

Potentials of Bio Fermented Rice Husk Meal as a Replacement to Brewer's Dried Grain in Finisher Broiler's Diet

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Abstract

Generation of rice husk waste is currently increasing in Nigeria leading to piles of heaps of the rice husk around the rice mills. Production cost for broilers has risen tremendously due to high cost of feed ingredients one of which is Brewer's Dried Grain (BDG). Rice husk has been identified as a feed stuff but it contains high fibre and is abrasive which hindered its utilization as feed ingredient in broiler production. This research was then, conducted to determine the effect of replacing BDG with bio fermented rice husk in finisher broiler's diet. Four treatment diets were formulated. T1 (control) contained 15% BDG while in T2, T3 and T4 bio fermented rice husk meal replaced BDG at 33.33%, 66.67% and 100% respectively. The diets were assigned to 120 broilers of 28 days old in a complete randomized design of 10 broilers each replicated 3 times. The performance of the broilers was observed for 28 days. The broilers were slaughtered to obtain the carcass and organ characteristics. The daily weight gain was similar ($P > 0.05$) among the groups while feed intake was highest for T4 group and no mortality was recorded. The percentage live weight of all the carcass and organ characteristics were similar ($P > 0.05$) among the treatment groups except the breast muscle which reduced for broilers on the test ingredient. The cost of producing the treatment diets was highest for control diet while cost of feeding broilers to a kilogram weight was least for the control group. The research concluded that though the fermented rice husk had a potential to substitute BDG in the diet of finisher broilers, there was an indication of high production cost.

Keywords: bio-fermented, brewer's dried grain, finisher broilers, performance, rice husk

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 (RIFAN, 2017) and for every 1000 kgs of paddy milled, about 220 kgs (23%) of husk is produced (Koteswara, Pranav, & Anusha, 2012; Moraes et al., 2014; Benassi et al., 2015). 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 (Nwofoke, 2016). 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 (Koteswara, Pranav, & Anusha, 2012; Haryana, 2018). 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 (Oyenuga, 1968, Jacquie, 2015) 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. Methods such as soaking in hot water, irradiation, acid and alkaline hydrolyses, ensiling, fermentation and use of enzymes and antibiotics have been suggested to have the tendency of reducing the limiting factors in rice husk utilization (Dierick et al., 1989; Longe, 1998; Cobianchi et al., 2012; Jiaying et al., 2016). Fermentation process which can either be solid substrate fermentation or submerged fermentation can produce several value-added products to agricultural waste and by-

products. 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 the 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 these feed ingredients are now expensive and scarce due to pressure on it, a situation which has contributed to high cost of producing poultry and the resultant unaffordable of the products.

This study was therefore designed to determine the effect of using bio-fermented rice husk, as a replacement to Brewer's Dried Grain in finisher broiler diet.

2. Materials and Methods

2.1 Study Area

The research was conducted at the Teaching and Research Farm, Department of Agricultural Technology, Akanu Ibiam Federal Polytechnic Unwana, Ebonyi State. Unwana is in tropical rain forest zone of Nigeria.

2.2 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, Ebonyi State, Nigeria.

2.3 Nature and Sieve Analysis of the Rice Husk Used for the Research

The rice husk used for the research comprises of variable sizes of particles of rice husk.

The sieve analysis of 100 gm of the rice husk done using a British standard meshes of 500 μ , 425 μ , 250 μ , 180 μ , pan and a sensitive digital scale is as follows:

500 μ = 69.2%; 425 μ = 9.02%; 250 μ = 8.11%; 180 μ = 6.48%; Less than 180 μ = 7.17%.

2.4 Degradation of the Rice Husk

Biofermentation of rice husk was carried out according to the procedure described by Fasuyi and Olumuyiwa (2012). A mixture of rice husk, water and Blackstrap molasses syrup was made in the ratio of 60 Kg to 60 liters to 3 liters respectively and was compressed into 150 liters capacity plastic container. The mixture was compressed manually as it was poured in, till the container was about $\frac{3}{4}$ filled. To ensure anerobic condition, the container was carefully covered with thick nylon covering. Sand was poured on top to the rest of the space and another nylon spread across to cross the rilm of the container before covering with its lid. The fermentation took place for twenty one days after which the container was opened. The layer of sand was gently removed and the husk was poured out into a clean slab and sun dried till to about 12% moisture content. Proximate composition of the biofermented rice husk and untreated rice husk was analyzed as described by AOAC (2000). The dried bio fermented rice husk was used for the formulation of the treatment diets.

