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Potentials of 8%NaOH Treated Rice Husk Meal as a Replacement to Brewers Dried Grain on the Performance, Carcass and Blood Indices of Finisher Broilers

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Abstract: ***8% NaOH treated rice husk was used to replace Brewers Dried Grain (BDG) in a 4 diet treatment trial. The control (T_1) contained no treated rice husk while the husk replaced BDG at 33.33%, 66.67% and 100% for T_2, T_3 and T_4. The diets were assigned to 120 broilers of 28 days old in a complete randomized design of 10 broilers each replicated 3 times. Performance data was collected for 28 days. After which, the carcass, organ, hematology and biochemical parameters were examined. The body weight gain of the broilers in control group were significantly ($P < 0.05$) better than those on the test ingredient. The daily feed intake was similar ($P > 0.05$) among the control andT_2 but significantly lower than that ofT_3 and T_4. There was significant reduction in breast muscle and liver/gallbladder for the groups on the test ingredient. The hematological and biochemical analysis also showed a significant effect in most of the parameters analyzed. The serum cholesterol dropped from 78.74mmol/l, which is value forT_1 to 51.78mmol/l, 51.50mmol/l and 73.60mmol/l for T_2, T_3 and T_4respectively. No mortality was recorded. The study recommends that 8% NaOH treated rice husk is not ideal to replace BDG in finisher broiler diet.***

Keywords: Rice husk, 8%NaOH, Performance, Blood, Finisher broilers

1. Introduction

Rice production has been on an increased in Nigeria, increasing from annual production of 5.5 million tonnes in 2015 to 5.8 million tonnes in 2017 [1]. In every 1000kgs of paddy milled, about 220kgs (23%) of husk is produced [2]. This has resulted to growth of heaps of rice husk around the milling location as the husk are mostly only used to make fire[3]. It then become necessary to develop avenues to utilize this agricultural waste product to avert the impending environmental hazards and pollution it poses to the people and the environs [2]. Rice husk has long been identified as a feedstuff [4, 5] but its problem of high silica, high fibre and abrasive nature make its degradation difficult thereby limiting its utilization as feed ingredient for animals. Different degradation techniques abound which has the tendency of degrading materials thereby reducing its abrasiveness. Some chemical treatments such as sodium hydroxide (NaOH) [6], ammonium [7], calcium oxide [8] and calcium hydroxide (Ca(OH)2) [9] 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.The high cost of conventional feed ingredients particularly those of energy source used in feed formulation has necessitated the search for alternative feed resources such as rice offal, groundnut shell, maize cob etcin feeding poultry [10].Such earlier research efforts resulted to the discovery of Brewer's Dried Grain (BDG) in feeding animals. Previously, the BDG was a heap of waste from brewery industries and these industries have to spend huge sum of money for it to be evacuated, but today, it has become one of the major feed ingredient that is used as an extender in poultry feed formulation. Unfortunately this feed ingredients is now expensive and scarce due to pressure on it, a situation which has contributed to high cost of producing poultry and the resultant unaffordability of their products.

This study was therefore designed to determine the effect of replacing BDG with 8%NaOH treated rice husk meal in the finisher broiler diet.

2. Methodology

Study area

The research was conducted at the Teaching and Research Farm, Department of Agricultural Technology, Akanu Ibiam Federal Polytechnic Unwana. Unwana is in tropical rain forest zone of Nigeria and lies within latitude 5048°N and longitude 7055°E. The air temperature range is 32°C - 21°C with total annual rainfall exceeding 3,500 mm [11].

Collection of the rice husk

The rice husk used for the research was obtained from one of the numerous rice mills at Eke market in Afikpo, Ebonyi State, Nigeria. The rice husk was transported to the Teaching and Research Farm of Akanu Ibiam Federal Polytechnic, Unwana, Nigeria.

