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Effects of Heating of Dietary Rice Bran on Growth Performance and Serum Cholesterol Levels of Broiler Chicken

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ABSTRACT

Rice bran (RB) is a valuable feed resource for poultry. However, inclusion of high levels of RB in broiler diets reduces growth performance while increasing the excretion of nitrogen and phosphorus. Objective of this study was to determine whether adverse effects of high dietary RB levels on growth performance of broiler chicken could be mitigated by heating. Giving completely randomized design, in 2 x 4 factorial arrangement, 144 broiler chicks in 48 floor pens received one of the eight experimental diets ad libitum from day 27-47. Experimental factors were two types (heated and non heated) and four levels (0, 10, 20 or 30%) of dietary RB. RB was heated at 80^0 C for three hours. All diets were isocaloric and isoprotein. Serum cholesterol contents and latency-to-lie (LTL) of eight randomly selected birds from each treatment were determined on day 44 and 46, respectively. Internal organ weights and tibia ash contents of eight randomly selected birds from each treatment were determined on day 47. Heating of RB had no significant ($P>0.05$) effect on any of the parameters measured. Growth performance parameters such as live weight on day 47, weight gain from day 27-47, feed conversion ratio (FCR) and the performance index of the birds fed RB free control diet were significantly better than those fed 20 or 30% RB. Internal organ weights, serum cholesterol contents, tibia ash contents and LTL were not affected either by the type or the level of rice bran or their interactions. It was concluded that heating of RB at 80^0 C for three hours does not mitigate the negative effects of high dietary RB inclusion levels on growth performance of broiler chicken.

Keywords: *rice bran, heating, performance, broiler*

INTRODUCTION

Rice bran, a by-product of rice milling industry, constitutes about 10% of the weight of rough rice (Hu *et al*., 1996). The RB production in Sri Lanka has been estimated around 365 200 MT (Central Bank, Sri Lanka, 2010). RB is relatively a cheap livestock feed ingredient in areas where rice is grown. In vitro nutritive value of RB is superior to or at least comparable with other cereals and cereal by products (Warren and Farrell, 1990). Atapattu, (2005) has shown that the unit costs of many nutrients and energy coming from RB are lower than those of other cereals and their by products. Oladunjoye and Ojebiyi, (2010) also found that the feeding cost of broilers fed diets with 20% RB was significantly lower than those fed 10% RB. Meanwhile, a number of studies have shown that RB and RB oil have hypocholesterolaemic effects both in human (Kahlon *et al.,* 1990; Hegsted *et al*., 1990) and in animals (Sharma and Rukmani, 1987; Ausman, 2005). Therefore, inclusion of RB in poultry diets may have health benefits as well.

However, a number of studies (Oladunjoye and Ojebiyi, 2010; Farrell and Martin, 1998; Martin *et al*., 1998) have shown that more than 20% RB in broiler diets reduced the performance and the bone status while increasing the excretion of minerals and nitrogen. The inferior in vivo nutritive value of RB and the performance of the broilers fed RB based diets are attributed to the presence some anti-nutrients such as phytate

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(Puminn, 2003), fibre (Martin *et al*., 1998; Warren and Farrell, 1990), anti-proteolytic substances (Deolankar and Singh,1979) and lipase (Ramezanzadeh *et al*., 1999).

Dietary citric acid (Wickramasinghe *et al*., 2009), balancing of RB based diets up to four amino acids (Piyarathna *et al*., 2009), formulation of diets based on the digestible amino acids (El Ghami *et al*., 2005) and the alteration of the dietary energy level (Atapattu and Prabath, 2010) did not mitigate the adverse effects of high dietary RB levels (40%) on the growth performance of broilers.

Heating has found to increase the phytate degradation of sorghum (Salah and Elhag, 1998) and sunflower meal (Youssef *et al*.,1989). Furthermore, heating is the most effective mean of controlling lipolytic rancidity of RB (Ramezanzadeh *et al*., 1999).

The first objective of this study was to determine whether adverse effects of high dietary RB levels on growth performance of broiler chicken could be mitigated by heating. Secondly, the study determined the effects of the type and level of RB on serum cholesterol contents of broiler chicken.

MATERIALS AND METHODS

Day old male broiler chicks were raised under standard management practices until they were 26 days old. On day 26 chicks were weighed and allocated into 48 floor pens (0.75m x 0.75m x 0.75m) so that between pen weights variation was minimam. Giving completely randomized design experiment, arranged in 2 x 4 factorial arrangements with six replicates, pens were randomly assigned into eight treatments. Each pen housed three birds. Eight broiler finisher rations were formulated to contain either heated or non-heated RB at 0, 10, 20 or 30%. The ingredient composition of the experimental diets is given in Table 01. RB was collected from a local rice mill two days before being incorporated into the rations. RB was heat stabilized by heating at 80^0C for three hours in an electrical oven. All diets met or exceeded the nutrient requirements as set out by NRC (1994). Experimental diets and water were provided ad libitum from day 27-46.

