The Pharma Innovation Journal 2017; 6(11): 120-124

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating 2017: 5.03
TPI 2017; 6(11): 120-124

www.thepharmajournal.com
Received: 20-09-2017
Accepted: 21-10-2017

Jyoti Shunthwal
Department of Animal Nutrition, College of Veterinary Sciences, LLR University of Veterinary and Animal Sciences, Hisar, Haryana, India

Sajjan Sihag
Department of Animal Nutrition, College of Veterinary Sciences, LLR University of Veterinary and Animal Sciences, Hisar, Haryana, India

Promila
Department of Animal Nutrition, College of Veterinary Sciences, LLR University of Veterinary and Animal Sciences, Hisar, Haryana, India

Nancy Sheoran
Department of Animal Nutrition, College of Veterinary Sciences, LLR University of Veterinary and Animal Sciences, Hisar, Haryana, India

Correspondence
Jyoti Shunthwal
Department of Animal Nutrition, College of Veterinary Sciences, LLR University of Veterinary and Animal Sciences, Hisar, Haryana, India

Effect of feeding linseed oil on growth performance and nutrients utilization efficiency in broiler chicks

Jyoti Shunthwal, Sajjan Sihag, Promila and Nancy Sheoran

Abstract
A total of 300 day-old commercial broiler chicks were procured and randomly distributed into five treatments, each treatment had four replicates with ten chicks in each replicate. Growth trial of 6 weeks was conducted in a complete randomized design comprising five dietary treatment groups. The control group (T_1) was offered maize- soybean meal based diet with sunflower oil. While, T_2, T_3, T_4 and T_5 were fed with linseed oil replacing sunflower oil of control group @ 25, 50, 75 and 100%, respectively. The body weight gain (g) and feed intake in different treatment groups during overall period of growth did not differed significantly ($P<0.05$) than the control group T_1. Feed conversion ratio during overall periods was not affected due to replacement of sunflower oil with linseed oil up to 100%. The results showed that the mean value of Energy efficiency ratio and Protein efficiency ratio of different dietary treatments having linseed oil did not differ significantly upto 100% replacement with linseed oil with the control group. Protein efficiency ratio, Dry matter metabolizability percent and nitrogen retention values did not vary due to replacing of sunflower oil with linseed oil at various levels. Also gross energy metabolizability did not differed significantly in all dietary treatments upto 100% replacement with linseed oil.

Keywords: linseed oil, broiler, giblet, thigh, protein efficiency ratio, energy efficiency ratio, nitrogen retention, dry matter metabolizability etc

Introduction
Chicken meat is popular all over in the world. Due to its large parts of white meat containing low level of saturated fat and high level of long chain polyunsaturated fatty acid (PUFAs), the meat is regarded as healthy meat [9]. Amount of fatty acid in the chicken meat depend on the feed provided to the chicken. Several studies suggest that in both birds and mammals, polyunsaturated fatty acids (PUFA) inhibit lipid synthesis [25, 5, 18, 20]. 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 [4, 8]. 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. 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 [12].
There is increasing recognition of the health benefits of PUFA in general, and of n3 fatty acids in particular, because these fatty acids are essential for humans [8, 12, 23]. Today we know that n3 fatty acids are important in the prevention and treatment of coronary disease, hypertension, diabetes and arthritis [22, 23, 24]. Several trials have shown that an increase in the content of long chain n3 PUFA in chicken broiler meat may be achieved by including linseed oil as a source of precursor, α-linolenic acid [27]. So the present study was planned to study the effect of linseed oil on growth performance and carcass yield and feed efficiency in broiler chicks.

