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Effect of Linseed oil supplementation on Hematological Parameters and Economics of Feeding in Broiler Chicks

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ABSTRACT

To assess the effect of using linseed oil as a replacer of sunflower oil, on the performance and carcass quality in broiler chicken a study of six weeks duration was conducted. Three hundred commercial broiler chicks were randomly distributed in five treatment group's viz. T_1, T_2, T_3, T_4 and T_5, with six replicates of ten birds each. The study involves recording the observations viz. periodic growth, feed efficiency, energy and nitrogen retention, carcass characteristics, fatty acid profile of meat , blood & serum parameters and cost of rearing broilers under different dietary treatments. The control group (T_1) was offered basal diet as per BIS (2007) specifications having sunflower oil, while in treatments groups T_2, T_3, T_4 and T_5; 25, 50, 75 and 100% sunflower oil of control was replaced with linseed oil , respectively. The linseed oil inclusion had no effects on hematological parameter whereas the haemoglobin concentration increased significantly ($P<0.05$) in 100% linseed oil group. Serum triglycerides, cholesterol level were significantly lower at 100% replacement of sunflower oil and LDL level was significantly decreased in all group having linseed oil inclusion than the control group. Serum profile was also improved in terms of reducing total cholesterol, triglycerides and low density lipoproteins. Also the economics of feeding regime did not differ significantly, so we can conclude the cost of production was similar to that of feed containing linseed oil.

Key words: *Linseed oil, Broiler, LDL, Cholesterol, triglycerides, haemoglobin.*

INTRODUCTION

Poultry has a crucial place in India, as the eggs and chicken meat are important and rich sources of protein, vitamins and minerals. Poultry provides rich organic manure and is an important source of income and employment to millions of farmers and other persons engaged in allied activities in the poultry industry. Chicken is the most widely accepted meat in India. Flaxseed is unique among oilseeds because of its exceptionally high content of α-linolenic acid (18:3, n-3), contains 35 to 45% oil, of which 45 to 52% is α-linolenic acid[2].

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In monogastric species such as poultry, the fatty acid profile of the meat and fat is directly affected by the source of fat in diet. The quality and quantity of lipids and their fatty acid composition in meat are influenced by internal (age, gender, genotype and castration) and external (temperature, feeding) factors [13]. The exact content and ratio between α-linolenic acid (ALA) and linoleic acid (LA) in linseed depends on the flax variety and could range from 14% to more than 60% of ALA[23,24]. The main reason for incorporating linseed oil in mixtures for broiler chicken is the favourable effect of polyunsaturated fatty acid (PUFA) on animal and human health. The first effect of adding linseed oil is a high increase in α-linolenic acid content[23] and a possible increase in other n3 PUFA[24]. Consequently, the ratio between competing n3 and n6 lines is also changed in favour of n3 fatty acids, which are essential for normal growth and development[17]. It has been reported that feeding omega-3 enriched diets to poultry increases the omega-3 content of eggs and meat and thus enriched poultry products offer consumers an alternative to enhance their omega-3 daily intake[10]. So to improve the fatty acid profile of meat towards n-3 unsaturated fatty acid, to see the effect of omega-3 rich oil on health, blood parameter of boilers the present study was planned.