Nature and sieve analysis of the rice husk used for the research

The rice husk used for the research comprises of variable sizes of reduced particles of rice husk. The sieve analysis of 100gm of the rice husk done using a British standard meshes of 500µ, 425µ, 250µ, 180µ, pan and a sensitive digital scale is as follows:

500µ = 69.2%,

425µ = 9.02%
250µ = 8.11%
180µ 6.48%
Less than 180µ 7.17%.

Degradation of the rice husk

The degradation of rice husk using 8% NaOHwas carried out adopting the method of [12]. A solution of NaOH was formed at 8% w/v solution of 97% sodium hydroxide (NaOH) under room temperature. 60Kg of the rice husk was soaked in 180 litres of the 8% NaOH solution. The mixture was stirred properly to allow for eveness, covered with the lid of the container and left for 24 hours under room temperature.After the treatment, the rice husk was rinsed thoroghly in water to remove unreacted NaOH before drying under the sun until it was well dried.Sample of of the rice husk was analyzed for proximate composition as described by [13].

Experimental birds and design

A total of 120 Marshal breed of broilers of 28 days of age were used for the experiment. The broilers were randomly assigned to four treatment goups in a Completely Randomized Design (CRD). Each treatment group was replicated 3times to obtain a total of 12 goups of 10 broiler each. Treatment 1 was the control group. Treatments 2,3 and 4 contained 8% NaOH degraded rice husk at 5%, 10% and 15% inclusion rates respectively. The broilers were randomly assigned toan experimental units partitioned 1m by 1m each and raised under a deep liter system of management. Feed and water were given *ad-libitum* and proper routine management practices and medications adopted. The feeding trial lasted for 28 days.

Data Collection

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. At the end of the 28 days feeding trial, 3 broilers were randomly selected from each replicate for carcass and organ weight assessment. The broilers were starved of feed for 12 hours prior to slaughter while water was provided. The blood for hematological assessment was collected from each of the selected broilers by puncturing the webal sub-clavicles vein with five milliliters scalp vein needle set. Five milliliters of blood was collected into a bottle containing ethylene diamine tetra-acetic acid (EDTA) as an anti-coagulant and the following parameters analyzed using Sysmex Auto Analyzer: Hemoglobin Concentration (HB), Packed Cell Volume (PCV), Total White Blood Cells (WBC[t]), the White Blood Cell differentials – (Heterophil, Eosinophil, the Basophil, the lymphocytes and the monocytes) the Red Blood Cells (RBC), Mean Cell Volume (MCV), Mean Cell Hemoglobin (MCH) and Mean Cell Hemoglobin Concentration (MCHC). Blood for biochemistry analysis was obtained by collecting another 5 ml blood into a test tube, with no anti-coagulant. The coagulated blood was subjected to standard method of serum separation and the harvested sera analyzed using RANDOX kit specified for each the parametersand a spectrophotometer. The parameters analyzed include: the kidney function – Urea and Creatinine, the cholesterol, Total Proteins and albumin, the glucose, the electrolytes - sodium, potassium, chlorine and the liver enzymes - Alkaline phosphatase (ALP), Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT). The carcass and organ analysis was obtained by slaughtering of the birds. Slaughtering was done by severing the jugular vein with a sharp knife. The carcass were dressed and cut into parts according to the method of [14]. The cut parts and organs were expressed as a percentage of live weight.

Experimental Diets

A total of 4 experimental diets were formulated for the research.T_1 which was the control contained no rice husk. T_2, $T_3$and T_4 containedrice husk degraded with 8% w/v sodium hydroxide (NaOH). The rice husk replaced Brewer's Dried Grain at 33.33%, 66.67% and 100% for T_2, T_3 and T_4 in each of these diets on weight to weight basis.

Data Analysis

The data obtained from this study, were subjected to statistical analysis using analysis of variance procedure and computed with IBM SPSS version 22. Significantly difference ($P < 0.05$) means were separated using Duncan Multiple Range Test of the statistical software.

