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Dietary Supplementation of Alpha Lipoic Acid on Serum Lipid Profile of Broiler Chicken Fed With Animal Fat Diet

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The objective of this study was to determine the effects of alpha lipoic acid on the performance and serum lipid profile in broiler chicken. In this study, eighty, day-old Venn Cobb commercial broiler chicks broiler chicks were randomly distributed into two treatment groups with four replicates of ten birds each and the birds were fed with experimental diets T_1 (Control ration as per BIS [1992] specifications with five per cent animal fat) and T_2 (control ration supplemented with 100 mg of alpha lipoic acid/kg diet). The broiler starter ration (23 per cent crude protein and 2800 kcal ME/kg of feed) fed up to 4 weeks of age and finisher ration (20 per cent crude protein and 2900 kcal ME/kg of feed) fed up to 6 weeks of age. At the end of 42 days of experimental period, five birds from each treatment were slaughtered and blood was collected for serum biochemical analysis. The growth performance was similar in both the treatment groups. Similarly, serum cholesterol, triglycerides and VLDL-cholesterol level was not affected by the alpha lipoic acid supplemented group. However, serum HDL-cholesterol level was significantly ($P<0.01$) increased in alpha lipoic acid supplemented group, whereas, LDL-cholesterol was reduced ($P<0.01$) in alpha lipoic acid supplemented group compared to control group. On conclusion, alpha lipoic acid supplementation had no effect on serum cholesterol, triglycerides and VLDL-cholesterol levels, but reduced the LDL-cholesterol level and increased the HDL-cholesterol level of broilers compared to control group.
Keywords: Alpha lipoic acid, Animal fat, Broilers, Lipid profile

1. Introduction

Poultry is one of the fastest growing segments of the agricultural sector in India, with an average growth rate of 8 to 10 per cent per annum. Today poultry is the major source of meat in India. Its share in total meat consumption is 28 per cent, as against

14 per cent 10 years ago. High price of mutton/chevon, religious restrictions on beef and pork and the limited availability of fish outside coastal regions have helped to make poultry meat the most preferred and most consumed meat in India.

Feed cost alone accounts for 70 per cent of the cost of production of broilers and the cost of energy feeds alone contributes to about 70 per cent of the feed cost (Saleh *et al*., 2004). This suggests that in order to minimize feed cost one must use the cheapest form of energy or the energy source that produces the greatest growth rate per unit cost. Nowadays, due to the use of highly modern rendering technologies, the by-products of abattoirs such as animal fat, meat cum bone meal, blood meal and feather meal are available at competitive prices. Each of these is an excellent source of specific nutrients and in general, provides a cost effective source of energy and protein.

Addition of dietary fat in the ration provides poultry nutritionists with the unique opportunity of significantly altering the energy density of diets. Generally fat contains twice as much energy as most of the other types of feed ingredients, so subtle changes in fat levels of ration can have a profound effect on energy concentration. A number of different fat sources are available for poultry feeding from the rendering industry. The primary sources are poultry fat, tallow, lard and their blends. In several countries there is considerable use of vegetable fats such as sunflower oil, soybean oil or palm oil which are relatively expensive when compared to the rendered products.

The metabolisable energy content of animal fat ranges from 7500 to 8000 kcal/kg. Addition of fat to poultry rations provides a concentrated energy source that is capable of increasing growth rate, decreasing feed intake and increasing feed efficiency (Pesti *et al*., 2002). The addition of fat to diets besides supplying energy increases the palatability of the ration, efficiency of utilisation of consumed energy and absorption of fat soluble vitamins.

Use of higher levels of animal fat in the feed may increase the oxidative stress in broilers, which is most often characterized by elevated lipid peroxidation or reactive oxygen species in blood. This may result in reduced immune potential in birds leading to greater disease susceptibility and suboptimal production. Lipoic acid (LA) also known as thioctic acid (1,2-dithiolane-3-valeric acid) is a naturally occurring compound in microorganisms, plants and animals. It is described as universal antioxidant since it can combat oxidative stress by quenching a wide variety of reactive oxygen species. Dihydrolipoic acid (DHLA), the oxidized form of LA is involved in the recycling of other antioxidants in the body such as glutathione, vitamin C, coenzyme Q_{10} and vitamin E. Both LA and DHLA are able to chelate a wide variety of metals that are associated with increased production of free radicals. Additionally, LA functions as a cofactor in several mitochondrial multi enzyme complexes involved in energy production.

In view of the key role of α-lipoic acid as an antioxidant, it is hypothesized that their incorporation in broiler diets may contribute to a reduction in the degree of adiposity and oxidative stress in broiler chicken, particularly when they are fed on diets with added animal fat. Therefore, the present study was planned in broiler chicken to investigate the effects of supplemental α-lipoic acid in diets with added animal fat on growth and lipid profile.

2. Materials and Methods

An experiment was conducted in the Department of Animal Nutrition, College of Veterinary and Animal Sciences, Mannuthy for a period of 42 days to study the effect of supplementation of α-lipoic acid in high fat diet on growth and lipid profile in broiler chickens.

2.1 Experimental birds

Eighty, day-old straight-run commercial broiler chicks (Vencobb) procured from Coastal Krishna breeding farm and hatcheries, Kunathumkara P.O, Ollukkara, Thrissur, Kerala formed the experimental birds. The birds were allotted to two treatment groups (T_1 and T_2) with four replications of 10 chicks each.