MATERIAL AND METHOD

Three hundred day-old broiler chicks were procured and randomly distributed into five treatment groups viz. T_1, T_2, T_3, T_4 and T_5 with six replicates of ten birds each. All the chicks were fed with starter ration up to 21 days and finisher ration from 22 to 42 days of age as per specifications[3]. The experimental diets (Table 1) were formulated to meet the nutrient recommendations[3]. The control group (T_1) was offered basal diet having sunflower oil. While chicks in treatment groups T_2, T_3, T_4 and T_5 were fed basal diet with linseed oil @ 25, 50, 75 and 100% by replacing sunflower oil, respectively.The chicks were kept hygienically on floor litter system in separate pens. The chicks were brooded at 35°C during the first week. The birds were vaccinated against prevailing diseases adopting a standard protocol. At the end of the experiment, one bird from each replicate was slaughtered ethically by mechanical stunning followed by exsanguinations and thigh and breast muscle sample were collected. The weekly record of the feed offered and residual amount was maintained for each replicate to calculate the feed consumption per bird. The birds were weighed individually at weekly intervals and the body weights were recorded to calculate body weight gain up to 6 weeks of age. Feed Conversion Ratio (FCR) for each replicate was calculated as follows: FCR=Total feed consumed (g)/Total body weight gain (g).A metabolism trial was conducted at the end of growth period. One bird from each replicate was randomly selected, preliminary period of three days was given for adaptation to the birds to new system of housing and management, followed by a collection period of three days. Haematological analysis was carried out using the blood collected from the experimental chickens at the end of the 6th week of the feeding trial. The birds were kept off feed and water for three hours and blood was collected from the jugular vein of the randomly selected bird per replication group using needle and syringe. Twelve millilitre of blood was collected from each chicken and transferred immediately into a set of sterile plastic bottles with and without anti-coagulant for haematological and serum biochemical tests, respectively. The erythrocytes values; {Haemoglobin (Hb), Red blood cells (RBC)}, White Blood Cells (WBC), Differential leucocyte count (DLC) (neutrophils, eosinophil, basophil, monocyte and lymphocytes) were carried out with the automated haematology cell counter MS4s (MeletSchloesingLaboratoires France). Fully automated Random Access Clinical Chemistry Analyzer (EM 200™Erba Mannheim – Germany) was employed for estimation of biochemical parameters using kits procured from Transasia Biomedical Limited India.

1. Total cholesterol was measured by CHOD-PAP method

2. Triglycerides was measured by GPO method
3. Direct HDL were estimated by phospotungstic acid method.
4. Direct LDL were estimated by PEG/PEGME method

Relative economics of feeding was calculated at the end of sixth week. The cost of production included the cost of chick and the cost of feed consumed. The cost of chick including the transportation cost was first calculated by using the following formula:

Chick cost= No. of chicks at the start of experiment/ No. of chicks at the end of experiment × cost of day old chick*****

*****cost of day old chick including transportation cost.

The cost of starter and finisher diets were calculated separately. Thereafter, the total cost of feed consumed was added to the chick cost per chick survived to get the cost of production per bird. The information about the price of major feed ingredients viz. maize, soybean meal, fish meal, ground nut cake, vegetable oil and mineral mixture was obtained from the Central Feed and Fodder Store, LalaLajpat Rai University of Veterinary and Animal Sciences, Hisar. The price of feed additives and supplements were considered as per the rate list supplied by respective manufacturers. The managemental and miscellaneous costs were not included in the calculation; however, it was same for all dietary treatments. Profit per bird was calculated by subtracting the production cost from the output of market rate of experimental birds (Rs. 80/kg live weight). The relative profit or loss was calculated by taking the difference in profit per bird between treatment groups and the control. Data was analysed statistically as described by Snedecor and Cochran[18]. Analysis of variance was used to study the differences among treatment means and they were compared by using Duncan's Multiple Range Test (DMRT) as modified by Kramer[9].

Table 1: Ingredient (%) and chemical composition (% DM basis) of basal diet

Feed ingredient	**Starter diet**	**Finisher diet**
Maize (kg)	53	57
Soybean meal (kg)	19	16
Ground nut cake (kg)	12	11
Rice police (kg)	3	4
Fish meal (kg)	7	5
Sunflower oil (kg)	4	5
Mineral mixture (kg)	2.0	2.0
*Feed additives (kg)	0.29	0.29
Chemical composition (% DM basis)		
Crude protein %	22.04	20.04
Crude fibre %	3.61	3.29
Ether extract %	8.90	8.91
Total ash %	5.66	5.84
**Metabolizable energy (Kcal/kg)	3056	3163

***Feed additives** include Vitamin Mixture-I-10 g, Vitamin, Amino acid and Ca mixture-II 20 g, Coccidiostat (Dinitro-0-Toluamide)-50 g, Choline chloride-50 g, Lysine-50 g, DL- methionine-80 g and Chlortetracycline -33.5g/100kg