2.5 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 groups in a Completely Randomized Design (CRD). Each treatment group was replicated 3 times to obtain a total of 12 groups of 10 broiler each. Treatment 1 was the control group. Treatments 2,3 and 4 contained bio fermented rice husk at 5%, 10% and 15% inclusion rates respectively. The broilers were randomly assigned to an 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 were adopted strictly in accordance with approved established standard. The feeding trial lasted for 28 days.

2.6 Data Collection

2.6.1 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 daily feed intake with daily weight gain while mortality was monitored during the course of the research.

2.6.2 Carcass and Organ Characteristics

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 broilers were weighed to obtain the live weight and then slaughtered. Slaughtering was done in accordance with approved national established standard by severing the jugular vein with a sharp knife. The carcasses were dressed to obtain the dressed weight, eviscerated and cut into parts according to the method of (Okorie, 2006) and weighed. The weights obtained were expressed as a percentage of live weight.

2.6.3 Cost Implication/Profitability

The cost of feed was ascertained based on the prevailing prices of the component feed ingredients. The cost of the test ingredient was calculated based on the cost of procuring the molasses used for the research. Other costs including medication and labor which were constant for all treatments were not included in the analysis.

2.7 Experimental Diets

A total of 4 experimental diets were formulated for the research. T₁ which was the control contained no rice husk. T₂, T₃ and T₄ contained bio-fermented rice husk. The rice husk replaced Brewer's Dried Grain at 33.33%, 66.67% and 100% for T₂, T₃ and T₄ in each of these diets on weight to weight basis. The nutrient composition of the diets was analyzed as described by AOAC (2000) while the metabolizable energy of the biofermented rice husk was calculated using the prediction equation as reported by Pausenga (1985). The ingredient composition of the experimental diets is presented in Table 1.

Table 1. Ingredient composition of the experimental diets

Ingredients	Dietary levels (%)			
	T ₁ (0.00)	T ₂ (5.00)	T ₃ (10.00)	T ₄ (15.00)
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
Bio fermented rice husk Meal (4.22%CP)	0.00	5.00	10.00	15.00
Brewer's Dried Grain (27%CP)	15.00	10.00	5.00	0.00
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 (nil)	5.00	5.00	5.00	5.00
**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	100	100	100
<i>Analysed nutrient composition of the experimental diets</i>				
Crude protein, %	21.23	20.12	19.62	19.24
Crude fiber, %	7.35	9.74	9.85	12.98
Crude fat, %	3.96	3.92	4.19	4.06
*Metabolizable energy (kcal/kg)	2945.33	2918.66	2842.41	2812.46

Note. ** To provide the following per kilogram of feed; vit A 10,000IU; vit. D3 1,500 IU; vit. E 2 mg; riboflavin 3 mg; pantothenic acid 10 mg; nicotinic acid, 2.5 mg; choline 3.5 mg; folic acid 1mg; magnesium 56 mg; lysine 1mg; iron 20 mg; zinc 50 mg; cobalt 1.25 mg. *ME = 35 × %CP + 81.8 × %EE + 35.5 × %NFE, where, ME = Metabolizable energy, CP = Crude protein, EE = Ether extract, NFE = Nitrogen free extract.

2.8 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 compared using Duncan Multiple Range Test (Duncan, 1955).

3. Results and Discussion

3.1 Proximate Composition

The result of the proximate analysis of the bio fermented rice husk meal used for the study is presented in Table 2. The result showed that the treated rice husk meal contains 4.22% crude protein, 37.34% crude fiber, 2.90 ether extract, 17.68% ash and calculated nitrogen free extract of 27.86%. The result when compared with the result obtained from non-treated rice husk showed that bio fermentation decreased the crude protein, crude fibre and ether extract content of the rice husk while the ash content increased. The crude protein level of the biofermented rice husk in the present research did not improve contrary to the expectation that addition of molasses which contain up to 44 g CP/kg DM (Xande et al., 2010) will rather improve the crude protein of the rice husk. A similar result was reported in the work of Kanengoni et al. (2016). However, biofermentation treatment was able to reduce crude fiber from 59.20% which was the value of crude fiber in untreated rice husk to 37.34% crude fiber for biofermented rice husk. The biofermentation process could have aided in the breakdown of the crude fibre resulting the reduction of crude fiber of the rice husk in the present research.