Table 01. Ingredient composition and the calculated nutrient levels of experimental diets

Ingredient (%)	Dietary RB level (either heated or non-heated)			
Rice bran	0	10	20	30
Maize meal	63	54.3	45.5	36.6
Soybean meal	27.4	26.2	24.8	23.6
Coconut oil	3	3	3.2	3.3
Fish meal	4	4	4	4
DCP	1.2	1.1	1	1
Sell powder	0.9	0.9	1	1
D methionine	0.04	0.04	0.04	0.03
Salt	0.25	0.25	0.25	0.25
Vit. Mineral Mixture	0.25	0.25	0.25	0.25
Calculated nutrient composition				
Metabolizable energy	3200 Kcal/Kg			
CP (%)	20			
Non phytate phosphorus (%)	0.35			
Calcium (%)	1.0			
Lysine (%)	1.0			
Methionine+Cystine (%)	0.72			

Daily feed intake and weekly live weights of the birds were recorded. Serum cholesterol contents of eight randomly selected birds from each treatment were determined on day 44, using commercial cholesterol assay kit (SPINREACT, S.A. Ctra, Santa Coloma, Spain). The latency-to-lie test was performed for another eight randomly selected birds from each treatment on day 46, as described by Weeks *et al*., (2002). All birds were weighed on day 47 and eight randomly selected birds from each pen were dissected to determine the internal organ weights such as liver, gizzard, pancreas, crop and small intestine. Tibia were analyzed for fat free ash as described by Kim *et al*., (2004). Performance index was calculated as live weight/FCR. Data were analyzed using GLM procedure of SAS (1989). Significant main effects were compared using DMRT procedure.

RESULTS AND DISCUSSION

Growth performance parameters and feed intake were significantly affected by the type of RB used (Table 02). However, growth performance parameters such as live weight on day 47 (Figure 01), weight gain (Figure 02), FCR (Figure 03) and performance index (Figure 04) of the broilers fed RB free control diet were significantly better than those fed diets containing 20 or 30% RB. There was no significant difference in growth performance parameters between those fed 0% and 10% RB diet and thus it is concluded that the maximum inclusion level that does not negatively affect the growth performance of the broilers is 10%. Gallinger *et al*., (2004) have also reported that more than 10-15% RB reduced the performance. In contrast to above findings, Farrell, (1994) concluded that RB could be included up to 20% in broiler diets. The nutritive value of RB varies widely depending on the cultivar (Wang *et al*., 1997) and milling conditions. Variations in the nutritive values used in different experiments may be the reason for those discrepancies.

Feed intake was not significantly altered by the level or the heating of RB (Table 02). In contrast several studies (Farrell and Martin, 1998; Atapattu and Gamage, 2006; Atapattu and Lal, 2007 and Piyarathna *et al*., 2008) have reported that high RB levels reduced the feed intake of poultry. Inferior FCR values reported with higher RB levels in the absence of negative effects on feed intake suggest that negative effects of RB on performance are attributed to lower feed utilization efficiency.

Bone status of the birds as determined by the LTL test and fat free tibia ash contents, was not affected by the dietary treatments. Before the imposition of the experimental diets having RB, birds had been fed a commercial broiler starter diet containing 0.5% non phytate phosphorus; a slightly higher level than what NRC (1994) recommended. Consequently, phosphorus reservoirs developed from 0-26 d might have supported the maintenance of bone status during the experimental period.

Oladunjoye and Ojebiyi, (2010) have reported higher internal organ weights of the broilers fed RB based diets. Contrary to those findings, none of the organ weights was significantly affected by the type or levels of RB.

The cost of formulations containing 0, 10, 20 and 30% RB were Rs. 71.80, 68.49, 65.37 and 62.11, respectively (as of January 2012). There was a significant linear reduction in feed cost when the dietary RB level increased from 0 to 30% (Feed cost; Rs = 188 - 1.10 x % of RB. (Oladunjoye and Ojebiyi, 2010) also found that the feeding cost of broilers fed diets with 20% RB was significantly lower than those fed 10% RB. However feed cost per 1 Kg of live weight gain was not significantly different among treatments and varied within a narrow range from Rs. 131 for heated 30% group to Rs. 146 for heated 20% group. Therefore, economic performance should be considered along with the production parameters in determining the optimum inclusion level of RB in broiler diets.

Hypocholesterolemic effects of RB and RB oil have been proven both in human (Kahlon *et al*., 1990; Hegsted *et al*., 1990) and in animal (Sharma and Rukmani, 1987; Ausman 2005)

studies. However, in this experiment, RB had no serum cholesterol lowering effects. The type and the level of dietary RB and their interaction had no significant effect on any of the carcass parameters.

