Single factor) using "Analyse-it'' for Microsoft Excel (3.03) Standard. Significant means were separated using the Duncan Multiple Range Test (14) taking $P < 0.05$ as significance level

Table 1: Proximate composition and amino acids profile of sorghum beer residue and Re- fermented sorghum beer residue

Proximate Composition	SBR	RSBR
Dry matter, %	95.10	87.87
Ash %	4.98	4.53
Crude Protein, %	21.73	38.19
Crude Fat %	1.2	1.91
Crude fibre, %	14.73	11.93
Nitrogen free extract %	23.24	42.29
Amino acid composition (g/100g protein)[a]		
Alanine	8.66	8.89
Arginine	4.66	5.18
Cysteine	2.18	2.38
Glycine	3.17	3.60
Histidine	2.40	2.90
Isoleucine	4.18	4.63
Leucine	13.71 14.31	
Lysine	2.38	3.02
Methionine	1.93	2.19
Phenylalanine	5.15	5.48
Threonine	3.48	4.53
Tyrosine	4.13	4.44
Serine	4.56	4.99
Valine	5.27	5.62

[a]Values represents averages of two determinations per sample
± standard deviations

Table 2: Composition (%) of broiler finisher diets containing replacement levels of urea plus methionine supplemented and fermented sorghum beer residue (4-8 weeks)

	Levels of RSBR inclusion (%)				
Ingredient (%)	**0**	**25**	**50**	**75**	**100**
Maize	48.00	43.85	42.50	42.40	40.11
Maize offal	10.00	10.00	10.00	10.00	10.00
RSBR	0.00	7.90	18.05	24.30	36.39
GNC	32.40	25.90	17.00	10.85	0.00
Fishmeal	3.80	3.80	3.80	3.80	3.80
Bone meal	2.50	2.50	2.50	2.50	2.50
Limestone	0.40	0.40	0.40	0.40	0.40
Palm oil	1.82	4.50	4.50	4.50	5.55
Lysine	0.40	0.40	0.40	0.40	0.40
Methionine	0.25	0.25	0.25	0.25	0.25
[1]Vit/Min Premix	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
ME (kcal/kg)	2948.09	3027.18	2963.91	2947.09	2945.31
CP (%)	20.53	20.52	20.47	20.46	20.50
EE (%)	5.49	4.86	4.13	3.66	2.76
CF (%)	4.32	5.21	5.61	6.16	7.12
Ca (%)	1.28	1.29	1.30	1.31	1.32
Avail.P(%)	0.88	0.87	0.87	0.86	0.86
Lysine (%)	1.23	1.18	1.17	1.15	1.20
Met. + Cyst. (%)	0.83	0.91	1.01	1.05	1.16
Cost ₦/kg	103.62	103.61	96.91	92.72	86.89

[1]Vitamin/ mineral premix (Animal Care.Optimix[R]) Each 1.25kg supplied: Vit A 12,000,000 I.U; D_3 3000,000 I.U; Vit. K 2500mg; B_1, 200mg; B_2 500mg; B_6 3,500mg; Niacin 40,00mg; B_{12} 20mg; Pantothenic acid 10mg; Folic acid 1,000mg; Biotin 80mg; Choline chloride 200,000gm; Anti-oxidant 125,000mg; Manganese 70,000gm; Iron 40,000gm; Copper 8000mg; Iodine 1,200mg; Selenium 250mg; Cobalt 250mg.

Results

Carcass yield and organ weights of finished birds

Table 3 shows the result of carcass analysis and the organ weights of the experimental birds. There were no significant differences (P>0.05) in dressing percentage, among birds on 0 and 25% RSBR diets and also among birds on 75 and 100% RSBR diets. The dressing percentage among birds on 50% RSBR diet was highest significantly (P<0.05) compared to that of birds on other diets. The dressing percentage of birds on 0 and 25% RSBR diets were significantly (P<0.05) higher compared to those on 75 and 100% RSBR diets.

Table 3: Carcass characteristics and organ weights of finished broiler chickens fed urea plus methionine supplemented and fermented SBR in diets (4-8 weeks)

