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Performance and Egg Quality Characteristics of Laying Birds Fed Diets Containing Rice Bran with and Without Yeast Supplementation

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Abstract: A total of 120 birds were divided into 5 groups of twenty four birds each. Each group was regarded as treatment. The treatment was subdivided into 3 groups of 8 birds each as replicates. Treatment 1 served as control diet with no rice bran and yeast supplementation, diet 2 and 3 contained 30 and 35% rice bran without yeast supplementation, respectively. Diets 4 and 5 were the same as diets 1 and 2 except that 2 g kg^{-1} of yeast was added to each. Between 45th and 50th week of age of the birds egg quality trial was conducted to assess haugh unit, shell thickness and yolk index. Results of feed intake, hen day egg production, feed conversion ratio and mortality were not significantly ($p<0.05$) influenced by dietary treatments. Haugh unit, yolk index and average weight of egg did not vary significantly ($p<0.05$) between treatments, however, shell weight and shell thickness were significantly affected by the treatments. Total cost of production was higher ($p<0.05$) for the control group compared to treatments 2, 3 and 5. Revenue generated from sale of eggs was higher for birds on treatment 4 compared to those on treatments 1 and 5 ($p<0.05$). Net farm income was higher for treatments 2, 3 and 4 compared to the control. It could be concluded from the results of this study that performance of birds was not affected by the levels of rice bran with and without yeast supplementation. However, shell thickness, shell weight and net farm income were significantly affected by the treatments.

Key words: Rice bran, yeast, performance, egg qualities

INTRODUCTION

The use of agro-industrial by-products in layers diets has been well documented (Wang, 1997; Odunsi *et al*., 1999; Onifade *et al*., 2000). Rice bran is one the most abundant agro-industrial by-product found in the study area (Sokoto state, Nigeria) as rice constitute major part of the staple food. It is largely used as animal feed (Wang, 1997) that is rich in B vitamins, fat and protein and compares favorably with other cereal grains in amino acid composition (Warren and Farrell, 1991). However it has high content of fiber (Warren and Farrell, 1990; Farrell, 1994) that is rich in the hemicelluloses containing highly branched arabinoxylans (Erbingerova *et al*., 1994). Yeast has been reported to increase the nutritive quality of feeds and performance of animals (Kumar and Dingle, 1996; Onifade and Babatunde, 1996; Abubakar *et al*., 2004). The present study attempted to take advantage of supplementing rice bran containing diets with yeast in order to come up with cheaper layer rations without compromising performance.

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MATERIALS AND METHODS

The study was conducted at the Teaching and Research Unit of the Department of Animal Science located along Aliyu Jodi Road Sokoto, Sokoto State, Nigeria.

The trial commenced at the 41st week and lasted for 12 weeks i.e., up to the 52nd week of age. A total of 120 birds of *Shika brown* strain were divided into 5 groups (treatments of 24 birds each). Each treatment was subdivided into three replicates of 8 birds each. Each treatment was assigned to one of the following experimental diets: Diet 1: control- no rice bran, no yeast; Diet 2: 30% rice bran, Diet 3: 35% rice bran. Diets 4 and 5 were the same as diets 1 and 2 except that they contain 2 g kg^{-1} of yeast. The gross composition of the diets is shown in Table 1 while the calculated chemical composition of the diets is presented in Table 2.

All the diets contained similar crude protein and energy levels. However crude fiber varied from 4.3% for the control to 13 and 15% for the low and high rice bran containing diets (Table 2).

Records of feed intake, egg production and mortality were taken. Feed conversion ratio in terms of number of eggs produced per kg of feed consumed, kg of egg produced per kg of feed consumed and dozen of eggs produced per kg of feed consumed were calculated from records of feed intake and egg production.

Egg Quality Assessment

Between the 45th and 50th weeks of age, egg quality assessment was carried out. Haugh unit, yolk index albumen index and shell thickness were determined. To determine these parameters, 5% of the

Table 1: Gross composition (%) of layers diets containing different levels of rice bran (RB) and yeast (Y)

	Treatments				
	1	2	3	4	5
Ingredients	0% RB 0 Y	30% RB 0 Y	35% RB 0 Y	30% RB 2 g kg^{-1} Y	35% RB 2 g kg^{-1} Y
Maize	42.60	40.60	38.60	40.60	38.60
G/nut cake	6.00	8.00	7.00	8.00	7.00
Soybeans	8.00	8.00	6.00	8.00	6.00
Wheat offal	30.00	0.00	0.00	0.00	0.00
Rice bran	0.00	30.00	35.00	30.00	35.00
Blood meal	2.50	2.50	2.50	2.50	2.50
Bone meal	5.00	5.00	5.00	5.00	5.00
Limestone	5.00	5.00	5.00	5.00	5.00
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00