****** Calculated values - BIS (2007)

RESULT AND DISCUSSION

The ingredients and chemical composition of basal ration has been presented in table 1. The data pertaining to feed intake in broiler chicken at 6 weeks of age under different dietar treatment are presented in table 2.The statistical analysis of data revealed that feed intake did not differed significantly between different dietary treatments during overall growth period. feed intake during 0-4 week of growth period feed intake in dietary treatment group T_5 with 100% linseed oil were significantly lower ($P<0.05$) than the control group. These results are similar to those reported that feeding flaxseed up to 6% of the total dietary matter had no effect on dry matter intake and on body weight[7, 11]. This may be partially explained by the fact that digestibility of unsaturated fats is higher than saturated fats. The data pertaining to body weight gain in broiler chicken at 6 weeks of age under different dietary treatment are presented in table 3.

Table 2: Cumulative feed intake (g/bird) during progressive week of growth period under different dietary treatments

Treatment	Period (Wks)		
	0-2 week	0 to 4 week	0 to 6 week
T_1	470.50±9.79	1641.67^{b}±37.33	3244.17±26.98
T_2	482.50±3.07	1556.67^{a}±11.15	3285.00±34.03
T_3	475.83±18.72	1535.50^{a}±15.90	3247.50±37.58
T_4	491.33±8.81	1598.67^{ab}±12.41	3315.33±24.70
T_5	490.83±14.92	1566.33^{a}±19.30	3293.67±33.51

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

Body weight of different linseed oil supplemented groups of broiler did not differed significantly with control. The results so obtained depicted that body weight gain of experimental broilers upto 2nd and 4th weeks of age was not affected by replacing sunflower oil with linseed oil in their ration. Similarly the body weight gain during whole period of experiment (0-6 weeks) of dietary treatment $T_{1,}$ $T_{2,}$ $T_{3,}$ T_4 and T_5 did not differed significantly. However birds fed with 4 per cent linseed oil had the lowest body weight gain when compared to control.

Table 3: Cumulative average weight gain (g/bird) in progressive age of weeks under different dietary treatments

Treatment	Period (Wks)		
	0 to 2 week	0 to 4 week	0 to 6 week
T_1	292.51^{ab}±1.96	882.70±1.91	1838.68±19.54
T_2	299.71^{ab}±3.79	899.15±11.07	1838.88±11.52
T_3	285.76^{a}±3.63	893.60±25.01	1844.65±11.62
T_4	296.41^{b}±3.29	897.88±9.51	1832.72±11.15
T_5	296.78^{b}±1.49	874.75±7.26	1827.45±8.49

