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Performance, carcass and organ characteristics of finisher broiler chickens fed graded levels of Sodium hydroxide treated rice threshing waste meal

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Target audience: Livestock farmers, Extension agents, Nutritionists, Feed millers

Abstract

Low availability of conventional feed ingredients has resulted to soaring cost of chicken necessitating exploration on harnessing agro waste products in poultry feeding. This study therefore, investigated the effect of diets containing 2%NaOH treated Rice Threshing Waste (TRTW) on the performance, carcass and organ characteristics of finisher broilers. The TRTW was used to formulate four treatment diets. The control (B_1) contained no TRTW while B_2, B_3 and B_4 contained TRTW at 2.5%, 5%, and 7.5% inclusion rates respectively. The diets were assigned to 120 broilers of 28 days post hatch in a completely randomized design of 4 treatment groups which were replicated 3 times. The birds were fed ad-libitum and managed under deep litter system for 21days. The result of the proximate composition of the Rice Threshing Waste (RTW) before and after the treatment showed that the treatment caused a reduction in crude protein and crude fibre. Performance of the birds showed no significant difference ($P>0.05$) for weight gain but feed intake was higher ($P<0.05$) for B_3 and B_4. Also, carcass and organ parameters had no significant effect except in back in which control had a higher value. Inclusion of TRTW at up to 7.5% in broilers diet therefore, caused no deleterious effect on the broiler chickens.

Key words: Carcass; Diet; NaOH treatment; Performance; Organ; Rice Threshing Waste

Description of Problem

The disruption of the supply chain of conventional feed ingredient caused by factors among which are: high production cost, low supply, climate change, increased competition between humans and animals for the feed ingredients especially maize and soybean, high demand for ingredients, regional security and disruptions, global conflicts, logistics and currency issues, rising costs in the feed milling and, activities of traders buying and hoarding the grains (1), has caused rise in poultry meat price (2). These factors resulted to the high cost of feed ingredients as feed alone accounts for 80% of the cost of raising poultry (3). To avert the high feeding cost, nutritionist believe that attention should be geared towards the discovery of avenues to utilize agricultural waste products which are usually abundant, not in use by humans, thrown away and not expensive, in compounding livestock feed. The discovery of these, will broaden the ingredient base for poultry feed production, create alternatives for the costly conventional feed

ingredients and reduce the cost of feeding which will result to reduction in poultry meat price.

Rice threshing waste (RTW) is a waste that emanates from threshing of rice stalk in the rice field to obtain the rice paddy. It is made up of mostly immature rice panicle, flowers and tender stalk part of the rice plant. The RTW forms a huge pile in the rice field during harvest and are subsequently allowed to decay in the field or set on fire. Exploration into this waste from rice is of interest due to the quantity of this waste that is generated in Nigeria, as presently, the country ranked top in Africa's rice production chart in 2025, with an estimated 8.7 million tonnes harvested during the 2024–25 season (4). The negative impact which the continuous burning of this waste has on greenhouse gas emission and need for climate smart agricultural activities is outrageous. The chemical composition of RTW shows that it contains protein, higher quantities of essential minerals and fibre (5). Thus, there is an indication that it could be an alternative ingredient for poultry feeding, though it is high in fibre which deters performance in poultry.

However, different degradation techniques abound which has the tendency of degrading materials thereby reducing its fibre. Treatments such as sodium hydroxide (NaOH) application (6; 7) are used to increase fiber digestibility and improve nutritional value of feed ingredients as such treatments may solubilize the cellulose and hemicellulose fractions that form the cell wall of plants. Feeding has been reported to exert immense influences on the development of carcass, organs and muscles in broilers (8). The breast muscle of broilers is a vital part of carcass quality and has the highest significant economic impact in broiler value (9) while examination of organs like the liver gives an insight into the toxicity level of the diet to which the bird was fed, as enlarged liver has been attributed to high toxicity level of diet consumed by the bird during its life time (10).

This study therefore, explored the performance, carcass and organ characteristics of finisher broiler chicken fed diets containing different inclusion rates of 2%NaOH treated RTW.