Materials and Methods
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 BIS (2007) specifications [3]. The chicks of control group (T_1) were offered maize – soybean based 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. 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. A representative sample of excreta from each replication was collected daily in same plastic bottles and bottles were again kept in deep freeze to determine moisture and nitrogen contents. Feed offered and weigh back records were maintained on daily basis during the trial period. The availability of nutrients for each replicate was calculated by dividing the amount of retained nutrients (ingested nutrients – excreted nutrients) with the amount of ingested nutrients.

$$\text{Nitrogen retention (\%)} = \frac{\text{Nitrogen intake (g)} - \text{Nitrogen excreted (g)}}{\text{Nitrogen intake (g)}} \times 100$$

Similarly, dry matter retention was also calculated. Protein efficiency ratio was calculated as: Body weight gain (g)/ Total protein intake (g) × 100. Energy efficiency ratio was calculated as:Body weight gain/ Total ME intake (Kcal/kg) × 100. The gross energy of oven dried feed, weigh back and excreta samples were determined by standard procedure using Bomb Calorimeter. The gross heat of combustion in calories per gram of the material was computed by substituting values in the following equation: Gross heat of combustion (cal/g)= $t\times w - (C_1+C_2+C_3)/M$, Where, t (Rise in temperature),w (Water equivalent), M (Weight of sample),C_1(Correction in calories for heat of formation of acid), C_2 (Correction in calories for heat of combustion of fuse wire), C_3 (Correction in calories for heat of combustion of thread, 27.73 cal/20 cm.). From gross energy values of feed weigh back and excreta, the metabolizable energy (ME) was worked out by using the equation given by Hill and Anderson (1958) ME = $E_{diet} - E_{excreta} - N\times 8.22$. Gross energy metabolizability (%) was calculated as follows: Nitrogen corrected metabolizable energy (Kcal/kg)/ Gross energy of dry feed (Kcal/kg)×100. The data were analyzed using general linear model procedure of statistical package for social sciences 20th version (SPSS) and comparison of means tested using Duncan's multiple range test and significance was considered at P<0.05.

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)

Results 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 which also reported that feeding flaxseed up to 6% of the total dietary matter had no effect on dry matter intake and on body weight [10]. This may be partially explained by the fact that digestibility of unsaturated fats is higher than saturated fats. Other reports [16] also revealed that the inclusion of n-3 PUFA rich oil sources in Japanese quail diet had no significant influence on cumulative feed consumption. However some researchers [19] did not find any difference on weight gain, feed consumption or feed efficiency by dietary incorporation of linseed oil (1.5–4.5%) in the diet of broilers. Also [14] observe any effect on feed intake and feed consumption due to dietary incorporation of LO at 2 and 4% levels in the diet.

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

			Periods		
Treatments	**0-2 week**	**0 to 4 week**	**0 to 6 week**	**2-4 weeks**	**5-6 week**
T_1	470.50±9.79	1641.67^b±37.33	3244.17±26.98	1171.17^b±28.36	1602.5^a±28.05
T_2	482.50±3.07	1556.67^a±11.15	3285.00±34.03	1074.17^a±11.72	1728.33^b±30.26
T_3	475.83±18.72	1535.50^a±15.90	3247.50±37.58	1059.67^a±11.60	1712.00^b±46.54
T_4	491.33±8.81	1598.67^{ab}±12.41	3315.33±24.70	1107.33^a±10.20	1716.66^b±29.85
T_5	490.83±14.92	1566.33^a±19.30	3293.67±33.51	1075.50^a±11.14	1727.33^b±42.33

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 were 1838.68, 1838.88, 1844.65, 1832.72 and 1827.45g, respectively, which did not differed significantly. These results are in agreement with those reported by [7, 2, 21] who reported non-significant influence on body weight of broilers. However birds fed with 4 per cent linseed oil had the lowest body weight gain when compared to control. Similar findings were reported for chicken fed diets supplemented with fish oil and rapeseed oil [13, 17, 10, 15]. Similar results were also reported by [11] that full-fat flaxseeds did not result in any significant differences in body weight.

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**	**3-4 weeks**	**5-6 weeks**
T_1	292.51^{ab}±1.96	882.70±1.91	1838.68±19.54	590.18±1.26	955.98±19.80
T_2	299.71^{ab}±3.79	899.15±11.07	1838.88±11.52	599.43±11.04	932.61±8.22
T_3	285.76^a±3.63	893.60±25.01	1844.65±11.62	607.83±22.98	951.05±14.31
T_4	296.41^b±3.29	897.88±9.51	1844.65±11.62	601.46±9.62	934.76±3.14
T_5	296.78^b±1.49	874.75±7.26	1827.45±8.49	577.96±6.54	955.28±5.62

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

Feed conversion ratio of the dietary treatments T_2, T_3, T_4, T_5 having 25%, 50%, 75% and 100% replacement of sunflower oil with linseed oil differed non-significantly (P<0.05) from the control T1 (100% sunflower oil) during overall growth period. This may be attributed to the isocaloric dietary treatments as well as nutritionally balanced diet given to the birds. FCR of T_2, T_3, T_4, T_5 was significantly better (P<0.05) compared to control group during the 2-4 weeks of growth, which may be due to better feed efficiency of linseed oil and better digestibility because of the presence of high levels of PUFA. Result reported [1] also found that feed conversion ratio were improved significantly (p≤0.05) in flaxseed group as compared with control group.