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

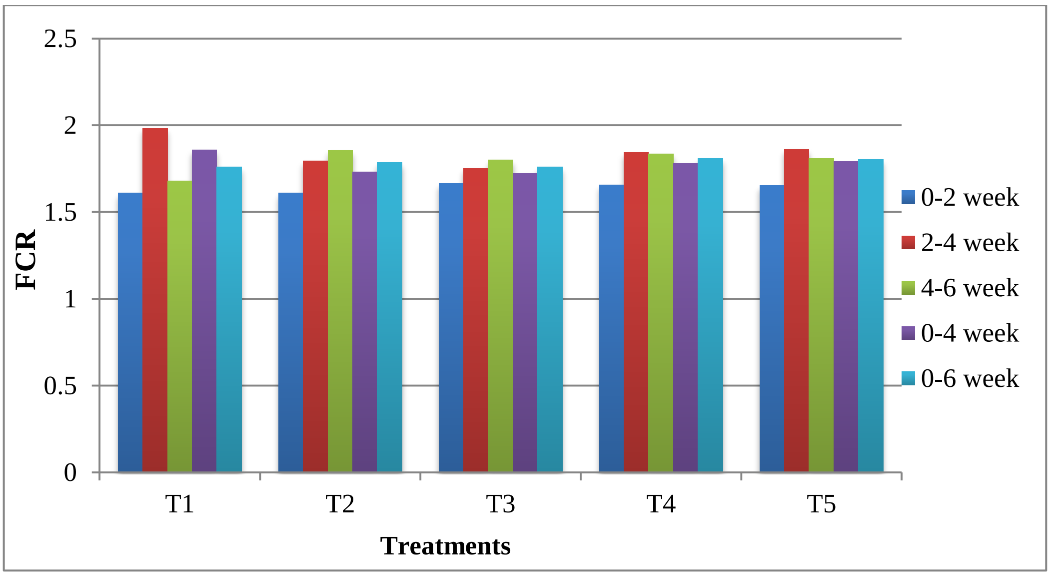

Fig. 1: Feed conversion ratio of broilers during different growth period under different dietary treatments

The result of the study depicted that FCR in broilers were not affected due to replacement of sunflower oil with different levels of linseed oil and up to 100% in the ration of broiler chicks. However, it fluctuated in different period of growth (Figure 1). RBC count, lymphocytes percentage, monocytes percentage, basophil percentage among all dietary treatments $T_{1,}$ $T_{2,}$ $T_{3,}$ $T_{4,}$ T_5 differed insignificantly (P<0.05) as compared to control group (Table 4.). Lymphocytes percentage of dietary treatment group T_2 (51.08%) and T_5 (55.04%) were statistically comparable to control group (52.08%). Neutrophil % of dietary treatment group T_3 (42.33%) and T_4 (43.50%) were significantly higher (P<0.05) than the control group (36.23%). WBC count (1000/mm^3) of treatment group T_2, T_3 and T_4 (15.5, 15.9 and 16.2, respectively) were significantly lower (P<0.05) than the control goup (19.7). it may be due to increase in the omega-3 fatty acids in the erythrocyte membranes particularly 18:3(*n*-3) and 20:5(*n*-3) with inclusion of flaxseed in the diet[4].

Similarly a significant differences (P<0.05) of blood picture including RBC counts, WBC counts, PCV between treatments and control group[1]. Within groups, significant (p < 0.05) increase in WBC counts were recorded in 10% flaxseed group as compared with 5% flaxseed group but on the other hand the RBC count and PCV count were also increased significantly.

The WBC count in treatment group T_4 and T_5 were significantly higher than the control group (Table 4). This may be attributed to the direct effect on the haemopoetic tissue or to the production of specific or non-specific antibodies against different antigens[8]. Also may be attributed to enhancement of cellular functions due to implementing these studied feed additives in broiler diets. Also a finding showed an increase in WBC counts in treated groups compared with the control group[1]. In present study there was no significant difference in the hemoglobin level of group 25%, 50% and 75% of sunflower oil replacement with linseed oil than the control group except at the 100% level.

There were non-significant difference among dietary treatment groups $T_{1,}$ $T_{2,}$ T3 and T4 in the haemoglobin level of broiler chicks except treatment group T_5 which had significantly higher haemoglobin level than $T_{1,}$ T_2 and T3 groups. Also researchers reported that there were non-significant differences (P<0.05) in hemoglobin percentage between treatments and control groups[1].

Table 4: Mean values of Hb, RBC, TLC & DLC contents in blood of broilers under different treatments

	Hb g/dl	RBC (Million/mm^3)	LYMPH %	MONO %	BASO%	EOSI %	NEUT %	WBC 1000/mm^3
T1	8.87^a±0.27	3.52±0.18	52.08^c±0.55	6.83±0.12	0.27±0.12	4.75^{ab}±0.20	36.23^a±0.68	15.5^a±1.28
T2	9.10^a±0.33	2.76±0.18	51.08^c±0.59	6.53±0.26	0.27±0.17	4.70^{ab}±0.33	37.42^a±0.76	15.9^a±0.21
T3	9.23^a±0.11	3.75±0.62	46.30^b±0.38	6.57±0.10	0.45±0.16	4.35^a±0.43	42.33^b±0.61	16.2^a±1.33
T4	9.75^{ab}±0.16	3.47±0.07	44.05^a±1.15	6.62±0.14	0.32±0.16	5.52^b±0.32	43.50^b±0.84	19.2^b±0.97
T5	10.33^b±0.4	3.12±0.32	50.45^c±0.46	6.60±0.21	0.28±0.12	4.78^{ab}±0.28	37.89^a±0.39	19.7^b±0.82