Materials and Methods

The research was conducted at the Teaching and Research Farm, Department of Animal Health and Production Technology, Akanu Ibiam Federal Polytechnic Unwana, Ebonyi State. Unwana is in the tropical rain forest zone of Nigeria with temperature peaks at 36.9°C (98.4°F) while dropping to 28.6°C (83.5°F) during colder months and highest recorded rainfall of 242mm (9.53") in a month, and the lowest of 7mm (0.28") per month with a corresponding humidity level at 88% and 51% (11).

Collection and treatment of the Rice Threshing waste (RTW)

The RTW used for the research was obtained from a rice field at Edda in Afikpo South Local Government Area, Ebonyi State, Nigeria. The RTW was sundried, milled to reduce the particle and then degraded. The degradation was carried out adopting method of (6; 7). A solution of 2%NaOH w/v solution was made under room temperature. Sixty kg of RTW was soaked in 180 liters of the 2%NaOH solution. The mixture was stirred properly to archive evenness, covered with the lid of the container and left for 24 hours under same room temperature. After this, the RTW was brought out and sun dried until it was well dried. Samples of non-treated and treated rice threshing waste meal (TRTW) were analyzed for their proximate composition according to (12).

Experimental Birds and Design

The total of 120 Ross 308 breed of finishing broilers of 28 days post hatch were used for the research. The broilers were randomly

assigned to four (4) treatment group in a Completely Randomized Design (CRD). Each treatment group was replicated 3 times to obtain a total of 12 groups of 10 broilers each. The groups were B_1 which was the control group, B_2, B_3 and B_4 groups. The groups were assigned to an experimental unit of 1m by 1m each partitioning and raised in a deep liter system. Feed and water were given *ad-libitum* and proper routine management practice and medication were strictly followed. The feeding trail lasted for 21days.

Experimental Diet

A total of four experimental diets was formulated for the research. Diet 1 which was the control contained 0% of TRTW. Diets B_2, B_3, and B_4 contained TRTW at 2.5%, 5% and 7.5% respectively. The TRTW was added on weight-to-weight basis. The ingredient composition of the diet is presented in Table 1.

Table 1. Ingredient composition of the experimental diets

Ingredient	Dietary Levels in %				
	B_1(0TRTW)	B_2 (2.5TRTW)	B_3 (5TRTW)	B_4 (7.5 TRTW)	
Maize (9% CP)	55.00	55.00	55.00	55.00	
Soya-bean meal (44 CP%)	5.00	5.00	5.00	5.00	
Groundnut cake (45 CP%)	13.00	13.00	13.00	13.00	
2% NaOH Treated RTW (8.75CP%)	0.00	2.50	5.00	7.50	
Brewers dried Grain (27 CP%)	15.00	12.50	10.00	7.50	
Fish meal (63 CP%)	3.00	3.00	3.00	3.00	
Blood-meal (77 CP%)	3.00	3.00	3.00	3.00	
Bone meal	5.00	5.00	5.00	5.00	
*Vit/mineral premix	0.25	0.25	0.25	0.25	
Lysine	0.25	0.25	0.25	0.25	
Methionine	0.25	0.25	0.25	0.25	
Common salt	0.25	0.25	0.25	0.25	
Total	**100.00**	**100.00**	**100.00**	**100.00**	
Calculated nutrient composition of the diets.					
Crude protein (%)	21.57	20.87	20.61	19.99	
Crude fibre (%)	4.14	4.24	4.44	4.51	
Crude fat (%)	4.82	4.80	4.72	4.51	
Metabolizable energy (Kcal/kg)	2944.75	2853.18	2761.16	2703.53	

*Note: *Contain the following: vit A 10,000IU, vit D_3 1500 IU; vit E 10,000mg, vit k_3 1500mg, vit B_1 1600mg, vit B_2 4000mg, pentothenic acid 10mg; nicotinic acid 2.5mg chlorine 3.5mg; folic acid 1mg; magnesium 56mg; lysine 1mg; iron 20mg; zinc 50mg; cobalt 1.25mg, biotin 7.5mg copper 30mg, manganese 40mg, selenium 2mg antioxidant 1250mg. **M.E* of T*RTW was calculated according to* (13) ME = *35 × % cp + 81.8 × % E.E + 35.5 × % NFE, where, M.E = metabolizable energy, CP = crude protein, EE = ether extract, NFE = nitrogen free extract.*

Data collection

Performance

The broilers were weighed at the beginning and end of the experiment to obtain their weight gain. Feed intake was determined by subtracting the weight of the leftover feed from the weight of feed offered after 24 hours. Feed conversion ratio was obtained by dividing the feed intake with weight gain while mortality was monitored during the course of the research.