	Levels of RSBR inclusion (%)					
Parameter	**0**	**25**	**50**	**75**	**100**	**SEM**
Final live weight (g/bird)	2803.33[a]	2723.33[a]	2823.33[a]	2436.67[b]	1766.67[c]	193.34
Dressing %	80.3[b]	80.17[b]	82.05[a]	77.99[c]	77.36[c]	0.85
Breast weight (%)	25.03[a]	22.16[c]	23.62[b]	20.48[d]	19.15[e]	1.05
Thigh weight (%)	23.25[a]	21[b]	23.93[a]	20.2[b]	14.57[c]	1.66
Back weight (%)	14.86[b]	14.69[b]	13.64[d]	14.23[c]	15.28[a]	0.28
Wings (%)	7.49[c]	8.51[a]	7.02[d]	8.14[b]	8.77[a]	0.32
Organs						
Liver (%)	2.32[c]	2.63[a]	2.36[c]	2.6[a]	2.55[b]	0.06
Gizzard (%)	2.32[c]	2.26[c]	2.3[c]	2.6[b]	2.92[a]	0.13
Heart (%)	0.48[c]	0.49[c]	0.47[c]	0.55[b]	0.66[a]	0.04
Abdominal fat (%)	2.32[a]	1.53[c]	2.42[a]	1.85[b]	1.79[b]	0.17
Intestinal length (cm)	216[c]	227.67[b]	229.67[b]	263.33[a]	211.33[c]	9.11

[a,b,c,d]Means within rows with different superscripts differ significantly (P<0.05)
RSBR = urea plus methionine supplemented and fermented SBR

The breast weight percentage for birds on the control was observed to be highest significantly (P<0.05) while that for birds on 100% RSBR was the least (P<0.05). The percentage breast for birds on 50% RSBR diet was significantly higher than those on 25% RSBR diet and significantly (P<0.05) lower than those of birds on 75% RSBR diet. The thigh percentage of birds on control and 50% RSBR diets were similar but significantly (P<0.05) higher than those of birds on other diets. Birds on 25 and 75% RSBR diets had similar thigh percentage which was significantly (P<0.05) higher than those on 100% RSBR diet. The percentage back of birds on 100% RSBR diet was the highest significantly (P<0.05) compared to those of birds on other diets. Back percentages for birds on control and 25% RSBR diets were similar but significantly (P<0.05) higher than those on 50% and 75% RSBR diets. The percentages for wings of birds on the 25 and 100% RSBR diets were similar and the highest (P < 0.05) compared to those of birds on control and other RSBR diets. The lowest wing percentage was observed with birds on 50% RSBR diet. The wing percentage of birds on 75% RSBR diet was significantly (P<0.05) higher than those on control diet. The percentage liver of birds on 25 and 75% RSBR diets were similar (P>0.05) but significantly (P<0.05) higher than those on 0, 50 and 100% RSBR diets. The percentage liver of birds on 0 and 50% RSBR diets did not differ (P>0.05) but were significantly (P<0.05) lower compared to those on 100% RSBR diet.

The gizzard and heart percentages for birds on 0, 25, and 50% RSBR diets were similar but significantly (P<0.05) lower than those for birds on 75 and 100% RSBR diets. The gizzard and heart percentages for birds on 100% RSBR diet were significantly (P<0.05) higher than those on 75% RSBR diet. The abdominal fat percentage for birds on control and 50% RSBR diets were similar but significantly (P<0.05) higher than those on 75 and 100% RSBR diets (which were similar.) The abdominal fat percentage for birds on 25% RSBR diet were significantly (P<0.05) the lowest. The intestinal length for birds on 75% RSBR diet was the highest (P<0.05) while the intestinal length of birds on 25 and 50% RSBR diets were similar

(P>0.05) but significantly (P<0.05) higher than those on control and 100% RSBR diets which were similar (P>0.05).

Haematological parameters of finisher broiler chickens fed urea plus methionine supplemented and fermented SBR in diets (4-8 weeks)

Observations of the haematological characteristics of finished broiler chickens fed urea and methionine supplemented and fermented SBR diets during the finisher period as presented in Table 4 revealed significant (P<0.05) differences in haematological parameters across the treatments, indicating that RSBR diets influenced the values of the parameters. In terms of packed cell volume (PCV), the values for birds on all RSBR supplemented diets range from 23.50.00 to 28.33. The PVC values for birds on control, 50 and 100% RSBR diets were similar (P>0.05) but significantly (P<0.05) lower than those of birds on 25 and 75% RSBR diets. Birds on 75% RSBR diet showed the highest (P<0.05) value compared to those on other diets.

Table 4: Haematological parameters of broiler chickens fed urea plus methionine supplemented and fermented SBR in diets (4-8 weeks)

		Levels of RSBR inclusion (%)					
Parameter	**NR**	**0**	**25**	**50**	**75**	**100**	**SEM**
Packed cell volume (%)	(24 – 48)	23.55^{c}	26.00^{b}	24.00^{c}	28.33^{a}	23.50^{c}	1.52
Haemoglobin (g/dl)	(8.0 -16.0)	7.51^{c}	8.63^{b}	7.50^{c}	9.43^{a}	7.63^{c}	0.51
Total protein (g/dl)	(4.0 -7.4)	3.47^{a}	3.47^{a}	3.6^{a}	3.06^{b}	2.67^{c}	0.16