3. Results and Discussion

Theresult of the proximate analysis of the 8% NaOH treated rice husk meal used for the study is presented in Table 2. The result showed that the 8% NaOH treated rice husk meal contains 2.66% crude protein, 4.20% crude fiber, 0.65 ether extract., 3.38% ash and calculated nitrogen free extract of 76.31%. The result when compared with the result obtained from non-treated rice husk showed that the NaOH was able to degrade and reduce the quantity of crude protein, crude fibre, ether extract and ash content of the rice husk. The finding conform with the report of [12].

The result of the performance of the broilers fed the different levels of the 8% NaOH treated rice husk is presented in table 3. The result showed the control (T_1) having a significantly ($P < 0.05$) higher values in final body weight, body weight gain and daily body weight gain than the groups on the test ingredient (T_2, T_3 and T_4) while among the groups on test ingredient, the values for these parameters did not differ ($P > 0.05$).The value obtained for feed intake from the control group was similar ($P > 0.05$) with the value obtained from T_2 but significantly ($P < 0.05$) lower than the value obtained from T_3 and T_4 while T_3 and T_4 did not differ significantly ($P > 0.05$). The feed conversion ratio also showed similarity ($P > 0.05$) among the control group and T_2, the value obtained in T_3 group was similar to T_2 while T_4 had a significantly ($P < 0.05$) highest value. No mortality was recorded in the course of the experiment. Body weight gain and mortality are sensitive indicators of changes in the nutritional qualities of a diet [15]. The significant different result obtained on body weight in the present research is an indication that the 8% treated rice husk was not compatible with the BDG. Rice husk has been reported not to be ideal for inclusion in monogastric animal nutrition due to its problem of low nutrients digestibility, high silica/ash content and abrasive characteristics [16].Though the 8% NaOH treatment was able to degrade the rice husk, evident of which was indicated in the proximate analysis result, but the break down may not

have been ideal enough to reflect in improvement in the utilization of nutrients in the rice husk by the finisher broilers to make it comparable with the BDG. The greater quantity of feed intake by broilers in T_3 and T_4 groups as against the broilers on the control and T_2 groups could not result to better body weight gain which was reflected in the higher value of the feed conversion ratio obtained from T_3 and T_4.The significant result obtained in feed conversion ratio (FCR) which is a measure of how well a flock converts feed intake into live weight and an indicator of management performance, and also profit at any given feed cost [17], is an indication of inadequacy of the 8% treated rice husk to replace BDG in the finisher broiler diet.

Table 1: Ingredient composition of the experimental diets

Ingredients	Dietary levels in %			
	T_1 (0.00)	T_2(5.00)	T_3 (10.00)	T_4(15.00)
Maize	55.00	55.00	55.00	55.00
Soya bean meal	5.00	5.00	5.00	5.00
Groundnut cake	13.00	13.00	13.00	13.00
8% NaOH Rice husk	0.00	5.00	10.00	15.00
Brewers dried Grain	15.00	10.00	5.00	0.00
Fish meal	3.00	3.00	3.00	3.00
Blood meal	3.00	3.00	3.00	3.00
Bone meal	5.00	5.00	5.00	5.00
**Premix	0.25	0.25	0.25	0.25
L Lysine	0.25	0.25	0.25	0.25
DL Methionine	0.25	0.25	0.25	0.25
Comon Salt	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**
Calculated nutrient composition of the diets				
Crude protein	20.56	20.03	18.82	17.60
Crude fiber	4.16	3.78	3.41	3.03
Crude fat	4.82	4.48	4.15	3.81
Methabolizable energy (kcal/g)	2944.75	2943.31	2941.32	2939.31

* *To provide the following per kilogram of feed; vit A 10,000IU; vit. D3 1,500 IU; vit. E 2mg; riboflavin 3mg; pantothenic acid 10mg; nicotinic acid, 2.5mg; choline 3.5mg; folic acid 1mg; magnesium 56mg; lysine 1mg; iron 20mg; zinc 50mg; cobalt 1.25mg*

