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Muscle Cholesterol and Serum Biochemical Changes in Broilers Fed with Crude Rice Bran Oil

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Abstract: An experiment was conducted to study the inclusion of crude rice bran oil on production performance, carcass characteristics and biochemical parameters for a period of seven weeks with two hundred and sixteen commercial, straight run day-old Vencobb broiler chicks. These chicks were randomly grouped into six treatments with three replicates of twelve chicks each. The treatment groups consisted of 0% (T_1), 1% (T_2), 2% (T_3), 3% (T_4), 4% (T_5) and 5% (T_6) crude rice bran oil included in the broiler diet. The breast muscle cholesterol revealed no significant difference between treatment groups. Whereas the mean thigh muscle cholesterol of other treatment group birds was significantly ($p < 0.05$) lower than those of control group. The serum total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides level did not differ significantly between treatment groups.

Key words: Crude rice bran oil, broilers, muscle cholesterol, serum biochemistry

Introduction

Poultry production in the country has gained momentum during the last four decades. Global poultry meat output will hit 80 million tonnes in 2005 showing a 2.3% gain over the latest estimate for 2004 and India, produces about 1,440 thousand tonnes of chicken meat, stands fifth in the world (Mandal *et al.*, 2005) and the per capita availability (per person/year) of poultry meat has increased from 600 g in 1992 to 1.3 kg in 2002 (Poultry International Executive Guide, 2004).

Rice is the primary cereal for human food in southern states of India and the oil is extracted from the rice bran, utilized as important feed resources in animals and poultry. The feeding cost alone being the major constraint in poultry enterprise. The cost of feed accounts about 65-70% for broiler. Cereal by-products and oilseed residues, usually constituting about 50% of poultry diet. The production of rice bran oil in southern states of India is 3.5 lakh metric tonnes/annum as edible and 1.3 metric tonnes/annum as inedible (Sea Millennium Hand Book, 2002). Oryzanol, which seems to have the greatest effect on lowering serum cholesterol and it is highest in crude rice bran oil (Rong *et al.*, 1997). Gamma-oryzanol, a phytosterol ferulate mixture extracted from rice bran oil has a wide spectrum of biological activities and also has antioxidant properties (Juliano *et al.*, 2005). Cholesterol lowering properties are present in rice bran oil and it lowers the total plasma cholesterol (6.3%), LDL-C (10.5%) and the LDL-C/HDL-C ratio (18.9%) (Berger *et al.*, 2005).

Hence, the present study was planned to determine the serum biochemical parameters of broilers by feeding different levels of crude rice bran oil in the diet.

Materials and Methods

Two hundred and sixteen, commercial, straight run day-old Vencobb broiler chicks were randomly grouped into six treatments with three replicates of twelve chicks each. Six experimental rations were prepared as per BIS Standards by including 0% (T_1), 1% (T_2), 2% (T_3), 3% (T_4), 4% (T_5) and 5% (T_6) crude rice bran oil on isocaloric and isonitrogenous basis and fed to the experimental birds kept in cages up to seven weeks of age. Birds were vaccinated against Marek's disease, Ranikhet disease and Infectious bursal disease. Body weight gain, feed consumption and mortality were recorded at every week individually.

At the end of 49th day of age, one male and one female from each replicate, totally six birds per treatment group were randomly picked up, blood samples were collected for measuring the serum biochemical characteristics and slaughtered as per the method of Arumugam and Panda (1970).

Muscle cholesterol: The meat samples were chopped and minced with mortar and pestle. The total lipid was extracted from the muscle samples as per the method of Folch *et al.* (1957) and the total meat cholesterol was estimated by one-step method of Wybenga *et al.* (1970).

Serum biochemistry: Blood samples collected from six birds randomly picked up for slaughter from each treatment group were allowed to clot and centrifuged for 20 min at 1500 rpm to separate the sera. The sera samples were stored at 20°C for the analysis of serum total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides as per the following procedures.

Table 1: Mean (\pm S.E.) breast and thigh muscle cholesterol of broilers at 7 weeks of age fed diet with different levels of crude rice bran oil

Parameters	Inclusion level of crude rice bran oil					
	T ₁ -0%	T ₂ -1%	T ₃ -2%	T ₄ -3%	T ₅ -4%	T ₆ -5%
Breast muscle cholesterol (mg/dl)	86.79 \pm 13.49	62.65 \pm 12.84	58.29 \pm 10.77	54.31 \pm 18.39	45.87 \pm 9.54	32.27 \pm 3.50
Thigh muscle cholesterol (mg/dl)	185.13 \pm 27.61	148.83 \pm 26.89	127.12 \pm 4.45	103.78 \pm 32.28	90.99 \pm 30.51	50.22 \pm 2.82

Each value is a mean of 6 observations, *Means within a row with no common superscript differ significantly ($p < 0.05$)

