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Performance, Carcass Characteristics and Cost Benefit Analysis of Broiler Chickens Fed Graded Levels of Rice Milling Waste

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Abstract

Two hundred and twenty five (225) Anak-2000 day-old broiler chicks were used to evaluate the performance, carcass characteristics and cost benefit analysis. The birds were allotted to five treatments. Each treatment has three replicates with 15 chicks each. Rice milling waste (RMW) replaced 0%(control), 25%, 50%, 75% and 100% of maize in five diets that were fed *ad libitum* for a period of three and six weeks at starter and finisher phases respectively. The experimental design was completely randomized design (CRD). Results obtained show that the mean values for final weight gain, daily weight gain and FCR among the treatments were not significantly different ($P > 0.05$) but the feed intake showed significant ($P < 0.05$) difference among treatments. The mean values for the live weight, slaughter weight and dressed weight and organ weights that were expressed as the percentage of the slaughter weight were not affected ($P > 0.05$) however, the shank and abdominal fat values differed significantly ($P < 0.05$) between the treatments. .Finally, the economic analysis showed that RMW-based diets supported heavier weight gain (2742.50–2957.14 g) compared to control diets (2715.39 g) and cost less to produce a unit weight(N221.04-264.91) than the control (N287.78) diets. The use of RMW in broiler chicken diet shows a reduction in the cost of production and increases in the profit margin of raising broiler chickens. Also it was observed that up to 100% level of maize could be replaced with RMW in broiler chicken diets without adverse effect on the productive parameters. Further study is suggested to establish rice milling waste as a source of energy in chickens' diets particularly on layers.

Keywords: performance, carcass characteristics & cost benefit analysis

Introduction

The problems of inadequate and poor quality feed supply in livestock and poultry production in particular has been identified as the main cause of insufficient animal protein supply in Nigeria. This is because of the competitive demand from man, industry and farm animals in the use of the conventional feedstuffs like cereal grains (e.g. maize) which form the major portion of poultry feed (Igwebuike *et al.,* 1995; Ibiyo and Atteh, 2000). Therefore, the use of alternative feed ingredients like the industrial by-products particularly rice milling waste (RMW) in poultry diets has been suggested as a means of alleviating feed scarcity and providing adequate animal protein for the citizens (Ogbonna *et al.,* 1993; Dafwang and Shwarman, 1996; Awesu *et al.,* 2002; Amaefule *et al*., 2006).This study therefore was designed to provide further information on the utilization of RMW as energy source for the replacement of maize in broiler chicken diets. Effect on productive performance, carcass characteristics and cost benefit were investigated.

Materials and Methods

A total of two hundred and twenty five (225) Anak-2000 day-old broiler chicks were weighed and randomly distributed to five dietary treatments. RMW was used to replace maize on weight for weight basis at 0%, 25%, 50%, 75% and 100% levels in diets 1, 2, 3, 4 and 5 respectively. Treatment 1 served as a control (Tables 1 and 2). Each treatment was replicated three times with 15 birds per replicate (i.e. 45 chicks per treatment).The chicks were brooded for 3 weeks during which times they were fed formulated test-starter and later six weeks on finisher diets. Feed and water were supplied *ad libitum.*

***Table 1*: Ingredient and analysized chemical composition of broiler starter experimental diets**

Ingredients	**Diets/Treatments** T_1 **O%RMW**	T_2 **25%RMW**	T_3 **50%RMW**	T_4 **75%RMW**	T_5 **100%RMW**
Maize	54.00	40.50	27.00	13.50	0.00
RMW	0.00	13.50	27.00	40.50	54.00
Soybean	13.00	13.00	13.00	13.00	13.00
GNC	12.00	12.00	12.00	12.00	12.00
Wheat Offal	9.00	9.00	9.00	9.00	9.00
Fish meal	7.00	7.00	7.00	7.00	7.00
Blood meal	2.00	2.00	2.00	2.00	2.00
Methionine	0.20	0.20	0.20	0.20	0.20
Salt	0.30	0.30	0.30	0.30	0.30
Pre-mix*	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Analysized Chemical Composition					
Dry matter (DM)	94.90	94.27	93.53	93.90	94.03
Crude Protein (CP)	24.35	24.49	24.70	24.01	25.40
Crude Fibre (CF)	10.17	9.07	9.00	8.01	7.57
Ether Extract (EE)	3.27	5.47	2.20	2.27	2.23
Ash	5.37	4.77	4.20	4.43	4.60
NFE	52.02	52.59	53.66	54.75	54.41
ME (Kcal/kg)	3012.53	3216.15	2997.03	3015.87	3276.63