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

The triglycerides level (mg/dl) in blood serum of different dietary treatment with 25%, 50%, and 75% replacement of sunflower oil with linseed oil (T_2, T_3 and T_4, respectively) were statistically comparable to control group (Figure 2). Triglycerides level of T_5 at 100% replacement of sunflower oil with linseed oil was significantly (P<0.05) lower (P<0.05) than the control.

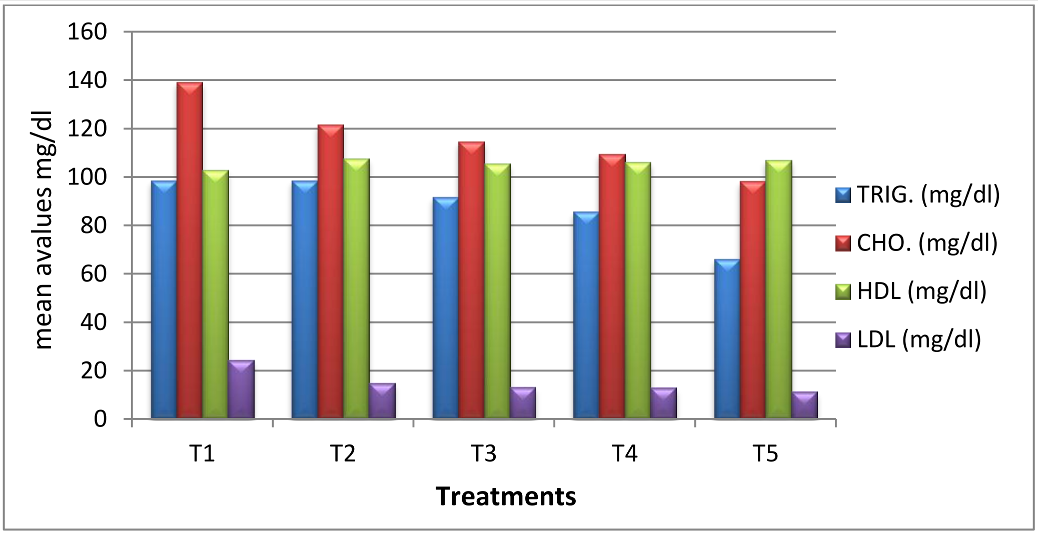

Fig. 2: Mean values of Serum triglycerides, Cholesterol (CHO), High density lipoproteins (HDL) and Low density lipoproteins (LDL) in broiler chickens under different dietary treatments.

Serum cholesterol level (mg/dl) of all dietary treatments up to 75% sunflower oil replacement with linseed oil decreased gradually from control group but differed non-significantly with each other (Figure 2.). The serum cholesterol of dietary treatment group T_5 at 100% replacement of sunflower oil with linseed oil decreased significantly ($P<0.05$) with the control group. As the linseed oil supplementation increased in different treatment from T_1 to T_5 serum cholesterol level decreased. Similar result were found that n6 and n3 fatty acids differ in their effect on serum lipid concentration, meaning that n6 fatty acids lower serum cholesterol level, but not triglycerides, while n3 fatty acids lower serum cholesterol and serum triglyceride levels even more[5]. Serum HDL level of all different dietary treatment differed non-significantly from each other. However, Serum LDL level (mg/dl) of dietary treatments containing 25%, 50%, 75% and 100% linseed replacement differed significantly ($P<0.05$) from the control group (sunflower oil group) (Figure 2). Similarly a study found that the introduction of 5% of linseed or sunflower oil did not affect triglycerides, LDL and HDL level while cholesterol level was significantly lower in bird fed with linseed oil ($P<0.05$)[19, 22]. Additionally, comparing PUFA-rich oils with saturated fatty acid-rich oils in broiler diets, observed a decrease in the triglyceride, CHO and HDL concentrations when the birds were given PUFA-rich oils compared to saturated fatty acid-rich oils[6, 14, 15, 20, 21]. According to a researcher diets rich in PUFAs (6n-PUFAs and 3n-PUFAs) may reduce triacylglycerol synthesis and fatty acids in the liver[15]. The reduction in the plasmatic triglyceride concentration in broilers given diets containing PUFA-rich oils compared to those given animal fat can be explained by the increase in the β- oxidation rate of unsaturated fatty acids, resulting in the removal of triglycerides from the blood to the tissues. A higher reduction in plasmatic triglycerides of broilers fed with a supplement rich in fish oil in comparison to other sources of 3n-PUFAs (flaxseed and flax oil)[16]. Additionally, they suggested that longer chain 3n-PUFAs such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) might be responsible for such reduction. Serum glucose, cholesterol and triglycerides concentrations were not affected ($p>0.05$) by dietary treatments[12]. Blood triglycerides and cholesterol levels were not affected by different FA composition of diets. It was found that there was no mortality of the experimental broilers in either of the dietary treatment groups except one in treatment group T_3 having 50% of linseed oil supplementation at 4^{th} week of growth period.The cost of production of broilers considering the cost of chick and feed at 6 week, reared under different treatments is presented in fig 3.