Table 2: Mean (\pm S.E.) serum biochemical parameters of broilers at 7 weeks of age fed diet with different levels of crude rice bran oil

Biochemical parameters	Inclusion level of crude rice bran oil					
	T ₁ -0%	T ₂ -1%	T ₃ -2%	T ₄ -3%	T ₅ -4%	T ₆ -5%
Total cholesterol (mg/dl)	90.96 \pm 7.77	90.00 \pm 8.85	84.78 \pm 9.63	81.12 \pm 5.55	75.83 \pm 5.23	74.17 \pm 5.97
HDL-cholesterol (mg/dl)	25.94 \pm 1.97	27.20 \pm 1.28	27.27 \pm 2.21	27.51 \pm 1.34	27.83 \pm 0.94	27.83 \pm 1.70
LDL-cholesterol (mg/dl)	61.84 \pm 8.39	61.22 \pm 7.15	54.78 \pm 9.82	51.51 \pm 5.97	46.69 \pm 5.54	44.32 \pm 5.72
Triglycerides (mg/dl)	12.35 \pm 0.47	12.05 \pm 1.03	11.11 \pm 1.36	10.85 \pm 0.70	10.10 \pm 1.81	8.18 \pm 0.71

Each value is a mean of 6 observations

S.No.	Parameters	Methods followed
1.	Serum total cholesterol	One step method of Wybenga <i>et al.</i> (1970) (Code No. 25924)*
2.	HDL cholesterol	One step method of Wybenga <i>et al.</i> (1970)
3.	Serum triglycerides	Enzymatic (Glycerol-3-phosphate oxidase/ Trinder), End point colorimetry, single reagent chemistry with LCF (Lipid Clearing Factor) (Code No. LG 061)*

*: Span Diagnostics Ltd., Sachin 394230 (Surat) India

Statistical analysis: The data collected on various parameters were subjected to statistical analysis as per the methods suggested by Snedecor and Cochran (1989). Angular transformation was applied to %age wherever needed before carrying out statistical analysis.

Results and Discussion

Muscle cholesterol: The mean breast and thigh muscle cholesterol of broilers as influenced by dietary inclusion of crude rice bran oil are presented in Table 1.

Analysis of variance of data on breast muscle cholesterol level revealed no significant difference between treatment groups. But, thigh muscle cholesterol level differ significantly ($p < 0.05$) between the treatment groups. Linear decrease in thigh muscle cholesterol was observed in groups fed with crude rice bran oil from 1 to 5%. The mean thigh muscle cholesterol of these groups were significantly ($p < 0.05$) lower than control group.

The analysis of data on breast muscle cholesterol revealed no significant difference among treatment groups due to dietary inclusion of crude rice bran oil. But the thigh muscle cholesterol revealed significant ($p < 0.05$) difference among the treatment groups. It was consistent with Ramesh Kumar (2000) who revealed that total cholesterol content of muscle was significantly reduced in groups fed sunflower seed, sunflower oil and rice bran oil when compared to groups fed tallow, palm oil and no fat/oil in broilers.

Breast muscle had lower cholesterol values than thigh muscle, because of its lower fat content. Cholesterol content was significantly influenced by the dietary fatty acid profile in broiler chickens at 49 days of age (Crespo and Esteve-Garcia, 2001).

Serum biochemistry

Serum total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides: The mean serum total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides of broilers as influenced by dietary inclusion of crude rice bran oil are presented in Table 2.

Analyses of variance of data on serum total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides level revealed no significant difference between treatment groups. All the serum biochemical parameters decreased linearly as the inclusion level of crude rice bran oil was increased in the diet. The serum biochemical parameters in all treatment groups were lower compared to control.

Crude rice bran oil included in broiler diet had no significant difference on serum total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides level among treatment groups. All the serum biochemical parameters decreased linearly as the inclusion level of crude rice bran oil was increased in the diet. The serum biochemical parameters in all treatment groups were lower compared to control. There was proportional decrease in the values of total serum cholesterol when the level of crude rice bran oil was increased from 1 to 5%. This finding was consistent with Fan *et al.* (1995) who reported that serum triglycerides and LDL cholesterol are lowered in growing chickens fed with diet containing blended oil (rice bran oil+maize oil).

Similarly, Ramesh Kumar (2000) stated that total cholesterol contents of serum were significantly reduced and HDL cholesterol contents of serum were significantly increased in groups fed with sunflower seed, sunflower oil and rice bran oil.

Based upon this study, it can be concluded that crude rice bran oil can be included beneficially up to 3% in the

broiler diet for reducing serum total cholesterol and production of lean meat. On the other hand, the inclusion of crude rice bran oil in broiler diet had significant effect on thigh muscle cholesterol but not on breast muscle cholesterol.

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