** = Premix supplying the following per kg: vitamin A = 12,000.00IU, Vitamin E = 15000mg, folic acid = 1000mg, panthotenic acid = 1500mg, vitamin B_{12} = 15000mg, Vitamin B_6 = 2,500mg, vitamin K = 2,000mg, choline = 50,000mg, Manganese = 10,000mg, vitamin D_3 = 25,000IU, Nicotinic acid = 40,000mg, vitamin B_1=2000mg, vitamin B_2 = 6,000mg, Biotin = 6,000mg, Vitamin C = 3,000mg, Copper = 15,000mg, Cobalt = 250mg and selenium = 1000mg*

RMW = Rice milling waste,
GNC = Groundnut cake,
NFE = Nitrogen free extract,
ME (kcal/kg) = 37 x %cp + 81 x %EE + 35.50 x %NFE
(Pauzenga, 1985)

***Table 2*: Ingredient and analyzed chemical composition of broiler finisher experimental diets**

	Diets/Treatments				
Ingredients	**T_1 O%RMW**	**T_2 25%RMW**	**T_3 50%RMW**	**T_4 75%RMW**	**T_5 100%RMW**
Maize	56.00	42.00	28.00	14.00	0.00
RMW	0.00	14.00	28.00	42.00	56.00
Soybean	12.00	12.00	12.00	12.00	12.00
GNC	11.00	11.00	11.00	11.00	11.00
Wheat Offal	10.00	10.00	10.00	10.00	10.00
Fish meal	6.00	6.00	6.00	6.00	6.00
Blood meal	2.00	2.00	2.00	2.00	2.00
Methionine	0.20	0.20	0.20	0.20	0.20
Salt	0.30	0.30	0.30	0.30	0.30
Pre-mix*	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Analyzed Chemical Composition					
Dry matter (DM)	94.57	94.13	94.97	93.90	93.73
Crude Protein (CP)	22.19	21.50	22.30	21.47	22.23
Crude Fibre (CF)	12.40	12.10	11.08	9.93	10.00
Ether Extract (EE)	4.73	4.10	3.23	3.10	2.97
Ash	4.80	4.83	4.07	3.97	3.90
NFE	52.31	53.93	52.05	56.50	56.60
ME (Kcal/kg)	3061.17	3042.06	2934.41	3053.69	3072.37

** = Premix supplying the following per kg: vitamin A = 12,000.00IU, Vitamin E = 15,000mg, folic acid = 1000mg, panthotenic acid = 1500mg,vitamin B_{12} = 15000mg, Vitamin B_6 = 2,500mg, vitamin K = 2,000mg, choline = 50,000mg, Manganese = 10,000mg, vitamin D_3 = 25,000IU, Nicotinic acid = 40,000mg, vitamin B_1=2000mg, vitamin B_2 = 6,000mg, Biotin = 6,000mg, Vitamin C = 3,000mg, Copper = 15,000mg, Cobalt = 250mg and selenium = 1000mg.*

RMW = Rice milling waste,
GNC = Groundnut cake,
NFE = Nitrogen free extract,
ME (kcal/kg) = 37 x %cp + 81 x %EE + 35.50 x %NFE
(Pauzenga, 1985).

Conventional management practices including vaccination were well observed in all the 5 treatments.

Daily feed intake was measured by subtracting the leftover feed from the quantity served; weekly weight gain was obtained by taking the weekly weight and feed conversion ratio (FCR) was determined by dividing the daily feed intake by the daily weight gain of each bird. Proximate analysis was carried out according to the procedures described by A.O.A.C. (1990) for the experimental diets (starter and finisher diets) (Tables 1 and 2).

At the end of the experiment, six chickens from each treatment (i.e. two from each replicate) were randomly selected and slaughtered. The live weight, slaughter weight, dressed carcass weight and weight of cut-up parts were weighed individually and expressed as the percentage of the slaughter weight.

The cost benefit analysis of the experimental diets was determined at the end of the study. The economic analysis was based on the market prices of feedstuffs used during the study period. The costs per kilogram of each diet and weight gain by each broiler chicken were assessed. Also the price of each chicken was determined. All data collected were subjected to the analysis of variance (ANOVA) using complete randomized design (CRD) (Steel and Torrie, 1980). Significant differences ($P < 0.05$) between the treatment means were separated and compared using Duncan Multiple range test (Duncan, 1955).