Table 2: Calculated chemical composition (%) of the layers diets containing different levels of rice bran (RB) and yeast (Y)

	Treatments				
	1	2	3	4	5
Parameters	0% RB 0 Y	30% RB 0 Y	35% RB 0 Y	30% RB 2 g kg^{-1} Y	35% RB 2 g kg^{-1} Y
ME (kcal kg^{-1})	2511.13	2567.50	2513.80	2567.50	2513.80
Protein (%)	16.31	16.00	16.00	16.00	16.00
Crude fiber (%)	4.30	13.20	15.10	13.20	15.10
Phosphorus (%)	0.80	0.90	0.90	0.90	0.90
Calcium (%)	3.10	3.10	3.10	3.10	3.10
Methionine (%)	0.44	0.42	0.42	0.42	0.42
Lysine (%)	0.90	0.96	0.92	0.96	0.92
Feed cost kg^{-1} (N)**	25.01	19.17	17.97	20.00	18.80

Based on prices of ingredients as at November 2002 total eggs laid by each group during five consecutive days of the trial were weighed using a sensitive electronic scale. After weighing, each egg was broken with a sharp knife and gently emptied into a petri dish. Using Venire Caliper, yolk height and diameter, as well as albumen height were measured from three different positions (broad end, narrow end and center) as described by Panda ***et al.* (2003).

These measurements were used to calculate Haugh unit and yolk index. Shell weight was measured using electronic scale while shell thickness was measured with a micrometer screw gauge. Haugh unit was calculated by taking the average values of albumen height and weight of the eggs using the formula below (Oluyemi and Roberts 2000):

$$Hu = 100 \log (H7.57\text{-}1.7W^{0.37})$$

Where,

Hu = Haugh unit
H = Albumen height (mm
W = Observed weight of eggs (g)

The yolk index was calculated using the formula below:

$$\text{Yolk index (Y1)} = \frac{\text{Yolk height (YH)}}{\text{Yolk diameter (YD)}}$$

Egg mass was calculated by dividing the total weight of eggs laid by the total number of birds.

Statistical Analysis

All data were subjected to analysis of variance using SAS (1990) following completely randomized design and means separation was done by Duncan Multiple Range Test (DMRT) as outlined by Steel and Torrie (1980).

RESULTS

Table 3 shows the results of the laying trial. Total feed intake varied from 8.2 kg for treatment 2 to 9.3 kg for treatment 5, with no significant differences between the treatments. The average daily feed intake followed a similar pattern (Table 3). Hen day egg production (HDE) of birds was similar ($p>0.05$) for all treatments despite the variation between 58% for treatment 5 to 64% for treatment 4. On the contrary hen housed egg production (HHE) was significantly higher (($p<0.05$) for treatments 4 compared to treatments 1 (54%), 3 (55%) and 5 (55%). Feed conversion ratios were similar for all treatments.

Cost of feed consumed per bird differed significantly ($p<0.05$) between the treatments. It decreased from N210 for birds on the control diet to N158 for birds on diet 2. The value obtained for the control diet was higher ($p<0.05$) compared to those observed for treatments 2, 3 and 4.

The highest mortality was recorded for birds on treatments 1 and 3 (5% each). For treatments 2 and 4, mortality was 4%, while no death was recorded for birds on treatment 5. These variations were however not significant ($p>0.05$) (Table 3).

Egg Quality Assessment

Results on egg quality assessment are presented in Table 4. Albumen height did not show any significant difference ($p>0.05$) between the treatments, although higher values were recorded for

Table 3: Performance of laying pullets fed different levels of rice bran (RB) and yeast (Y) between 41-52 weeks of age