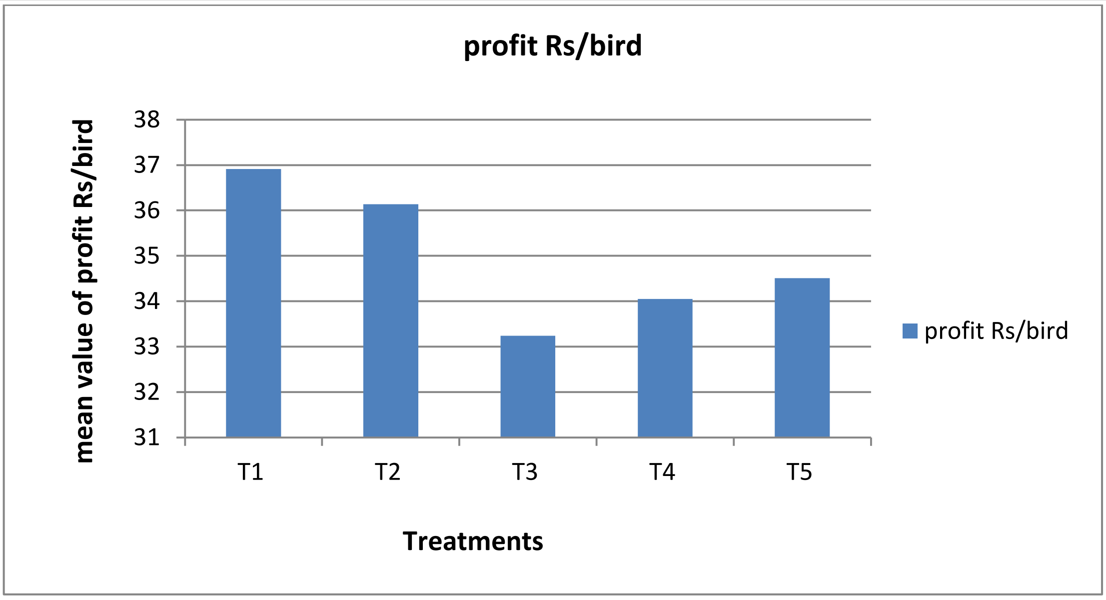

Fig. 3: Mean values of economics of broilers under different dietary treatments

The net profit in control group T_1 was highest (Rs. 36.91) as compared to groups T_2 (Rs.36.14), T_3 (Rs.33.24), T_4 (Rs.34.05) and T_5 (Rs.34.51).

CONCLUSION

Thus from current study it can be inferred that linseed oil feeding to broiler chicks improves the n6/n3 ratio of fatty acid in body system by improving blood parameters of birds, as well as there was no compromise with the cost of production using linseed oil in the ration of broiler chicks.

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