Table 2. Proximate composition of the bio - fermented and untreated rice husk meal

Nutrient	Proximate Composition (%DM)	
	Bio fermented rice husk	Untreated rice husk
Dry matter content (%)	90.00	89.03
Crude Protein (%DM)	4.22	5.24
Crude fiber (%DM)	37.34	59.20
Ether extract (%DM)	2.90	3.40
Ash content (%DM)	17.68	16.35
Nitrogen Free Extract (%DM)	27.86	4.84

Note. DM = Dry matter.

3.2 Performance

The result of the performance of the finisher broilers fed different levels of bio fermented rice husk is presented in Table 3. The result showed that the broilers in the control group (T₁) had a significant (P < 0.05) highest weight which was 2468.80 g which was similar (P > 0.05) with T₃ and T₄ which were 2416.70 g and 2441.70 g respectively while the final weight of T₂ which was 2335.40g was significantly (P < 0.05) lower than the value obtained from the control but similar (p > 0.05) with the values obtained from T₃ and T₄. The Av. body weight gain and the daily weight gain did not differ among the treatment groups while the broilers in T₄ group consumed significantly highest (P < 0.05) daily feed which was 144.21 g which was similar with T₂ (136.01) while the broilers on the control group and T₃ group consumed least feed. The Feed Conversion Ratio was least for broilers in the control group which was similar with the value obtained in the T₃ group while the value obtained from the T₂ and T₄ were higher and similar with the value obtained from T₃. No mortality was recorded in the course of the experiment. Though in the present research, there was a significant difference in the final body weight of the broilers in the control group and those in T₂ group but the body weight gain and the daily weight gain of the broilers were similar among all the treatment groups and no mortality was encountered. Body weight gain and mortality are sensitive indicators of changes in the nutritional qualities of a diet (International Life Science Institute, 2003). The similarity of the finisher broilers obtained in this research on body weight gain and no 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 (Aderolu, Iyayi, & Onilude, 2007). The similarity in weight gain of these broiler as obtained in the present research is an indication of improvement in the nutrient digestibility and absorption of the rice husk which could be due to the bio fermentation of the rice husk. The bio fermentation could have 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 in which the crude fiber was reasonably broken down. The molasses used for the fermentation of the rice husk has been reported to have nutritive and appetizing quality (Pérez, 1995; Hussein et al., 2016) which could have enhanced the feed consumption of the diets containing the bio fermented rice husk which also could have led to uniformity in the body weight gain among the broilers on the test ingredient and those on the control diet. Furthermore, molasses supplement in feed has been reported to increase the production of short chain fatty

acid such as acetic and propionic acids in the caecum of chickens (Gultemirian et al., 2014) which could have contributed to the improvement in weight gain of the broilers on the test ingredient. The result agrees with the work of (Fasuyi & Olumuyiwa, 2012) who reported best performance indices for broilers fed rice husk fermented for 21 days. The feed intake was however, highest for broilers in T₄ group and then the T₂ group which was an indication that the broilers in these treatment groups consumed more feed to gain the similar weight and which also accounted for the higher and similarity in the feed conversion ratio for the broilers in the two treatment groups.

Table 3. Performance of finisher broilers fed different levels of bio fermented rice husk meal

Parameters	Treatment levels (%)				SEM
	T ₁ (0.00)	T ₂ (5.00)	T ₃ (10.00)	T ₄ (15.00)	
Av. Initial Body Weight (g)	759.52	725.56	738.10	728.57	27.55
Av. Final Body Weight (g)	2468.80 ^a	2335.40 ^b	2416.70 ^{ab}	2441.70 ^{ab}	51.07
Av. Body Weight Gain (g)	1709.23	1623.51	1678.57	1713.09	50.31
Av. Daily Weight Gain(g)	63.30	60.13	62.18	63.45	1.86
Av. Daily Feed Intake(g)	128.34 ^b	136.01 ^{ab}	134.93 ^b	144.21 ^a	3.70
FCR(Daily feed intake/DWG)	2.03 ^b	2.27 ^a	2.18 ^{ab}	2.28 ^a	0.09
Mortality	-	-	-	-	

Note. Without superscript = not significant. Means with different superscript in the same row differ significantly ($P < 0.05$). SEM = Standard Error Mean. Av = average. FCR = feed conversion ratio. DWG = Daily weight gain.

