International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Potentials of 4% NaOH Treated Rice Husk Meal as Feed Ingredient in Finisher Broiler's Diet

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Abstract: ***Rice husk treated with 4% NaOH 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 treated rice husk replaced BDG at 33.33%, 66.67% and 100% for T_2, T_3 and T_4respectively. The diets were assigned to 120 broilers of 28 days old in a complete randomized design of 10 broilers each replicated 3 times. Data were collected on their performance for 28 days. After which, the carcass, organ, hematology and biochemical parameters were examined. For the performance, the body weight gain of the broilers were similar (P > 0.05) while the control had a significantly (P< 0.05) lower value in daily feed intake and feed conversion ratio. The carcass parameters were similar except in vent and gizzard. All the hematological parameters were similar (P > 0.05) while the biochemical parameters had a significant effect in cholesterol, alkaline phosphatase and alanine aminotransferase. The cholesterol level dropped within the groups with T_1 being 78.74mmol/l, while T_2, T_3 and T_4 were 52.69mmol/l, 49.10mmol/l and 35.90mmol/l respectively. No mortality was recorded. The study recommends that 4% NaOH treated rice husk can replace BDG in finisher broiler diet.***

Keywords: Rice husk, 4%NaOH, Performance, Blood, Finisher broilers

1. Introduction

Rice husk is an agro waste product generated during the milling of rice grain. Rice husk is currently produced in large quantity in Nigeria due to the increasing level of rice production in the country. The annual rice production in Nigeria has increased from 5.5 million tonnes in 2015 to 5.8 million tonnes in 2017 [1] and for every 1000kgs of paddy milled, about 220kgs (23%) of husk is produced [2]. Presently, heaps of rice husks has continued to rise in most milling locations as it is mostly either burnt for heat or dumped as a waste in the majority of rice producing countries [3]. Disposing and evacuating the rice dumps is urgently necessary because of the impending environmental hazards, degradation and pollution it poses to the people and the environs [2].The exploitation of agro by-products and farm wastes as alternative feed ingredient for poultry and livestock feeding trials has been the current trend in animal production and the potentials of these agro-wastes are yet to be well discovered. 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 current high cost of feeding animals especially the mono gastric animals, due to high cost of conventional feed ingredients, as a result of pressure on them, by human and industries has necessitated the need to intensify effort on the discovery of alternative feed ingredients in feeding these animals. 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 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 result an unaffordable of the products.

This study was therefore designed to determine the effect of replacing BDG with 4%NaOH treated rice husk meal in 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 [10].

Collection of the rice husk

The rice husk used for the research was obtained from one of the numerousrice mills at Eke market in Afikpo, Ebonyi State, Nigeria. Therice 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 experiment

The rice husk used for the research comprises of variable sizes of reduced particles of rice husk. The sieve analysis of the rice husk used for the experiment using a British standard meshes of 500µ, 425µ, 250µ, 180µ, pan and a sensitive

digital scale. The following sizes were obtained in 100gm of the rice husk:
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 by alkali treatment of rice husk was carried out adopting the method of [11]. A solution of NaOH was formed at 4% w/v solution of 97% sodium hydroxide (NaOH) under room temperature. 60Kg of the rice husk was soaked in 180 litres of the 4% 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 [12].

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 4% NaOH degraded rice husk at 5%, 10% and 15% inclusion rates respectively. The broilers were randomly assigned to thean experimental units of 1m by 1m each partitioning and raised in 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 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]), 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 parameters and 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 were obtained by slaughtering of the birds after 12 hours of starvation. 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 [13]. 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 4% w/v sodium hydroxide (NaOH). The rice husk replaced Brewers 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

The result of the proximate analysis of the 4% NaOH treated rice husk meal used for the research is presented in Table 2. The result showed that the 4% NaOH treated rice husk meal contains 2.82% crude protein, 4.60% crude fiber, 0.65 ether extract. and 3.30% ash. 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 [11].