Table 4: Cumulative feed conversion ratio during progressive week of growth period under different dietary treatments.

Treatment	Period (Wks)				
	0-2 weeks	**0 to 4 week**	**0 to 6 week**	**3-4 weeks**	**5-6 weeks**
T_1	1.61±0.06	1.86^b±0.04	1.76±0.04	1.98^b±0.04	1.67^a±0.04
T_2	1.61±0.01	1.73^a±0.03	1.79±0.03	1.79^a±0.04	1.85^b±0.04
T_3	1.66±0.02	1.72^a±0.05	1.76±0.04	1.75^a±0.05	1.80^{ab}±0.05
T_4	1.65±0.02	1.78^{ab}±0.02	1.81±0.02	1.84^a±0.03	1.83^b±0.03
T_5	1.65±0.03	1.79^{ab}±0.03	1.80±0.03	1.86^{ab}±0.03	1.80^{ab}±0.04

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

The statistical analysis of data revealed that dry matter metabolizability percent values did not vary due to replacing of sunflower oil with linseed oil at various levels. Nitrogen retention (%) of different dietary treatments T_2, T_3, T_4 and T_5 (61.93, 63.40, 32.49 and 63.5) did not vary significantly from the control group (62.08%). The mean value of protein efficiency ratio of different dietary treatments T_2, T_3, T_4 and T_5 (2.80, 2.84, 2.76 and 2.78) did not vary significantly from the control group (2.84). It shows that birds utilized dry matter efficiently at all linseed oil level. In contrary to this result some found that there was lower ME values for birds fed diets containing full-fat flaxseed with no affect on protein retention [6].

Table 5: Dry matter metabolizability, nitrogen retention, PER and EER in the experimental broilers under different dietary treatments

Treatment	**DM Metabolizability (%)**	**N retention (%)**	**PER**	**EER**
T_1	65.03±0.51	62.08^{ab}±0.64	2.84±0.03	17.96±0.21
T_2	66.66±0.65	61.93^a±0.34	2.80±0.04	17.69±0.18
T_3	65.07±1.20	63.40^{ab}±0.50	2.84±0.02	17.96±0.17
T_4	65.40±0.54	62.49^{ab}±0.26	2.76±0.02	17.48±0.16
T_5	64.34±0.53	63.50^b±0.49	2.78±0.03	17.54±0.22

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

Gross energy metabolizability percent values of rations in broilers of the dietary treatment group T_2, T_3, T_4 and T_5 (58.25, 58.28, 58.26 and 58.29%, respectively) did not differ significantly from the control group (58.32%). Similar findings were observed that the content of oils in the feed mixtures did not influence the intake of energy and consumption of energy per unit of weight gain [26]. But gross energy metabolizability of dietary group containing 25% of sunflower oil replacement with linseed was significantly higher than the 50% replacement. The gross energy metabolizability of 100% linseed oil group was non-significantly higher than the control group.

Table 6: Metabolizable energy (kcal/kg) and percent gross energy metabolizability in experimental birds under different dietary treatments

Treatments	Gross energy of feed (kcal/kg)	Gross energy of excreta (kcal/kg)	Nitrogen corrected metabolizable energy (kcal/kg)	Gross energy metabolizability (%)
T_1	5165.93±21.53	1976.91±1.02	3013.04±21.13	58.32±0.17
T_2	5148.80±20.29	1976.01±1.41	2969.35±29.70	58.25±0.24
T_3	5159.30±19.16	1976.80±2.20	3047.32±18.32	58.28±0.14
T_4	5147.12±20.37	1973.79±1.60	2998.91±27.84	58.26±0.23
T_5	5152.04±18.27	1974.63±1.67	3003.18±19.09	58.29±0.16