Carcass and organ characteristics

At the end of the 21 days feeding trial, 3 broilers were randomly selected from each of the replicates for carcass and organ assessment. The broilers were starved for

12 hours prior to slaughter so that the crop will be empty during dressing to curtail contamination by undigested feed particle during dressing, while water was provided. The broilers were weighed to obtain their live weight and then slaughtered. Slaughtering was done in accordance with approved established standard by ethical committee of the Institution in line with the Veterinary Council of Nigeria, by severing the jugular vein with a sharp knife. The carcass was dressed to obtain the dressed weight, eviscerated and cut into parts according to the method of (14) and weighed while the intestines were measured using tailor's tape. The weights obtained were expressed as a percentage of live weight. The organs were also collected, weighed and also expressed as percentage of live weight.

Data analysis

The data obtained were subjected to statistical analysis using one-way analysis of variance procedure at ($P < 0.05$) level of Significance and computed with GenStat analytical software.

Results and Discussion

Proximate composition

The result of the chemical composition of the 2% NaOH treated RTW and the untreated RTW as presented in Table 2 showed that the untreated RTW contained 7.00% moisture, 10.50% Crude protein, 15.50% ash, 1.84% crude fat, 18.42% crude fibre, and 245.92kcal/100g energy while the 2%NaOH treated RTW contain 8.50% moisture, 8.75% Crude protein, 1.50% crude fat, 17.40% Crude Fibre, 22.00% ash and 208.82kcal/100g energy. The result showed that the 2%NaOH treatment reduced the values of crude protein, crude fibre, crude fat and energy content of the RTW. The higher levels of CP in the untreated rice threshing waste could be due to the gradual degradation of cell wall components that protects the cell contents including protein compounds as a result of the NaOH treatment. This assertion is supported by the findings of (15), who postulated that untreated rice straw contained higher CP. Also, there was a reduction in percentage crude fat and crude fibre while ash content increased as a result of the treatment. Several authors have reported the tendency of NaOH treatment to break down ester bonds between the lignin and compounds such as the acetic acids, cellulose and hemicellulose of the cell wall due to its saponification properties, leading to reduction in the crude fibre and fat content of materials (16;17). The result of the present research is in line with the reports of (18;6;7).

Table 2. Chemical composition of untreated and treated RTW

Nutrients	Chemical composition (%DM)	
	Untreated RTW	Treated RTW
Moisture	7.00	8.50
Ash	15.50	22.00
Crude fat	1.84	1.50
Crude Fibre	18.42	17.40
Crude protein	10.50	8.75
Carbohydrate	47.76	40.83
Energy (kcal/100g)	245.92	208.82

Note Source: Field study (2025). DM = Dry matter

Performance

The result of the performance as presented in Table 3 which showed similarity ($P>0.05$) in final weight, body weight gain and feed conversion ratio for all the treatment group while feed intake for the

control group (B_1) was similar ($P<0.05$) with B_2 (3026.00) group but significantly ($P<0.05$) higher for birds on B_3 (3177.33) and B_4 (3195.33) groups. The similarity in the final weight of these broilers obtained in the present research showed that the birds tolerated the 2%NaOH treated RTW well. Though the RTW was seen to be high in fibre, but the present result showed that the NaOH treatment may have broken down some substances in it, thereby rendering it suitable for the broilers. The finding conforms with the work of (6). The higher feed intake for birds in B_3 and B_4 groups could be because of the low energy level of the B_3 and B_4 diets as feed intake increases linearly with decreasing dietary energy level (19). The no mortality recorded in the course of the research further confirm that the materials are not lethal.