	Treatments					
	1	2	3	4	5	
Parameters	0% RB 0 Y	30% RB 0 Y	35% RB 0 Y	30% RB 2 g kg^{-1} Y	35% RB 2 g kg^{-1} Y	SEM
Average feed intake (g/bird)	8401.50	8218.30	8874.90	8374.10	9265.30	672.18
Average daily feed intake (g bird^{-1}day^{-1})	100.01	97.84	105.65	99.69	110.30	8.00
Hen day egg production (%)	60.00	59.30	60.70	64.30	58.30	1.69
Hen housed eggs produced (%)	54.00^{b}	59.30^{ab}	54.70^{b}	61.30^{a}	55.30^{b}	3.24
FCR (kg feed consumed dozen eggs produced^{-1})	2.00	2.00	2.10	1.90	2.30	0.21
FCR (kg of feed consumed kg^{-1} of egg produce)	2.93	2.97	3.07	2.73	3.43	0.31
Feed cost kg^{-1} (N)	25.00	19.20	18.00	20.00	18.80	0.00
Cost of feed consumed bird^{-1} (N)	210.13^{a}	157.57^{b}	159.47^{b}	167.27^{b}	173.90^{ab}	12.94
Mortality (%)	5.33	4.16	5.33	4.16	0.00	1.11

^{abcde}Means along the same row with different superscripts are significantly ($p<0.05$)

Table 4: Egg quality of laying birds fed diets containing different levels of rice bran (RB) and (Y)

	Treatments					
	1	2	3	4	5	
Parameters	0% RB 0 Y	30% RB 0 Y	35% RB 0 Y	30% RB 2 g kg^{-1} Y	35% RB 2 g kg^{-1} Y	SEM
Albumen height (mm)	5.30	5.70	5.40	5.90	5.50	0.21
Yolk index	3.83	3.48	3.50	3.42	3.32	0.10
Shell thickness (mm)	0.29^{b}	0.35^{ab}	0.30^{b}	0.39^{a}	0.31^{b}	0.01
Shell weight (g)	13.35^{bc}	13.76^{ab}	13.79^{a}	13.14^{c}	13.52^{abc}	0.13
Haugh unit (%)	87.22	90.55	87.22	88.22	88.71	1.31
Total egg mass (g/bird/day)	33.87	32.97	34.47	36.40	33.20	1.71
Average egg wt (g/bird)	56.67	55.69	56.86	56.57	56.90	0.89

^{abc}Means along the same row with different superscripts are significantly ($p<0.05$)

treatments 4 (5.9 mm) and 5 (5.5 mm) compared to treatments 1 (5.3 mm), 3 (5.4 mm) and 2 (5.7 mm). Yolk index did not also differ between the treatments even though the control group recorded the highest value of 3.83 compared to the other treatments.

Shell thickness was higher ($p<0.05$) for birds on treatment 4 (0.39 mm) compared to those on treatments 1, 3 and 5. The other treatments did not differ significantly in shell thickness. Shell weight was higher for treatment 3 (13.8 g) compared to treatments 1 (13.4 g) and 4 (13.1 g) ($p<0.05$). Haugh unit did not differ significantly between the treatments, even though the highest value was recorded for birds on diet 2 (91%) and the least was recorded for birds on the control and treatment 3 (87%). Egg mass (g per bird/day) varied slightly from 33 g for treatment 2 to 36 g for treatment 4 ($p>0.05$). Egg weight averaged 57 g/bird across the treatments (Table 4).

Cost Analysis of Feeding Experimental Diets to the Laying Birds

Total variable cost (Nbird^{-1}) (that is cost of feed, medication, labor and empty crates) was higher ($p<0.05$) for treatments 1 (N1,094) and 4 (1,050) compared to treatments 2 (N963) and 3 (N962) (Table 5). Total fixed cost (i.e., cost of chicks and housing) was similar ($p>0.05$) for all treatments (N233 bird^{-1}).

Total cost of production (fixed and variable) was higher ($p<0.05$) for the control group (N1, 327) compared to treatments 2 (N1,205), 3 (N1,195) and 5 (N1, 23). Total cost of production did not differ significantly between the other treatments (Table 5). Revenue generated from sale of egg eggs was higher for birds on treatment 4 (N1,761) compared to those on treatments 1 (N 1,553) and 5 (N 1,558) ($p<0.05$). The other treatments did not differ significantly in this parameter.