^{a,b,c}Means within rows with different superscripts differ significantly (P<0.05)
RSBR = urea plus methionine supplemented and fermented SBR
NR= Normal range (15). SEM = Standard error of mean

The results of the haemoglobin concentration obtained followed a similar pattern with that of PCV. The values for haemoglobin were; 7.15, 8.63, 7.50, 9.43 and 7.63 for 0, 25, 50, 75 and 100% respectively. The haemoglobin concentration (g/dl) among the birds across the treatments was highest (P<0.05) for birds on 75% RSBR diet and least (P<0.05) among birds on the control, 50 and 100% diets which were similar (P>0.05). The Hb concentration for birds on 75 RSBR diet showed the highest (P<0.05) values. The haemoglobin concentration for birds on all diets were within the normal range. Table 5 showed that the average amount of total protein (TP) values (g/dl) for birds across the treatments was observed to be similar (P>0.05) for that of birds groups which were fed control, 25 and 50% RSBR diets, and significantly (P<0.05) higher than that for birds on 75 and 100% RSBR diets. The TP value for birds on 100% RSBR diet showed the least (P<0.05). Birds on control, 25 and 50% RSBR diets showed adequate level of proteins while birds on 75 and 100 % RSBR diets showed low level of proteins.

Discussion

At the end of the finisher period (56 days), The carcass weight in relation to the live weights (dressing percentage) of birds on all diets except those on 100% RSBR diets were comparable to the standard (80%) for broilers at marketing (16). These values of dressing percentages were similar to that reported by (17) but higher than that reported previously (18). The dressing percentage was observed to be affected in birds on 100% RSBR diets only. This could be attributed to the poor quality of the diet as reflected in the

depressed daily gains of birds on 100% RSBR diet. The percentage breast of birds was observed to be depressed on RSBR supplemented diets compared to those on control. This finding is in agreement with that previously observed (18) but is in conflict with that of (19) and (20) who both observed increased breast percentage when wheat meal-based diet was supplemented with amino acids. Birds on 25, 75 and 100% RSBR diets had significantly lower percentage thigh compared to those on control and 50% RSBR diets. This observation is in agreement with the findings of (20) who reported a decrease in percentage thigh with higher dietary levels of lysine in wheat diets as well as (18) who reported a decrease in percentage thigh with increased dietary supplementation of amino acid and enzymes in re-fermented brewers' dried grains (RBDG) diets.

All the PCV, Hb and TP values obtained in this study were within the normal range for birds as reported by (21), and indicative of nutritional adequacy of dietary protein (22). The packed cell volume (PCV) values ranged from 32.13 to 35.66 %, which fell within the normal range (22.0 – 35.0 %) for broiler chickens (20). According to (23), a reduction in the concentration of PCV in the blood is indicative of the presence of a toxic factor which has deleterious effect on blood formation. There were no signs of toxic effects throughout the experimental period. The results obtained for Hb followed to an extent a similar pattern with that of PCV indicating that the diets were nutritionally adequate to meet the proteins needs of the birds. Low Hb concentration according to (24), apart from denoting anaemia but could also indicate animals on low protein intake, parasite infection or liver damage. Reduction in Hb count will lower effective oxygen transportation. The increase in Hb concentration observed in this study with RSBR supplementation of diets is in agreement with the reports of some authors who observed increments in Hb values on addition of green materials in broiler diets (25). On the contrary, (26) observed non-significant increase in Hb values when 20 and 30% of Moringa oleifera leaf meal was introduced in cassava-based broiler diets while (27) also observed insignificantly lower Hb values when pigs were fed on 40% whole cassava meals. Total protein was highest (3.6) in 50% RSBR diet and lowest (2.67) in 100% RSBR. This was probably a reflection of the protein quality in RSBR, as alluded to by (28). Similar results were obtained by (29) and (30). It can be seen in this study that the total protein concentrations decreased as the dietary levels of RSBR increase in the diets. This might explain partially the poor utilization of RSBR by the birds at relatively higher dietary inclusion levels (31).

Conclusion and Application

Based on this study, it was concluded that:

1. The dressing and thigh percentages among birds on 50% RSBR diet were highest significantly ($P<0.05$) compared to that of birds on other diets respectively while the percentage liver of birds on 0 and 50% RSBR diets did not differ ($P>0.05$) but were significantly ($P<0.05$) lower compared to those on 100% RSBR diet.
2. The PCV values for birds on control, 50 and 100% RSBR diets were similar ($P>0.05$) but significantly ($P<0.05$) lower than those of birds on 25 and 75% RSBR diets while the heamoglobin and Total protein in g/dl were similar ($P>0.05$) to that of birds on 50% and those of birds on control.
3. For application, up to 50% RSBR can be used in the diet of broiler finishing chickens in place of groundnut cake to

adequately support carcass yield and organs weights without detrimental or deleterious effect.

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