Results and Discussion

Proximate composition: The mean values of the analyzed chemical composition of the experimental starter and finisher diets are presented in Tables 1 and 2 respectively. The proximate composition of the experimental starter and finisher diets did not show any significant difference ($P > 0.05$) between the five treatments but slight variations in numerical values were obtained. The crude protein levels (24.01-25.40%) and (21.19-22.30%) for starter and finisher diets were similar to the range of 21-24% and 19-21% respectively, recommended for broiler chickens in the tropics (Kekeocha, 1984; Oluyemi and Roberts, 2000). The crude fibre levels (7.5-10.17%) and (9.93-12.40%) for starter and finisher diets respectively were higher than the maximum level of 5%

recommended for broiler chickens (Olomu, 1978; Oluyemi and Roberts, 2000).The crude fibre content in the starter (10.17, 9.07, 9.00, 8.01 and 7.57%) and finisher (12.40, 12.10, 11.08, 10.00 and 9.93%) in diets 1, 2, 3, 4 and 5 respectively decreased with increased levels of RMW.This may be attributed to low crude fibre level of RMW.

Final Body Weight Gain

The results of final body weights on Table 3 show that there were no significant differences (P > 0.05) between the treatments. However, broiler chickens on RMW- based diets numerically recorded heavier weights (2742.50-2957.14 g) compared to maize- based diets (2715.39 g).The results of this study agreed with the report of Abdulraheem *et al.* (2006) who observed no significant differences in the final weights when rice bran was used to replace maize in broiler chicken diets.

The mean range (2715.39 - 2957.14 g/bird) of final weight obtained in this study was superior to the value (2495 g/bird) reported by Olomu (1995) for broiler chickens at 9 weeks of age in the tropics. The differences in final weight in this study compared with the value reported by the above author may be attributed to the good quality of the experimental diets used in this study.

Body Weight Gain

Table 3 shows the mean value obtained for the average daily weight gain (ADWG). ADWG of 42.55 to 46.39 g/ bird obtained in this study was not significantly different (P > 0.05) between treatments. However, birds on RMW- based diets numerically gained more weight (42.95 – 46.39 g) than the control (42.55 g). Generally, the average daily weight gain recorded in this study is higher than the 34.18 g/bird as reported by Olomu (1995). The results of this study show that up to 100% level of the maize in the diets could be replaced by RMW without adverse effect on the health and productive performance of broiler chickens. The result is at variance with the report of Parr *et al*. (1988) who gave 40% as the optimum level of maize that could be replaced by RMW in broiler chicken diets. The higher daily weight gain of birds in RMW- based diets compared to maize- based diet is reflected in the final weight gain (Table3).

Table*3:* Productive performance of broiler chickens fed maize and RMW –based diet

Parameters	Diets/Treatments					
	T_1	T_2	T_3	T_4	T_5	SEM
Initial body weight (g)	34.56	34.67	34.80	34.33	34.55	0.31^{NS}
Final body weight (g)	2715.39	2907.32	2765.12	2742.50	2757.14	118.66^{NS}
Overall weight gain (g)	2680.83	2872.65	2730.32	2708.17	2922.59	100.30^{NS}
Daily Weight gain (g)	42.55	45.60	43.34	42.95	46.39	7.39^{NS}
Daily feed intake (g)	92.71^{b}	95.84^{a}	90.51^{c}	90.01^{c}	96.45^{a}	18.40^{*}
Feed conversion ratio (FCR)	2.33	2.10	2.04	2.09	1.98	0.31^{NS}

a, b, c = Means in the same row bearing different Superscripts differ significantly (P < 0.05)
RMW = Rice Milling Waste,
SEM = Standard Error of mean,
NS = Not significant (P > 0.05)

Feed intake

The average daily feed intake (g /bird) is presented in Table 3. Significant differences (P < 0.05) in feed intake were observed between the five dietary treatments in which birds in treatments 2 and 5 recorded the highest feed intake, while the least was in 3 and 4. Generally, broiler chickens on RMW- based diets did not show any particular trend in their pattern of feed consumption, though significant differences in treatment means were obtained between the different treatments including the control group. The explanation for this could be that the energy levels of diets with increased RMW levels was not significantly affected as the other ingredients adequately made up for the energy need of the chickens as the diets were calculated to be isocaloric and isonitrogenous. It also showed that the diets were all balanced as to meet the nutrient requirements and tissue development. The mean values (90.01 – 96.45 g/bird) of daily feed intake recorded in this study disagreed with the report of Olomu (1995) who showed that feed intake should be around 160 g/bird in the tropics. The low value of feed intake recorded in this study compared with the report of the author could be due to high ambient temperature (26.52^{0}C – 30.19^{0}C) recorded during the period of the experiment which was above the temperature range (10.0^{0}C – 24.0^{0}C) reported as the ideal temperature for broiler chickens in the tropics (Oluyemi and Roberts, 2000). High ambient temperature, according to Kwari and Ubosi (1991) reduces feed intake.

