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Comparative evaluation of lysolecithin from rice bran oil *vis-à-vis* lipotropic agents in broiler chicken diet

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The milling of paddy for rice yields sizeable quantity of rice bran as a by-product, which is a good source (12 to 25 g/100g) of edible oil (Roy *et al.* 2002). The estimated global potential for rice bran oil is 7–8 million metric tons (Prasad 2006). The gums present in crude rice bran oil are removed employing enzymatic degumming of rice bran oil using phospholipase A_1, wherein lysolecithin (LL) is produced as a by-product (Chakrabarti *et al.* 2009) at a rate of about 10–15 kg/metric ton of rice bran oil. Dietary soya lecithin increased the weight gain of chicks individually (Emmert *et al.* 1996) and in combination with soya acid oil (Dubey *et al.* 2014) and increased laying performance and phospholipid content in eggs of hens (Sun *et al.* 2010), whereas LL increased egg weight and feed efficiency as well as vitamin A and E content of egg yolk in laying hens (Han *et al.* 2010). Fat digestibility in pigs was also improved with LL (Xing *et al.* 2004).

The similarity of rice bran lecithin with soyabean lecithin (Adhikari and Adhikari 1986) and presence of several chemical constituents like oryzanol, tocopherols, tocotrienols, steryl esters etc. offer scope for its use in poultry diet. In a previous study at this lab, the LL from rice bran oil could be used in broiler chicken diet as a source of energy (Raju *et al.* 2011). The present study was conducted for further evaluating the effect of lysolecithin (LL) of rice bran oil *vis-à-vis* commonly used lipotropic agents in broiler chicken diet containing supplemental fat.

Day-old commercial broiler chicks (270) of combined sex were divided at random into 6 equal groups with nine replicates of 5 chicks each and reared in 3-tiered SS battery brooders in an open sided house under uniform managemental conditions. The chickens were vaccinated against Newcastle and infectious bursal diseases. The experimental protocol was as per the guidelines of the Institute Animal Ethics Committee. Crude LL obtained from rice bran oil was procured from a local source, where the phospholipid gums present in crude rice bran oil were removed using phospholipase A_1 as per Prasad (2006). The crude LL containing 80 to 90% moisture was dried using a 20 kg capacity rotary evaporator. The LL fraction of the crude LL was separated by complete removal of neutral lipids employing acetone fractionation method and used in the experiment.

Six experimental diets were prepared to contain no test compound (control), choline chloride with 50% active compound (0.1%), betaine (0.1%), a commercial soya-lysolecithin product (0.1%) and LL from rice bran oil at 2 levels (0.1 and 0.5%) and fed from day 1 till 35 d of age. The diets were primarily based on maize and soyabean meal and formulated to contain nutrients as per NRC (1994), except energy. All the diets were maintained *isocaloric* and *isonitrogenous*. The diet contained 22.5% protein and 2,900 Kcal ME/kg during starter (1 to 21 d) and 19.5% protein and 3,000 Kcal ME/kg during finisher (22 to 35 d) phases. Concentrations of other nutrients were kept uniform among diets. The diets were allotted to the treatment groups employing the completely randomized design.

Data on weekly body weight and feed intake were recorded and feed conversion ratio was calculated. At 21 and 35 d of age, about 2–3 ml of blood was collected through the brachial vein from eight chickens in each treatment group into non-heparinised tubes. Subsequently, serum was separated and analysed for the concentrations of total protein, cholesterol and triglycerides using reagent kits. At the end of experiment, nine chickens from each treatment group were killed by decapitation and data on dressing yields and weights of visceral and lymphoid organs were recorded. Abdominal fat was collected as per Fancher and Jensen (1989). Samples of liver and thigh muscle from each slaughtered bird were analysed for fat and protein contents (AOAC 1995). At the end of experiment, a 3-day digestibility experiment was performed on three replicate groups of three chicks each per treatment. Relative

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Table 1. Influence of feeding rice bran oil lysolecithin (LL) and other lipotropic agents on performance of broiler chicken