Table 2: Proximate Composition of the 8%NaOH Treated and Untreated Rice Husk Meal

Nutrient	Proximate Composition (%DM)	
	8% NaOH treated rice husk	Untreated rice husk
Dry matter content	87.20	89.03
Crude Protein	2.66	5.24
Crude fiber	4.20	59.20
Ether extract	0.65	3.40
Ash content	3.38	16.35
Nitrogen Free Extract	76.31	4.84

DM = Dry matter. SEM = Standard Error Mean

Table 3: Performance of finisher broiler fed different levels of 8% NaOH treated Rice husk meal

Parameters	Dietary levels (%)				
	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	SEM
Initial Av body weight (g)	759.52	728.57	733.33	761.90	16.92
Final Av body weight (g)	2468.75^a	2264.60^b	2268.90^b	2177.10^b	33.73
Av body weight gain (g)	1709.23^a	1536.00^b	1535.60^b	1415.20^b	22.72
Av daily body weight gain(g)	63.30^a	56.79^b	56.87^b	52.41^b	0.84
Av daily feed intake (g)	128.37^a	123.67^a	143.37^b	137.77^b	3.16
Feed conversion ratio	2.03^a	2.18^{ab}	2.24^b	2.63^c	0.07
Mortality	0	0	0	0	

Without superscript = not significant. Means with different superscript in the same row differ significantly ($P < 0.05$). SEM = Standard Error Mean

The carcass characteristics and organ characteristic measured in percentage live weight (%LW) did not differ ($P > 0.05$) in dressed weight, the eviscerated weight, the thigh/drumstick, the wing, the back, the heart, the gizzard and the intestinal length while the breast muscle, the liver/gallbladder and the vent had a significant ($P < 0.05$) result. The breast muscle of broilers on the control group were similar with those on T_2 group but significantly ($P < 0.05$) higher than the value obtained in T_3 and T_4 while T_3 and T_4 were similar. Also the size of the liver was significantly ($P < 0.05$) larger for broilers in the control group while that of T_2, T_3 and T_4 did not differ ($P > 0.05$).The %LW of the vent for broilers in the control group was similar with those in T_2 group but significantly ($P < 0.05$) higher than the value obtained in T_3 and T_4 groups while the values obtained in T_2, T_3 and T_4 did not differ ($P > 0.05$). In the present study, the breast muscle which is the most valuable portion of the chicken carcass with high significant economic impact in the market [18], had a reduction in size for broilers on the test ingredient though the T_2 group was similar with the control. Also the liver which is the most voluminous gland present in animal body that plays a fundamental role in the digestion of nutrients, through the production of bile, liver enzymes, in the metabolism of sugar, proteins, and fats [19] reduced significantly in the broilers on the test ingredient. Increased liver size has been ascribed to toxicity in feed ingredient [20]. The liver size in the present experiment reduced significantly an indication of non-toxicity of the 8% NaOH. However, despite the non-significant result obtained in some of the carcass and organ parameters, the significant reduction inbreast muscle which is a parameter of high economic value, is an indication that the 8% treated rice husk is inadequate to replace BDG on carcass quality.

Table 4: Carcass and organ characteristics of finisher broilers fed different levels of 8% NaOH treated rice husk meal

Parameters	Dietary levels %				
	T_1(0.00)	00)	T_3(10.00)	T_4(15.00)	SEM
Live weight (g)	2366.67	2216.67	2250.00	2150.00	12.01
Dressed weight (%LW)	93.11	94.47	95.46	94.29	1.78
Eviscerated weight (%LW)	76.60	80.24	77.26	71.43	4.23
Breast muscle (%LW)	18.28^a	17.17^b	15.94^c	15.75^c	0.43
Thigh/drumstick (%LW)	19.57	22.31	20.71	20.03	1.80
Wing (%LW)	6.78	7.22	6.72	7.44	0.70
Back (%LW)	10.95	11.43	11.76	12.13	1.59
Heart (%LW)	0.58	0.60	0.45	0.47	0.17
Liver/gallbladder (%LW)	3.08^a	2.56^b	2.21^b	2.49^b	0.26
Gizzard (%LW)	3.65	3.61	3.26	3.42	0.31
Vent	3.39^a	2.71^{ab}	2.63^b	2.00^b	0.30
Intestinal length (%LW)	255.33^{ab}	238.33^b	261.67^a	235.33^b	9.46

LW = Live weight. Without superscript = not significant.