The result of the performance of the broilers fed the different levels of the 4% NaOH treated rice husk is presented in table 3. The final average body weight, the average body weight gain and the daily body weight gain of the broilers on the treatment diets were all similar ($P > 0.05$) with those on the control diet. 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 [14]. The similarity of the finisher broilers obtained in this research on body weight and mortality are indication that the treated rice husk was 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 [15]. The similarity in performance parameters of these broiler therefore, is an indication of improvement in the nutrient digestibility and absorption of the rice husk due to the treatment with 4% NaOH. The NaOH treatment resulted in the breakdown of the nutrients in the rice husk thereby rendering the nutrients to be at par with that contained in BDG evidence of which was also seen in the proximate analysis result. The average daily feed intake of the broilers on the T_1 (control) group was 128.37g which differed significantly ($P< 0.05$) with that of broilers on the test ingredient while among the broilers on test

ingredient (T_2, T_3 and T_4) the values were similar ($P > 0.05$). Also, the broilers on the control diet had a significantly ($P < 0.05$) lower feed conversion ratio of 2.03 than the broilers on the test ingredient group while the feed conversion ratio was similar ($P > 0.05$) for broilers on the treatment groups. The broilers on the treatment group consumed more quantity of feed to gain an equal weight with the broilers on the control group. The significant increase in feed intake by the broilers on the treatment groups could be as a result of reduction in the metabolizable energy of the treatment diets. Modern broiler strains adjust their feed intake to change in the dietary metabolizable energy density (NRC, 1994), as dietary energy level decreases birds satisfy their energy need by increasing their feed intake [16].

Table 1: Ingredient composition of the experimental diets

Ingredients	Dietary levels in %			
	T1	T2	T3	T4
Maize	55	55	55	55
Soya bean meal	5	5	5	5
Groundnut cake	13	13	13	13
4% NaOH Rice husk	0	5	10	15
Brewers dried Grain	15	10	5	0
Fish meal	3	3	3	3
Blood meal	3	3	3	3
Bone meal	5	5	5	5
**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	20.05	18.95	17.73
Crude fiber	4.16	3.8	3.45	3.09
Crude fat	4.82	4.48	4.15	3.81
Methabolizable energy (kcal/g)	2944.75	2942.59	2940.81	2939.09

** 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 4%NaOH Treated and Untreated Rice Husk Meal

Nutrient	Proximate Composition (%DM)	
	4% NaOH treated rice husk	Untreated rice husk
Dry matter content	86.83	89.03
Crude Protein	2.82	5.24
Crude fiber	4.60	59.20
Ether extract	0.65	3.4
Ash content	3.30	16.35
Nitrogen Free Extract	75.46	37.54

DM = Dry matter

Table 3: Performance of finisher broiler fed different levels of 4% 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	776.19	740.95	764.29	16.92
Final Av body weight (g)	2468.75	2524.17	2441.67	2516.67	33.73
Av body weight gain (g)	1709.23	1747.98	1729.76	1752.38	22.72
Av daily body weight gain(g)	63.30	64.74	64.06	64.90	0.84
Av daily feed intake (g)	128.37^a	138.78^b	140.15^b	142.92^b	3.16
Feed conversion ratio	2.03^a	2.14^b	2.19^b	2.20^b	0.39
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 had no significant difference ($P > 0.05$) among the treatment groups for the dressed weight, the eviscerated weight, the breast muscle, the thigh/drumstick, the wing, the heart, the liver/gallbladder and the intestinal length while the back, the gizzard and the vent had a significantly ($P < 0.05$) different result among the groups. The back in T_4 had the highest significant ($P < 0.05$) value of 13.18% of the live weight (LW) followed by T_3 which was 12.15% LW and similar with T_4 while the values for T_2 and the control were 10.31 and 10.95% LW respectively which were similar with T_3. The gizzard of broilers in T_4 group had the significant highest value of 3.7% LW which was similar with that of broilers on control group (T_1) and T_2 while the T_3 group had the least gizzard size of 3.26% LW. The vent of broilers in T_4 had the least value while the values obtained in T_1, T_2 and T_3 were similar. The organ which include the heart, the liver/gallbladder and the intestinal length showed no significant difference except the gizzard and the vent. Among the organ parameters, the liver is the most voluminous gland present in animal body and plays a fundamental role in the digestion of nutrients, through of the production of bile, liver enzymes, in the metabolism of sugar, proteins, and fats [18]. Dietary nutrient inadequacies [19] or the presence of antinutritional factors [20] may affect the liver and kidney yields of broilers. Despite the significant result obtained in some of the carcass and organ parameters, the breast muscle which is the most valuable portion of the chicken carcass with high significant economic impact in the market [17] and the liver had no significant effect. The similarity of the result obtained in these parameter of value is an indication of adequacy of the diets and that the test ingredient compared favorably with the BDG.