2.2 Experimental rations

The birds were fed with standard broiler starter ration (23 per cent crude protein and 2800 kcal ME/kg of feed) up to four weeks of age and finisher ration (20 per cent crude protein and 2900 kcal ME/kg of feed) up to six weeks of age as per BIS (1992) specifications.

The two experimental rations formulated were:

T_1-Standard broiler chicken ration as per BIS (1992) specifications with five per cent animal fat (Control ration).

T_2- Control ration + 100 mg α-lipoic acid /kg diet

The ingredient composition of the two different broiler starter and finisher rations are presented in Tables 1.

2.3 Alpha lipoic acid

The laboratory grade α-lipoic acid added in ration T_2 is manufactured by Leo Chem Pvt., Ltd. Seshadripuram, Bangalore.

2.4 Experimental design

The chicks were randomly divided into 8 replicates of 10 chicks each and were allotted randomly to two dietary treatments such as T_1 and T_2 with four replicates in each treatment. All birds were maintained under identical management conditions. Feed and clean drinking water were provided *ad libitum* in all the pens throughout the experimental period.

2.5 Slaughter experiment

At the end of the experimental period of 42 days, four birds from each treatment were fasted overnight, slaughtered and dressed at Department of Poultry Science (Poultry products Technology unit), College of Veterinary and Animal Sciences, Mannuthy as per the procedure described in BIS (1973). Blood was collected for serum biochemical studies.

2.6 Serum biochemical studies

Serum was collected for the estimation of total cholesterol (Enzymatic calorimetric method), HDL cholesterol (PT. MG. Acetate method) and triglycerides (GPO-POD method) using the kits supplied by Agappe diagnostics, Agappe Hills, Ernakulam.

2.7 Statistical analysis

Data collected on various parameters were statistically analyzed by Completely Randomized Design (CRD) as described by Snedecor and Cochran (1994). Means were compared by Duncan's Multiple Range Test (DMRT).

Table 1. Ingredient composition of broiler starter and finisher ration, %

Ingredients	Broiler starter rations, %		Broiler finisher rations, %	
	T1	T2	T1	T2
Maize	40	40	48.5	48.5
Soybean meal	41.4	41.4	32.89	32.89
Wheat bran	9	9	9	9
Animal fat	5	5	5	5
Dicalcium phosphate	2	2	2.1	2.1
Calcite	1.79	1.79	1.8	1.8
DL-methionine	0.14	0.14	0.04	0.04
Choline chloride	0.1	0.1	0.1	0.1
Trace mineral mixture	0.01	0.01	0.01	0.01
B complex vitamins	0.01	0.01	0.01	0.01
Vitamin-AB_2D_3K	0.1	0.1	0.1	0.1
Toxin binder	0.1	0.1	0.1	0.1
Coccidiostat	0.05	0.05	0.05	0.05
Liver supplement	0.05	0.05	0.05	0.05
Salt	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
To 100kg of the above mixture following are added				
α-Lipoic acid (g)	-	10	-	10

Trace mineral mixture (Trim Forte-Padmaja Laboratories Pvt., Ltd, Chinnoutpalli), B complex vitamins (Meriplex-Vesper Pharmaceuticals Group Pvt., Ltd. Bangalore), Vitamin-AB_2D_3K (Mervite-Vesper Pharmaceuticals Group Pvt., Ltd. Bangalore).

3. Results and Discussion

3.1 Serum lipid profile

The serum lipid profile (mg/dl) of experimental birds belonging to the two dietary treatments (Table 2) T_1 and T_2 were 62.51 and 56.60 for triglycerides, 131.51 and 122.69 for total cholesterol, 46.56 and 62.63 for HDL cholesterol, 84.94 and 60.05 for LDL cholesterol, 12.50 and 11.32 for VLDL cholesterol, respectively and values were within the normal range for broiler chicken as reported by Kaneko *et al*. (2008).

Alpha lipoic acid supplementation did not affect the triglyceride level in the present research, which concur with the findings of Hamano *et al.* (2000). Hamano *et al.* (2000) reported that supplementation of 50 ppm lipoic acid in broiler diet, had no effect on blood triglyceride level, but total cholesterol level was reduced by 25 per cent compared to control group.

In contrast, Hamano *et al.* (1999) and Hamano, (2002) found that lipoic acid supplementation reduced the plasma triacylglycerol when compared to the non supplemented group in broiler birds. Similarly, Amom *et al.* (2008) reported that supplementation of lipoic acid (4.2 g/kg/day) to the basal diet (one per cent cholesterol rich diet), significantly reduced the total cholesterol and LDL-cholesterol in blood of rabbits compared to those fed with basal diet.

Table 2. Serum lipid profile of birds maintained on two dietary treatments, mg/dl

Parameters	Triglycerides †	Total cholesterol †	HDL cholesterol†	LDL cholesterol†	VLDL cholesterol †
Control (T_1)	62.51 ±1.86	131.51 ±3.25	46.56 ±2.56^a	84.94 ±3.77^a	12.50 ±0.37
Alpha lipoic acid (T_2)	56.60 ±3.64	122.69 ±4.53	62.63 ±3.50^b	60.05 ±6.05^b	11.32 ±0.73

a, b - Means bearing different superscripts within the same column differ significantly (P<0.01);

† Mean of four values with SE

4. Conclusion

Alpha lipoic acid supplementation had no effect on serum cholesterol, triglycerides and VLDL-cholesterol levels, but reduced the LDL-cholesterol level and increased the HDL-cholesterol level of broilers compared to control group.

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