Feed Conversion Ratio (FCR)

Table 3 shows the values of the FCR of the birds fed maize and RMW- based diets. FCR values of 2.33, 2.10, 2.04, 2.09 and 1.98 for treatments 1 (control), 2, 3, 4 and 5 respectively, were not significantly different (P > 0.05) between the treatments. Feed conversion ratio is the feed consumed per unit weight gain and therefore measured how efficient the birds convert feed consumed into meat. The FCR recorded in this study is similar to the value (2.50) reported by Olomu (1995).

Carcass Analysis

Results of carcass characteristics are shown in Table 4. The results show no significant differences (P > 0.05) between treatments for the live weight, slaughter weight and dressed carcass weight. The report is in harmony with the observation of Abdulraheem *et al.* (2000) who observed no significant differences between treatments when rice bran was used to replace maize in broiler chicken diets. However, dressing percentage differed significantly (P < 0.05) between treatments. The results of the dressing percentage show that treatments 4 had the highest value (86.29%) and 2 the lowest value (74.15).

Birds in RMW-based diets recorded higher dressed carcass weight compared with maize (control) – based diet. The higher dressed carcass weights of broilers fed RMW-based diets, is considered to be a direct consequence of the better final body weight and FCR of the broiler chickens in these treatments. It also suggests that RMW was not inferior to maize especially when there was no significant differences between broiler chickens fed on maize and RMW – based diets.

Table 4: Carcass Components of Broiler Chickens Fed maize and RMW – based diets.

	Diets/Treatments					
Parameters	T_1	T_2	T_3	T_4	T_5	SEM
No of chickens slaughtered	6	6	6	6	6	
Live Weight (g)	2533.33	2683.33	2466.70	2566.70	2525.00	122.53^{NS}
Slaughter weight (g)	2341.70	2550.00	2291.70	2358.33	2400.00	124.93^{NS}
Dressed weight (g)	1830.33	1885.00	1830.83	2042.50	1822.50	114.70^{NS}
Dressed Percentage (%)	78.27^{b}	74.15^{b}	80.35^{ab}	86.29^{a}	75.33^{b}	2.60*
Weight of Cup-up Parts as percentage of slaughter weight (%)						
Wings	8.66	8.41	8.82	9.48	8.68	13.08^{NS}
Head	2.23	1.98	2.18	2.23	2.26	3.57^{NS}
Thigh	12.19	11.82	12.66	13.68	12.35	18.52^{NS}
Back	8.62	9.69	10.66	10.83	9.99	23.53^{NS}
Breast	22.72	23.32	25.27	26.95	22.75	51.93^{NS}
Thorax	7.03	5.84	6.07	7.07	5.80	15.90^{NS}
Drumstick	10.04	9.64	10.39	11.17	10.20	15.78^{NS}
Neck	4.71	4.82	5.13	5.84	5.42	11.20^{NS}
Shank	4.04^{ab}	3.47^{b}	3.85^{ab}	4.00^{ab}	4.52^{a}	6.96*
Organ Weight as percentage of slaughter weight (%)						
Heart	0.46	0.46	0.44	0.59	0.55	1.04^{NS}
Gizzard	2.45	2.37	2.36	2.50	2.20	4.57^{NS}
Abdominal fat	1.75^{c}	2.75^{abc}	3.20^{ab}	3.56^{a}	1.97^{bc}	10.86*
Liver	2.29	1.79	2.37	2.53	2.45	4.14^{NS}
Crop	0.60	0.52	0.55	0.54	0.60	2.39^{NS}
Proventriculus	0.43	0.36	0.49	0.50	0.49	1.08^{NS}

NS = Hot significant (P > 0.05)
* a, b, c = Means in the same row bearing different Superscripts differ significantly (P < 0.05)
SEM = Standard error of mean

The weight of cut-up parts expressed as the percentage of slaughter weight (Table 4) did not differ significantly (P >0.05) except for the shank that showed significant difference (P < 0.05) between treatments. The results of cut-up parts obtained in this study agreed with those of Amaefule *et al.* (2006) who observed no significant differences in carcass and organ characteristics of broiler chickens fed RMW-based diets.