Table 4: Carcass and organ characteristics of finisher broilers fed different levels of 4% NaOH Treated Rice husk meal

parameters	Dietary levels %				
	T_1	T_2	T_3	T_4	SEM
Live weight (g)	2366.67	23823.33	2366.67	2300.00	1.46
Dressed weight (%LW)	93.11	95.58	95.13	93.57	1.80
Eviscerated weight (%LW)	76.60	72.54	78.07	73.41	5.80
Breast muscle (%LW)	18.28	17.31	17.37	16.81	0.86
Thigh/drumstick (%LW)	19.57	20.66	21.90	20.19	2.29
Wing (%LW)	6.78	7.26	7.36	7.40	0.40
Back (%LW)	10.95^b	10.31^b	12.15^{ab}	13.18^b	0.90
Heart (%LW)	0.58	0.42	0.51	0.55	0.11
Liver/gallbladder (%LW)	3.08	2.17	2.14	2.45	0.20
Gizzard (%LW)	3.65^{ab}	3.4^{ab}	3.29^b	3.76^a	0.19
Vent	3.39^a	3.53^a	3.26^a	2.26^b	0.23
Intestinal length (%LW)	255.33	227.67	247.00	240.67	19.76

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

The result of the hematological analysis of the broilers fed diet containing the 4% NaOH treated rice husk is presented in table 5. The result showed that the broilers on the treatment diets were similar with the broiler on control diet in all the parameters analyzed. The haematological 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]. This result showed that the 4% treated rice husk conform to BDG for these hematological parameters analyzed.

Table 5: Hematological indices of finisher broilers fed 4% NaOH Treated Rice husk

Parameters	Dietary levels (%)				
	T_1	T_2	T_3	T_4	SEM
RBC X ($x10^{12}$/L)	3.14	3.35	3.30	3.20	0.70
PCV (%)	52.70	52.50	52.20	51.60	1.05
HB (g/dl)	12.00	11.80	11.60	11.30	0.55
WBC ($x10^9$/L)	203.70	207.50	211.20	203.10	4.70
Hetrophils	63.00	62.00	62.67	61.00	1.01
Eosinophil	3.00	2.00	1.73	3.00	0.59
Basophils	1.00	0	0	1.00	0.09
Lymphocytes	27.00	31.00	31.00	30.00	1.85
Monocytes	6.00	5.33	5.60	5.00	0.99
MCV (fl)	167.83	159.43	159.51	161.25	1.61
MCH (Pg)	38.22	35.22	35.15	35.31	1.68
MCHC (g/dl)	225.03	224.36	220.95	219.32	2.48

Without superscript = not significant.