3.3 Carcass and Organ Characteristics

The result of carcass and organ analysis is presented in Table 4. The result showed that the carcass and organ characteristics calculated in the percentage live weight of the broilers had no significant difference ($P > 0.05$) among the treatment groups in all the parameters analyzed except in the breast muscle. The breast muscle of the broilers on the control group had a significant higher value which was 18.28% while the values for T₂, T₃ and T₄ were similar. The breast muscle is the most valuable portion of the chicken carcass with high significant economic impact in the market (Scheuermann et al., 2003; Zuidhof et al., 2014). The significant reduction in breast muscle obtained in the present research is an indication of inadequacy of bio fermented rice husk to replace BDG since this most valuable carcass of significant economic importance was negatively affected. However in the present research, 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 (Suzuki et al., 2008), did not differ significantly ($P > 0.05$). Increased liver size in poultry has been associated with the presence of anti-nutritional factors (Ledoux et al., 1992; Bailey et al., 2000; Oloruntola, 2018). The similarity in the result obtained in liver size of the broilers in the present research is an indication that bio fermented rice husk may be devoid of anti-nutritional factor.

Table 4. Carcass and organ characteristics of finisher broilers fed different levels of bio fermented rice husk meal

Parameters	Dietary levels %				SEM
	T ₁ (0.00)	T ₂ (5.00)	T ₃ (10.00)	T ₄ (15.00)	
Live weight (LW) (g)	2366.67	2466.67	2416.67	2233.33	163.92
Dressed weight (%LW)	93.11	91.55	91.53	92.60	2.07
Eviscerated weight (%LW)	76.60	73.21	75.27	76.91	4.04
Breast muscle (%LW)	18.28 ^a	16.22 ^b	16.22 ^b	15.92 ^b	0.79
Thigh/drumstick (%LW)	19.57	19.93	19.10	19.13	2.47
Wing (%LW)	6.78	6.67	7.62	8.00	0.91
Back (%LW)	10.95	10.65	12.00	11.90	0.58
Neck (%LW)	5.23	5.39	4.64	5.41	0.56
Head(%LW)	1.92	2.30	2.11	1.81	0.40
Heart (%LW)	0.58	0.58	0.41	0.45	0.09
Liver/gallbladder (%LW)	3.08	3.06	2.74	2.29	0.32
Gizzard (%LW)	3.65	3.50	3.15	3.45	0.27
Vent (%LW)	3.39	3.39	3.39	3.15	0.19
Intestinal length (cm)	255.33	233.67	240.33	255.00	11.40

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

3.4 Cost Implication/Profitability

The result of the profitability of feeding broilers with diet containing bio fermented rice husk is presented in table 5. The result showed that cost of producing a kilogram weight of the control diet was ₦142.25 while the cost for T₂, T₃ and T₄ diets were ₦139.50, ₦136.75 and ₦134.00 respectively indicating a reduction in cost as inclusion rate of the test ingredient increased. The cost of feeding broilers to a kilogram live weight was however lower for the control group due to the reduction in feed intake while the cost of feeding the broilers to a kilogram live weight was higher for T₂, T₃ and T₄ due to the increase in feed intake observed in the present research.

Table 5. Profitability of feeding finisher broilers with bio fermented rice husk meal

Parameters	Dietary levels (%)				SEM
	T ₁ (0.00)	T ₂ (5.00)	T ₃ (10.00)	T ₄ (15.00)	
Av. Final live weight (g)	2468.80 ^a	2335.40 ^b	2416.70 ^{ab}	2441.70 ^{ab}	51.07
AV. Weight Gain Within the Period (28 days) (g)	1709.23	1623.51	1678.57	1713.09	50.32
Av. Feed Consumed per Broiler Within 28 days (g)	3593.52 ^d	3808.28 ^b	3778.04 ^c	4037.88 ^a	1.04
Feed price per kg (₦)	142.25	139.50	136.75	134.00	-
Cost of feed consumed per broiler within 28 days (₦)	511.18	531.26	516.65	540.10	-
Feed cost per broiler per Kg weight gain within 28 days (₦)	299.60 ^d	327.23 ^a	307.73 ^c	315.85 ^b	0.02
Feed cost per broiler per kg live weight (₦)	207.06 ^d	227.47 ^a	213.78 ^c	221.60 ^b	0.20

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

4. Conclusion

It can be concluded from the findings of this research that the bio fermented rice husk meal has potentials to replace BDG in the diet of finisher broilers as the weight gain of the broilers were similar. Also, the bio fermented rice husk is not toxic as there was no mortality and no increase in liver size of the broilers in the present research. However, replacing BDG with bio fermented rice husk increased the feeding cost of the finisher broilers.

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