Means with different superscript in the same row differsignificantly ($P < 0.05$). SEM = Standard Error Mean

The result of the hematological analysis of the broilers fed diet containing the 8% NaOH treated rice husk is presented in table 5. The result showed that the broilers in the control group had a significantly ($P < 0.05$) higher value in RBC, WBC, heterophil, monocytes and MCV, the value obtained for lymphocytes was lower , while the PCV, HB and eosinophil had a similar ($P > 0.05$) value with that obtained in the T_2 group. The hematological examination is among the methods which may contribute to the detection of some changes in health and physiological status, which may not be apparent during physical examination but which affects the fitness of the animal [21]. The significant result obtain in most of the hematological parameter in the present study may be attributed to inefficiency of 8% treated rice husk to replace BDG in feeding finisher broilers.

Table 5: Hematological indices of finisher broilers fed different levels of8% NaOH treated rice husk meal

Parameters	Dietary levels (%)				
	T_1(0.00)	T_2(5.00)	T_3(10.00)	T_4(15.00)	SEM
RBC X ($x10^{12}$/L)	3.60^{a}	2.21^{c}	3.20^{b}	3.14^{b}	0.11
PCV (%)	52.70^{a}	52.00^{ab}	51.00^{b}	35.90^{c}	0,59
HB (g/dl)	12.00^{a}	11.60^{a}	10.60^{b}	10.00^{b}	0.27
WBC ($x10^{9}$/L)	203.70^{a}	196.00^{b}	189.9^{c}	190.00^{c}	1.53
Hetrophils	63.00^{a}	58.00^{b}	55.00^{b}	56.00^{b}	1.54
Eosinophil	3.00^{a}	3.00^{a}	1.00^{b}	1.00^{b}	0.43
Basophils	1.00	0.00	0.00	1.00	0.09
Lymphocytes	27.00^{b}	36.00^{a}	39.00^{a}	38.00^{a}	1.85
Monocytes	6.00^{a}	3.00^{b}	4.00^{b}	4.00^{b}	0.52
MCV (fl)	167.83^{a}	162.44^{b}	159.31^{c}	144.44^{d}	3.38
MCH (Pg)	38.22^{b}	45.24^{a}	33.13^{c}	32.22^{c}	1.25
MCHC (g/dl)	227.03^{b}	278.55^{a}	207.84^{c}	223.07^{b}	1.17

Without superscript = not significant. SEM= St

Table 6: Biochemical indices of finisher broiler fed different levels of 8% NAOH treated rice husk meal

Parameters	Dietary levels (%)				
	T_1(0.00)	T_2(5.00)	T_3(10.00)	T_4(15.00)	SEM
Total protein(g/dl)	3.78^{ba}	3.41^{c}	3.50^{bc}	3.99^{a}	0.15
Albumin(g/dl)	2.05^{a}	1.91^{b}	2.10^{ab}	1.72^{c}	0.50
Cholesterol(mg/dl)	78.74^{a}	51.78^{c}	51.50^{c}	73.60^{b}	0.31
AST(u/l)	20.00^{d}	24.00^{b}	26.00^{a}	22.00^{c}	0.74
ALT(u/l)	15.00^{c}	20.00^{a}	20.00^{a}	18.00^{b}	0.62
ALP(u/l)	53.70^{b}	53.20^{c}	52.85^{d}	55.64^{a}	0.12
Urea(mmol/L)	10.21^{b}	10.95^{a}	10.70^{c}	9.86^{a}	0.30
Creatinine(mmol/L)	0.66	0.66	0.63	0.65	0.10
Glucose(mg/dl)	141.0^{c}	162.0^{b}	173.0^{a}	143.0^{c}	0.29
Sodium(mEq/l)	125.37^{d}	138.60^{b}	140.37^{a}	135.90^{c}	0.37
Potassium(mEq/l)	4.10^{d}	5.23^{c}	5.97^{b}	8.84^{a}	0.10
Chlorine(mEq/l)	96.76^{d}	111.17^{a}	110.15^{b}	105.85^{c}	0.70