Table 6: Biochemical indices of finisher broilers fed different levels of 4%NaOH treated rice husk meal

Parameters	Dietary levels (%)				
	T1 (0.00)	T2 (5.00)	T3 (10.00)	T4 (15.00)	SEM
Urea (mmol/L)	10.21^b	9.97^b	10.68^a	10.70^a	0.18
Creatinine (mmol/L)	0.66	0.59	0.71	0.62	0.08
cholesterol(mg/dl)	78.74^a	52.69^b	49.10^c	35.90^d	0.19
Total Protein (g/dl)	3.78^{ab}	3.05^c	4.28^a	3.48^{bc}	0.26
Albumin (g/dl)	2.05^{ab}	1.76^b	2.39^a	1.88^b	0.17
Na^+(mEq/l)	128.37^b	125.61^c	133.32^a	129.62^b	0.86
K^+(mEq/l)	4.10^b	4.12^b	2.65^c	4.91^a	0.07
CL^-(mEq/l)	96.76^b	94.68^c	104.67^a	95.21^c	0.52
Alkaline phosphatase (ALP) (u/l)	53.70^a	52.26^b	50.95^c	51.91^{bc}	0.42
Aspartate aminotransferase (AST) (u/l)	20.00^b	24.00^a	22.00^{ab}	24^a	1.02
Alanine aminotransferase (ALT) (u/l)	15.00^a	21.00^b	23.00^b	22.00^b	0.98

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

The result of the biochemical analysis of the broilers fed 4% 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 significant result in these parameters however, did not follow a definite trend as to attribute the difference to the presence of the test ingredient except in cholesterol, alkaline phosphatase (ALP) and alanine aminotransferase (ALT). The cholesterol was significant among all the treatment groups with the control group having the highest value of 78.74mmol/l while the values obtained from groups on the test ingredient dropped to 52.69mmol/l, 49.10mmol/l and 35.90mmol/l for T_2, T_3 and T_4respectively.The decreased values of the serum cholesterol obtained in this experiment with the inclusion of the test ingredient may be an indication that the test ingredient has an effect on the serum cholesterol of the birds. A decrease in serum cholesterol has been ascribed to indicate an impaired lipid metabolism and transportation [22]. 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 [23]. In the present research, the fat content of the diets containing the test ingredient reduced which could have caused a reduction in the triglyceride biosynthesis and favored the re-distribution of cholesterol among the lipoprotein molecules. The drop in cholesterol level as observed in the present experiment is an advantage especially now that people are very conscious of reducing cholesterol content of their animal protein source. Also, the ALP significantly (P< 0.05) reduced from a value of 53.70 for broilers on the control group to 52.26, 50.95 and 51.91 for T_2, T_3 and T_4 respectively which were similar. The ALT in reversal increased from 15 which was the value obtained from broilers in the control group to 21, 23 and 24 being values for T_2, T_3 and T_4 respectively which were similar. ALP activity occurs in many different tissues and specific diagnostic value of these enzymes in birds are poor [23]. Despite the significant results obtained among the control group and groups on the test ingredient in the two liver enzymes (ALT and ALP), the effect did not show on the liver organ which is suggestive that the effect may be negligible.

4. Conclusion and Recommendation

The findings from this experiment showed the 4%NaOH treated rice husk can replace BDG up to 100% in feeding of finisher broiler. In the present experiment, the performance of the finisher broilers on the test ingredient was apar with those of the control. Though there were significant effect in some carcass and organ parameters, the carcass of value (breast muscle) and the organ of value (liver) did not show any significant difference (P < 0.05). The hematological parameters showed no effect. The biochemical parameters though significant in most of the parameters but the trend was not suggestive to attribute it to the test ingredient except the ALP, the ALT and the cholesterol which had a definite trend. The significant effect on the liver enzymes however, could not reflect on the liver organ. There was a distinct reduction in the level of cholesterol for groups on the test ingredient.

Based on the findings of this study, it is recommended that the rice husk can be treated with 4%NaOH and used in place of BDG in formulation of broiler finisher mesh.

5. Acknowledgement

The researchers are grateful to TETFUND for providing the grant used for conducting this research.

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