Table 5: Cost analysis of raising layers on the experimental diets containing different levels of rice bran (RB) and yeast (Y)

	Treatments					
	1	2	3	4	5	
Parameters	0% RB 0 Y	30% RB 0 Y	35% RB 0 Y	30% RB 2 g kg^{-1} Y	35% RB 2 g kg^{-1} Y	SEM
Total variable cost (N bird^{-1})	1094.37^{a}	962.97^{b}	962.14^{b}	1050.34^{a}	990.56^{ab}	45.33
Total fixed cost	232.50	232.50	232.50	232.50	232.50	0.00
Total cost of prod	1326.87^{a}	1205.47^{b}	1194.64^{b}	1282.84^{ab}	1223.06^{b}	45.32
Sale of eggs	1553.31^{b}	1638.31^{ab}	1646.67^{ab}	1760.67^{a}	1558.0^{b}	120.00
Spent layers*	500	500	500	500	500	0.00
Total revenue	2073.82^{b}	2158.31^{ab}	2166.67^{ab}	2280.67^{a}	2078.00^{b}	70.10
Net farm income	746.95^{b}	952.84^{a}	972.03^{a}	997.83^{a}	854.94^{ab}	89.12

^{ab}Means along the same row with different superscripts are significantly different ($p<0.05$); *Mortality was not taken into consideration. (It varied from 4-5 % for all treatments ($p>0.05$) and could not be ascribe to the treatments)

Revenue from sale of spent layers and litter was the same for all treatments. Total revenue was higher ($p<0.05$) for treatment 4 (N2281) compared to treatments 1 (N2074) and 5 (N2078) (Table 5). Net farm income was higher for treatments 2 (N952.84), 3 (N972.03) and 4 (N997.83) compared to the control (N746.95).

DISCUSSION

Laying Performance

Neither the level of rice bran nor yeast supplementation had any significant effect on feed intake. The results however showed that yeast supplementation led to non-significant increase in feed intake at both levels of rice bran incorporation. This could be due to the flavor-enhancing characteristic of yeast, as observed by Martin *et al.* (1989). Nahashon *et al.* (1996) also reported increased feed intake when diets of laying birds were supplemented with microbial enzymes. It has long been recognized that yeast increases feed intake in animals (Günter, 1989; Wallace, 1997), probably due to its ability to produce glutamic acid, which has flavor enhancing properties (Lyons, 1987; Rose, 1987). Average daily feed intake of birds on all treatments was similar throughout the 3 months of the trial (96-111 g/bird/day). Adamu and Ubosi (1998) reported lower values of 92.78-98.53 g/bird/day. However, Abdullahi (2004) reported higher values of 141.77 to 156.6 g/bird/day for laying birds aged 42-59 weeks.

The similar feed intake recorded across the treatments could be due to the uniform energy contents of the diets. Birds are known to eat to satisfy their energy requirements (Gietema, 1992). Therefore where energy values are similar, feed intake will not be expected to vary.

Feed conversion ratio was not significantly influenced by either levels of rice bran or yeast addition to the diets. However, yeast supplementation tended to decrease feed conversion efficiency at the high incorporation level of rice bran. This could be attributed to higher feed intake without concomitant increase in egg production. The feed conversion ratios reported in this trial were within the range of 1.5-3.15 kg of feed consumed kg^{-1} of egg produced reported by Farrell *et al.* (1981); Bamgbose and Tewe (1994) and Panda *et al.* (2003).

Neither rice bran levels nor yeast supplementation had any significant effect on the overall hen day egg production. Production figures obtained by birds on all treatment groups were in line with those of Farrell *et al.* (1981) who reported 57-62% egg production, but lower than the 84.6-86.4% reported by Nahashon *et al.* (1996). Meeusen (1999) also reported egg production of 90% when he fed high fiber diets supplemented with enzymes. Hen housed production for all treatment diets was low, which was mainly due to mortality.

Egg mass and egg weight did not differ significantly between treatments. The egg mass recorded in this study is within the range of 33-36.4 g/bird/day. The average egg size varied from 56.00-57.00 g. Farrell *et al*. (1981) and Panda *et al*. (2003) reported egg weight of 52-57.4 g for layers of 40 to 60 weeks of age. Meeusen (1999) reported higher egg mass of 57.6-58.3 g/bird/day and egg weight of 64.2 g for birds fed high fiber diets supplemented with K-enzyme HF. Onifade *et al*. (1999) reported egg mass of 31.5-38.52 g/bird/day and an average egg weight of 55-56.43 g when they fed diets containing different levels of maize offal and cassava meal to layers.

Mortality was not influenced by dietary treatments during the laying period. It varied between 4-5% for all treatments, except for treatment 5 where no mortality was recorded. Examination of the dead and sick indicated Marek's disease infection. Mortality recorded in this experiment was lower than the 12% reported by Abdullahi (2004) in his study with *Shika brown* layers fed a commercial layer diet.