Without superscript = not significant. Means with different superscript in the same row differsignificantly ($P < 0.05$).
SEM = Standard Error Mean

The result of the biochemical analysis of the broilers fed 8% NaOH treated rice husk is presented in table 6. The result showed a significant difference ($P < 0.05$) among the treatment groups in most the parameters analyzed. The levels of biochemical parameters in the blood of birds can be used as an indication of its productive performance and of metabolic diseases [22] (ROTAVA *et al*., 2008). Though the result of the biochemical parameters in the present study did not present a definite trend in most of the parameters but there was a definite trend in cholesterol, AST, the ALT and the electrolyte (the potassium, sodium and the chloride). The broilers in the control had a significant higher value in cholesterol and significant lower values in AST, ALT, sodium, potassium and chlorine. The definite trend in these parameters could be attributed to the presence of the test ingredient. A decrease in serum cholesterol has been ascribed to indicate an impaired lipid metabolism and transportation [23]. The cholesterol concentration will vary with bird's diet and a decrease in cholesterol level has been associated with some cases of reduced fat in the diet [24]. In the present study, the calculated crude fat content of the diets was highest in control diet which may have accounted for the highest cholesterol value obtained from the serum of broilers in this group. The reduction in the serum cholesterol among the treatment groups in the present study however did not drop accordingly with increase in inclusion levels of the test ingredients. The T_4diet which had the least crude fat composition did not produce broilers with the least serum cholesterol level. The reduced fat content of the diets containing the test ingredient could have caused a reduction in the triglyceride biosynthesis and favored the re-distribution of cholesterol among the lipoprotein molecules to result in the reduction in the serum cholesterol. The reduction in cholesterol level as obtained in the present study however is an advantage especially now that people are very conscious of reducing cholesterol content of their animal protein source. The AST and the ALT in the present study increased with the inclusion of the test ingredient. Both the AST and the ALT have been described as not being specific for determining hepatocellular damage in poultry, but are highly sensitive in detecting hepatocellular damage caused by ethylene glycol in pigeons [25]. However, the significant result obtained in these parameters in the present study is an indication that the test ingredient may not be comparable with BDG for these liver enzyme parameters. The serum electrolytes (sodium, potassium and the chlorides) in the present study reduced significantly for the group on the test ingredient. Sodium, potassium and chlorides play a crucial role in maintaining body acid-base balance as well as osmotic pressure in body fluids and the role of each individual component is difficult to define without knowing and taking into consideration the other two elements [26]. The significant reduction in these parameters also is an indication of non-conformity of 8% NaOH treated rice husk meal with BDG for the synthesis of these electrolytes by the finisher broilers.

4. Conclusion and Recommendation

The findings from this study showed the 8%NaOH treated rice husk is not ideal to replace BDG in feeding of finisher broiler. Despite the degradation of the rice husk as seenin the proximate analysis result, the control group proved to be superior to the groups on the test ingredient in the performance and carcass analysis. Also the hematological and biochemical analysis showed a reduction or increase in values of most of the parameters examined when compared with the groups on the test ingredient. Based on the findings of this study, it is recommended that the rice husk treated with 8%NaOH may not be ideal to replace BDG in formulation of broiler finisher diet.

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