Table 3. Performance of finisher broilers fed varying levels of 2%NaOH treated RTW

Parameters	Dietary Levels in %				SEM
	B_1(0TRTW)	B_2 (2.5TRTW)	B_3 (5TRTW)	B_4 (7.5 TRTW)	
Av. Initial wt(g)	953.33	933.33	900.00	923.30	0.02
Av. Final wt(g)	1673.33	1686.70	1653.30	1633.30	0.11
Av. Body wt gain(g)	720.00	753.30	753.30	710.00	0.14
Av. Total feed intake(g)	3034.67^b	3026.00^b	3177.33^a	3195.33^a	36.52
Av. Daily feed intake (g)	144.51^b	144.10^b	151.30^a	152.16^a	1.73
Av. FCR(g)	4.12	4.06	4.34	4.50	0.77
Mortality (no)	0	0	0	0	

Means with different superscript in the same row differ significantly ($P < 0.05$). SEM = Standard Error Mean, Av = Average. Wt= Weight, FCR= Feed Conversion Ratio.

Carcass characteristics

The carcass characteristic of finisher broiler chicken fed different levels of TRTW expressed in percentage live weight as presented in Table 4 showed no significant difference ($P>0.05$) among the treatment groups for dressed weight, breast muscle, thigh and drumstick, shank and the intestinal lengths. Although the eviscerated, the back, the neck head and wing weights had a significant effect ($P<0.05$) but, the values of parameters in the groups fed the test ingredient were uniform with the control except for the back. The back had the highest value (16.77%) for birds in the control group while the values for B_2, B_3 and B_4 had no significant difference. This showed that the TRTW may not have impacted on any other parameters examined except in the back. Moreover, the breast muscle which is the most valuable portion of the chicken carcass with high significant economic impact in the market and, an important criterion taken into account by breeders and processors due to its economic valuation (9;20) was not negatively affected.

Organ characteristics

The result of the organ characteristics of finisher broiler chickens fed varying levels of TRTW as presented in Table 5 showed no significant difference ($P>0.05$) among the treatment groups for all the organ parameter analyzed. This could be evidence that the diets were not toxic as enlarged liver has been attributed to high toxicity level of diet consumed by the bird during its life time (10).

Table 4. Carcass characteristics of finisher broilers fed varying levels of 2%NaOH treated RTW

Parameters	Treatment levels (%)				SEM
	T_1 (0.0RTW)	T_2 (2.5 RTW)	T_3 (5 RTW)	T_4 (7.5 RTW)	
Live wt (G)	1933.33	1983.33	1933.33	1816.70	0.08
Dressed wt (% LW)	94.60	95.20	94.17	93.87	1.47
Eviscerated wt (% LW)	79.90^{ab}	81.50^{a}	73.33^{b}	78.73^{ab}	2.69
Breast muscle (% LW)	17.70	16.27	16.67	16.20	1.75
Thigh & Drumstick (% LW)	19.37	18.37	17.47	17.43	1.57
Back (% LW)	16.77^{a}	13.47^{b}	13.27^{b}	12.57^{b}	1.08
Neck and head (% LW)	5.47^{ab}	4.90^{b}	5.10^{b}	6.43^{a}	0.47
Wing (% LW)	7.83^{ab}	10.53^{a}	8.20^{ab}	7.42^{b}	1.87
Shank (% LW)	4.20	5.04	3.25	3.80	1.09
Intestinal lengths					
Small intestine (cm)	242.00	271.67	270.67	262.00	19.78
Large intestine (cm)	15.00	14.67	12.67	12.33	1.68
Caecum (cm)	28.67	31.33	27.00	27.67	2.97

Means with different superscript in the same row differ significantly (P < 0.05). SEM = Standard Error Mean, wt = weight, LW = Live weight.

Table 5. Organ characteristics of finisher broilers fed varying levels of 2%NaOH treated RTW

Parameters	Treatment levels (%)				SEM
	T_1 (00RTW)	T_2 (2.5 RTW)	T_3 (5 RTW)	T_4 (7.5 RTW)	
Heart (% LW)	0.46	0.48	0.51	0.45	0.10
Liver & Gall bladder (% LW)	2.54	2.80	2.23	2.42	0.37
Gizzard & Proventriculus (% LW)	2.41	2.25	2.65	3.08	0.45
Vent (% LW)	0.56	0.68	0.72	0.59	0.20

SEM = Standard Error Mean, LW =Live weight

Conclusion and Application

Based on the results of this research, it was concluded that inclusion of 2%NaOH treated rice threshing waste at up to 7.5% inclusion level do not have deleterious effect on the performance, carcass and organ characteristics of finisher broiler chickens.

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