Table 02: Effects of four levels of heated and non-heated rice bran on growth performance, internal organ weights, latency-to-lie and serum cholesterol levels of broiler chicken.

Type of RB	Non heated				Heated				Probability		
Level of RB (%)	0	10	20	30	0	10	20	30	Type	Level	Interaction
Live weight (g) 27 d	1077	1076	1093	1082	1090	1078	1080	1085	NS	NS	NS
47 d	2426	2313	2272	2204	2439	2373	2240	2301	NS	0.03	NS
Weight gain (g)	1348	1236	1178	1122	1348	1294	1159	1216	NS	0.02	NS
Feed intake (g)	2662	2576	2565	2455	2628	2583	2539	2567	NS	NS	NS
FCR	1.98	2.09	2.18	2.18	1.95	2.00	2.19	2.11	NS	0.02	NS
Performance index	1230	1113	1045	1006	1251	1190	1024	1090	NS	0.001	NS
Carcass parameters*											
Liver	2.2	2.2	2.3	2.8	2.2	2.3	2.6	2.3	NS	NS	NS
Gizzard	1.4	1.4	1.4	1.3	1.4	1.4	1.4	1.4	NS	NS	NS
Pancrease	0.17	0.13	0.17	0.18	0.16	0.16	0.18	0.16	NS	NS	NS
Crop	0.37	0.36	0.36	0.36	0.32	0.36	0.42	0.42	NS	NS	NS
Small intestine											
Weight	6.2	6.2	6.2	6.3	5.2	6.2	6.2	6.1	NS	NS	NS
Length	7.7	8.1	7.8	8.4	7.3	7.9	8.4	7.7	NS	NS	NS
Tibia ash (%)	39	44	39	38	42	38	38	41	NS	NS	NS
LTL (Min)	189	229	155	178	194	274	164	157	NS	NS	NS
Serum cholesterol (mg/dl)	132	135	136	134	127	129	132	130	NS	NS	NS

* as a percentage of empty carcass

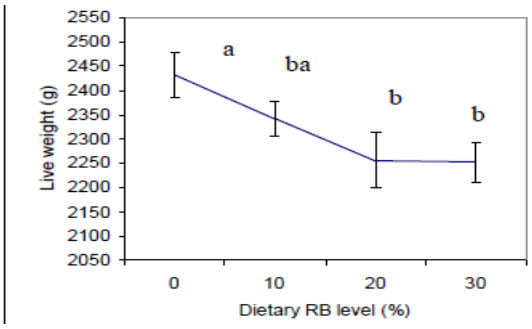

Figure 01: Effects of four dietary rice bran levels on live weight of broiler chicken on day 47.

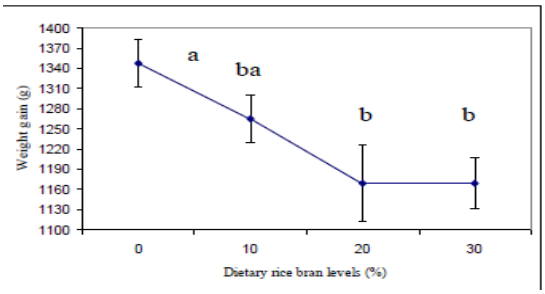

Figure 02: Effects of four dietary rice bran levels on live weight gain of broiler chicken from day 27-47

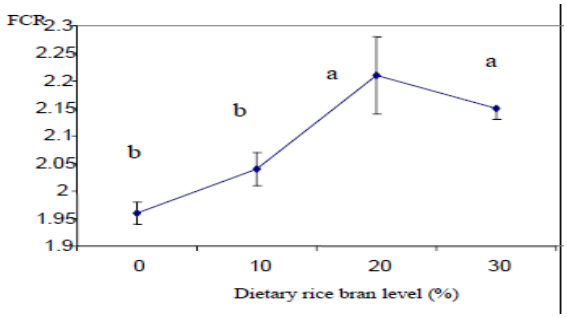

Figure 03: Effects of four dietary rice bran levels on feed conversion ratio of broiler chicken

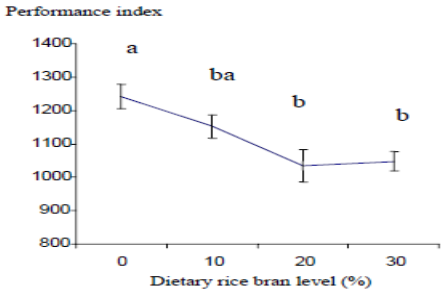

Figure 04: Effects of four dietary rice bran levels on performance index of broiler chicken

CONCLUSIONS

It was concluded that inclusion of more than 10% rice bran in broiler finisher diets reduces the growth performance. RB had no effect on serum cholesterol levels of broilers. Heating of rice bran at 80^0 C for three hours does not mitigate the adverse effects of high RB inclusion levels of growth performance.

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