Test agent	% in diet	Body wt. (g)		Feed intake (g)		FCR	
		21 d	35 d	0-21 d	0-35 d	0-21 d	0-35 d
Control	0.0	734.9	1419.6[a]	886.2	2238.0	1.28	1.63
Choline chloride	0.1	732.2	1465.5[ab]	898.7	2313.3	1.31	1.63
Betaine	0.1	747.7	1496.1[b]	924.0	2294.4	1.31	1.58
Commercial LL	0.1	726.3	1448.7[a]	891.7	2326.6	1.31	1.66
LL	0.1	738.6	1443.9[a]	916.6	2306.8	1.32	1.65
LL	0.5	751.4	1439.1[a]	932.1	2301.6	1.32	1.65
N		9	9	9	9	9	9
SEM		3.636	6.617	6.315	19.094	0.001	0.001
P		0.346	0.016	0.2	0.841	0.507	0.546

Means in a column bearing different superscripts differ significantly (P<0.05).

Table 2. Influence of feeding rice bran oil lysolecithin (LL) and other lipotropic agents on slaughter traits and nutrient retention of broiler chicken

Test agent	% in diet	Slaughter traits (g/kg)		Retention (%)	
		Ready to cook weight	Abdominal fat	Dry matter	Fat
Control	0.0	688.4	10.39	71.21[abc]	82.35
CC	0.1	694.9	14.50	73.24[ab]	83.77
Betaine	0.1	695.3	12.63	70.66[bc]	83.07
Com. LL	0.1	608.1	11.69	73.73[a]	85.64
LL	0.1	677.3	12.88	70.29[c]	82.19
LL	0.5	688.3	13.89	72.97[ab]	85.39
N		9	9	3	3
SEM		13.078	0.649	0.427	0.486
P		0.367	0.514	0.040	0.142

Means in a column bearing different superscripts differ significantly (P<0.05).

digestibility of dry matter and fat were estimated by determining the proportion of consumed amount that was retained. The data were subjected to one-way analysis of variance under completely randomised design (Snedecor and Cochran 1968) using SPSS software (version 10) and the means were compared by multiple range test (Duncan 1955).

Body weight at 21 d was not affected by the dietary treatments, while at 35 d the group fed betaine recorded higher (P<0.05) body weight in comparison to control and that of choline fed group was intermediate (Table 1). Rice bran oil LL at either level did not affect the body weight. Other groups showed no difference. Feed intake and feed efficiency were unaffected with the addition of rice bran oil LL in the diets. This is in agreement with our previous study (Raju *et al.* 2011), where improved growth of broiler chickens was observed with dietary inclusion of rice bran oil LL only at a level of 2.5% or more, which is higher than the level (0.1–0.5%) used in the current experiment. Gheisar *et al.* (2015) however, reported improved broiler performance during 21–35 d of age with soya lysolecithin (0.08%), probably indicating the role of LL source in influencing the performance of broiler chicken. Further, type of fat in diet was found to affect the responses to LL supplementation in chickens (Jansen *et al.* 2015).

Lysolecithin from rapeseed or safflower (An *et al.* 2000) or from soyabean (Overland *et al.* 1993) also showed no effect on broiler chicken and pigs, respectively. Further,

Table 3. Influence of feeding rice bran oil lysolecithin (LL) on serum biochemical profile of broiler chickens

Test agent	% in diet	Serum biochemical profile					
		21 d			35 d		
		Triglycerides (mg/dL)	Cholesterol (mg/dL)	Protein (g/dL)	Triglycerides (mg/dL)	Cholesterol (mg/dL)	Protein (g/dL)
Control	0.0	56.4	120.7[ab]	2.54	61.5[b]	122.3	2.96
Choline chloride	0.1	62.6	109.8[a]	2.37	68.0[b]	127.2	3.21
Betaine	0.1	53.8	129.7[b]	2.60	42.5[a]	112.8	3.13
Commercial LL	0.1	60.5	126.0[ab]	2.52	37.7[a]	120.7	3.17
LL	0.1	70.4	137.4[b]	2.88	39.2[a]	132.7	3.19
LL	0.5	62.1	127.5[ab]	2.70	33.8[a]	116.5	3.19
N		9	9	9	9	9	9
SEM		1.98	2.62	0.005	2.668	2.174	0.053
P		0.22	0.05	0.07	0.001	0.097	0.77

Means in a column bearing different superscripts differ significantly (P<0.05).