Values obtained for heart, gizzard, liver, crop and proventriculus were expressed as the percentage of slaughter weight (Table 4) and did not differ significantly (P > 0.05) between treatments. This result aggressed with the report of Amaefule *et al. (*2006). However, there were significant differences (P < 0.05) in the mean values obtained for abdominal fat between treatments. Higher values (1.97 – 3.56%) of abdominal fat in RMW – based diets were recorded compared with maize (control) – based diet (1.75%). The explanation here may be that the lower fibre content in RMW-based diets compared with maize (control) – based diets might have resulted in better utilization of energy content of RMW – based diets. High energy density of the diet increased abdominal fat. The result of this study agrees with the findings of Jackson *et al.* (1982) and Ubosi *et al.* (1990) who demonstrated that increase in dietary energy levels increased abdominal fat pad and hence weight gain.

Economic analysis

The data on the economic analysis of the experimental diets for broiler chickens fed maize and RMW – based diets are presented in Table 5. The results of the daily feed intake obtained in this study indicated significant differences (P < 0.05), but the final weight and daily weight gain were not significantly different (P > 0.05) among the treatments. The total weight gain recorded were significantly different ($P < 0.05$), in which the RMW – based diets recorded higher gain over the maize (control) – based diets. Feed cost (N/Kg) showed that diets 2, 3, 4 and 5 were cheaper than diet 1(control) and were significantly different ($P < 0.05$) among the treatments. Also, feed cost per kilogram gain (N/Kg) was lowest in treatment 5, hence treatment 5 proved more cost effective than the other treatments.

Table 5: Economic analysis of broiler chickens fed maize and RMW – based diets

	Levels of replacement of maize by rice milling waste					
Parameters	**0%**	**25%**	**50%**	**75%**	**100%**	**SEM**
Number of Chickens	45	45	45	45	45	
Initial Weight (g)	34.56	34.66	34.80	34.33	34.56	0.44^{NS}
Final Weight (g)	2715.39	2907.32	2765.12	2742.50	2957.14	167.81^{NS}
Daily Weight gain (g)	42.55	45.60	43.34	42.95	46.39	7.39^{NS}
Daily Feed Intake (g/bird)	92.23^{b}	95.84^{a}	90.51^{C}	90.01^{C}	96.45^{a}	18.40*
Total Weight gain (g)	2680.83^{C}	2872.66^{ab}	2730.32^{b}	2708.17^{b}	2922.58^{a}	51.73*
Total feed intake (g)	5840.46^{b}	6037.79^{a}	5701.88^{bc}	5670.80^{C}	6076.55^{a}	28.80*
Feed cost/kg Feed (N/kg)	132.06^{a}	125.92^{b}	119.57^{c}	110.75^{d}	106.41^{d}	12.41*
Total feed cost (N)	771.24^{a}	760.29^{ab}	681.77^{b}	628.04^{c}	646.58^{C}	9.33*
Feed cost/gain (N/Kg)	287.78^{a}	264.91^{ab}	249.73^{b}	231.75^{bc}	221.04^{C}	6.11*

Key:

NS = Not significant ($P > 0.05$)
* a, b, c, d = Means in the same row bearing different Superscripts differ significantly ($P < 0.05$)
SEM = Standard error of mean
RMW = Rice Milling Waste

Feed cost per kilogram gain decreased with increase in RMW level of inclusion. The highest cost per kilogram feed (N287.78) was observed in treatment 1(control) and the lowest feed cost (N221.04) in treatment 5 (100% RMW).

Comparing the total weight gain and daily weight gain/bird, treatments 5(2922.58 g) and 2(2872.66 g), and 5(46.39 g) and 2(45.60 g) respectively, had the highest values. The results of this study suggest that the use of RMW as an alternative source of energy in broiler chicken diets was feasible as it can fully replace maize without adverse effect on productive parameters like growth and feed conversion ratio.

These results disagreed with the report of Parr *et al.* (1988) who reported 40% as the limit of RMW supplementation in broiler chicken diets. The use of RMW as energy source in broiler chicken diets also reduced feed cost greatly and gave better returns in terms of cost per kg gain.

Conclusion

The results of this study show that maize can be replaced completely with RMW up to 100% level in broiler chicken diets without adverse effect on productive performance, carcass characteristics and caused a downward reduction in the unit price per chicken as evidence by the cost benefit analysis.

Recommendation

Further study is suggested to be conducted in layer chickens to establish RMW as a source of energy in layer chicken diets and to determine its suitability and the level of inclusion. The use of RMW in poultry nutrition particularly broiler chickens should be encouraged where the feed ingredient is available to help reduce feed cost which accounts for 70- 80% of the cost of production.

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