Both the levels of rice bran and yeast supplementation significantly influenced feed cost. The control diet was more expensive than the other diets. High level (35%) of rice bran reduced the cost of feed per kg by about 28% while the lower inclusion rate (30%) reduced the cost by 23%, compared to the control diet. These results indicate that egg production at lower cost could be obtained when rice bran is included in layers diets, with or without yeast addition. Tuleum *et al*. (1998) observed reduced cost of feed with increasing levels of rice offal in layers diets.

The cost of feed consumed was higher ($p<0.05$) for the control diet compared to the other treatments, except the high rice bran yeast supplanted diet. This further demonstrates the cost effectiveness of including rice bran in the diets.

Effect of Yeast Supplementation on Egg Quality Characteristics

Albumen height ranged from 5.3 to 5.90 mm across treatments ($p>0.05$). The values obtained were slightly lower than those (8.7-9.8 mm) reported by Apata (1998) and Onifade *et al*. (1999). Yolk index which varied from 0.32-0.63, was also not influenced significantly by the dietary treatments. These values fall within the accepted range of 0.33 to 0.50 for fresh eggs (Ihekoronye and Ngoddy, 1985).

Shell thickness and shell weight were significantly influenced by dietary treatments. Birds on the low rice bran yeast-supplemented diet had thicker shells (0.39 mm) compared to the control (0.29 mm) and those on diets 3 (0.32 mm) and 5 (0.31 mm). These values are lower than those earlier reported by Ayorinde *et al*. (1999) and Abdullahi (2004) (0.37 to 0.42 mm).

Haugh unit of 87.22-90% recorded for the different dietary treatments in this work were higher than the values (79.57-83%) reported by Ayorinde *et al*. (1999) and those (56.01-76.82%) reported by Bamgbose and Tewe (1994). The values obtained were however lower than the 93.7-97.87% reported by Apata (1998) and 84-99% reported by Sekoni *et al*. (1994). The results indicate that irrespective of levels of rice bran and yeast supplementation, high haugh unit could be obtained. According to Kohlmeyer and Shaffner (1944) eggs with haugh unit above 70% are graded A, those with HU of 50-69% are graded B while those with HU below 50% are graded C. All eggs laid in this study thus belong to the A grade, which indicates that neither the levels of rice bran nor yeast supplementation had any negative effect on HU.

Cost Analysis

Cost of feed was higher for the control group compared to the other treatments, but the difference was only significant between the control and the diets containing no yeast. Cost of feed represented 64% of the total cost of production for the control group. This declined to 63, 62, 60 and 60% for treatments 2, 3, 4 and 5, respectively. In poultry production, cost of feed is said to constitute between 70% (Onifade, 1993; Oluyemi and Roberts, 2000; Agbede and Aletor, 2003) and 88%

(Abdullahi, 2004) of the total cost of production. The values obtained in this study are lower than these estimates, but fall within the range of 50-65% reported by Tackie and Fleischer (1995). Incorporating the low and high levels of rice bran into the diets reduced cost of feeding by about 5.8-9.8%.

Revenue was accrued from sale of eggs, spent layers and litter material. Of these, only the revenue obtained through sale of eggs was significantly influenced by the treatments. Birds on the low rice bran yeast supplemented diet (diet 4) generated significantly higher revenue from sale of eggs compared to those on the control and the high rice bran yeast supplemented diets.

The higher revenue generated from birds on the low rice bran yeast supplemented diet was accompanied by a higher margin of N997.83, which was significantly better than that recorded for the control group (N746.95/bird). Similarly, net farm income obtained from birds on low and high rice bran with or without yeast was higher ($p<0.05$) than that of the control. Reduction in net farm income observed for birds on high rice bran yeast supplemented diet could be related to higher feed intake, which resulted in a concomitant increase in the cost of production.

CONCLUSIONS

It could be concluded from the results of this study that feed intake, hen day egg production, feed efficiency and mortality of birds were not affected by the levels of rice bran used, with or without yeast addition.

Among egg quality traits only shell thickness and shell weight were significantly affected by the treatments, with higher values recorded for some of the rice bran containing diets in relation to the control. Economic analysis revealed higher net farm income with the rice bran containing diets compared to the control. It could therefore be concluded that it is more profitable to raise layers on the levels of rice bran used in this study, with or without yeast addition, compared to the type of control diet employed.

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