Table 4. Influence of feeding rice bran oil lysolecithin (LL) on serum biochemical profile and protein, and fat content of liver and thigh muscle of broiler chickens

Test agent	% in diet	Muscle		Liver	
		Fat (%)	Protein (%)	Fat (%)	Protein (%)
Control	0.0	13.73	72.68	9.24	60.79^{a}
Choline chloride	0.1	13.99	72.53	9.99	70.78^{b}
Betaine	0.1	15.14	71.61	10.48	69.44^{b}
Commercial LL	0.1	13.67	67.06	10.21	66.51^{ab}
LL	0.1	14.34	71.83	10.81	67.92^{b}
LL	0.5	14.04	71.94	10.23	72.68^{b}
N		9	9	9	9
SEM		0.383	0.744	0.180	0.965
P		0.903	0.246	0.202	0.005

Means in a column bearing different superscripts differ significantly (P<0.05).

similar to the trend recorded in the current study, betaine supplementation was reported to improve growth in broilers (Rama Rao *et al.* 2011) and enhance hepatic lipid export, and fatty acid oxidation in high-fat diet-fed rats (Xu *et al*. 2015). Slaughter variables, organ weights and dry matter and fat retention estimates were not affected (Table 2). On the contrary, beneficial effect of LL on fat digestibility in pigs (Xing *et al.* 2004) and AMEn during early life in chicks (Zaefarian *et al.* 2015) were reported, while mixed effects on intestinal morphology were found in broiler chicken with LL supplementation (Khonyoung *et al*. 2015).

Serum cholesterol content at 21 d of age was the highest and lowest in the groups fed rice bran oil LL (0.1%) and choline chloride, respectively (Table 3). Both the groups however, did not differ with the control. Kahlon *et al.* (1992) also found no effect of dietary inclusion of whole rice bran, rice bran oil or its fractions on plasma cholesterol concentration in hamsters, while in liver, the cholesterol content was not affected with defatted rice bran and rice bran oil gum, however, decreased with rice bran oil. Serum triglycerides at 35 d were significantly low in the groups fed betaine, commercial LL and both the levels of rice bran oil LL in comparison to control and the group fed choline chloride. Raju *et al.* (2011) also reported decreased serum triglyceride content in broiler chickens fed rice bran oil LL. The serum concentration of cholesterol level at 35 d of age, protein at both the ages and triglycerides at 21 d of age were however, unaffected. Further, muscle and liver fat contents were unaffected by the dietary treatments (Table 4). The liver protein content was significantly (P<0.05) higher in the groups fed various lipotropic agents.

SUMMARY

The possibility of using lysolecithin from rice bran oil (LL) as a lipotropic agent was explored in the diet of broiler chickens. The LL was evaluated at 0.1 and 0.5% levels in diet vis-à-vis choline chloride, betaine or a commercial LL (0.1% of any) in broiler chickens (270) from 0 to 35 d of age. The diets were *isonitrogenous* and *isocaloric*. Body weight at 35 d was significantly higher in the group fed betaine, while LL showed no effect on growth, feed consumption, serum cholesterol concentration, slaughter variables and liver protein, and fat contents in comparison to control. The serum concentration of triglycerides at 35 d of age, however, decreased significantly with betaine, commercial LL and rice bran oil LL at both the levels. It is concluded that rice bran oil LL at dietary levels upto 0.5% showed no adverse effect on performance and reduced serum triglycerides content in broiler chickens, while betaine improved body weight.

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