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

References

1. Al-zuhairy MA, Alasadi YJ. Effect of *in ovo* injection with Newcastle Disease Vaccine, Multivitamins AD3E, and Omega-3 on performance and immune response of broilers. International Journal of advanced Biological Research. 2013; 3(2):208-211.
2. An BK, Tanaka K, Ohtani S. Effects of various n-3/n-6 fatty acid ratios in diet on lipid metabolism in growing chicks. Animal Science and Technology. 1995; 66:918-2365.
3. BIS. Requirement for chicken feeds. IS: 1374-2007, New Delhi.
4. Bhatty RS. Nutrient composition of whole flaxseed and flaxseed meal. Flaxseed in Human Nutrition 1995; 22-42.
5. Blake WL, Clarke SD. Suppression of rat hepatic fatty acid synthase and S14 gene transcription by dietary polyunsaturated fat. The Journal of nutrition. 1990; 120(12):1727-1729.
6. Bond JM, Julian RJ, Squires EJ. Effect of dietary flaxseed on broiler growth, erythrocyte deformability and fatty acid composition of erythrocyte membranes. Canadian Journal of Animal Science 1996; 77(2):279-286.
7. Chanmugam P, Boudreau M, Boutte T, Park, RS, Hebert J, Berrio L *et al*. Incorporation of different types of n-3 fatty acids into tissue lipids of poultry. Poultry Science 1992; 71(3):516-521.
8. Conquer JA, Holub BJ. Effect of supplementation with different doses of DHA on the levels of circulating DHA as non-esterified fatty acid in subjects of Asian Indian background. Journal of Lipid Research. 1998; 39(2):286-292.
9. Haug A, Eich-Greatorex S, Bernhoft A, Wold JP, Hetland, H, Christophersen, OA *et al*. Effect of dietary selenium and omega-3 fatty acids on muscle composition and quality in broilers. Lipids in Health and Disease 2007; 6(1):1.
10. Hernandez FIL. Performance and Fatty Acid Composition of Adipose Tissue, Breast and Thigh in Broilers Fed Flaxseed: A Review. Current Research in Nutrition and Food Science Journal. 2013; 1(2):103-114.
11. Kavouridou K, Barroeta AC, Villaverde C, Manzanilla EG, Baucells MD. Fatty acid, protein and energy gain of broilers fed different dietary vegetable oils. Spanish Journal of Agricultural Research. 2008; 6(2):210-218.
12. Lee KH, Olomu JM, Sim JS. Live performance, carcass yield, protein and energy retention of broiler chickens fed canola and flax full-fat seeds and the restored mixtures of meal and oil. Canadian Journal of Animal Sciences. 1991; 71(3):897-903.
13. Leskanich CO, Noble RC. Manipulation of the n-3 polysaturated fatty acid composition of avian eggs and meat. World's Poultry Science. 1997; 15:183-189.
14. Lopez-Ferrer S, Baucells MD, Barroeta AC, Grashorn MA. Influence of vegetable oil sources on quality parameters of broiler meat. Archiv Fuer Gefluegel Kunde (Germany). 1999; 63:3-9098
15. Lopez-Ferrer S, Baucells MD, Barroeta AC, Grashorn MA. n-3 enrichment of chicken meat. 1. Use of very long-chain fatty acids in chicken diets and their influence on meat quality: fish oil. Poultry Science. 2001; 80(6):741-752.
16. Marco DJM, Acda SP, Roxas DB, Merca FE. Effect of omega-3 fatty acid enriched feed supplement on broiler performance and carcass quality. Philippine Journal of Veterinary and Animal Sciences. 2013; 39(1):53-62.
17. Manohar GR, Edwin SC. Effect of dietary omega-3 PUFA rich sources on growth performance of japanies quail. International Journal of Science, Environment and Technology. 2015; 4(2):393-399.
18. Nguyen CV, Smulikowska S, Mieczkowska A. Effect of linseed and rapeseed or linseed and rapeseed oil on performance, slaughter yield and fatty acid deposition in edible parts of the carcass in broiler chickens. Journal of Animal and Feed Sciences. 2003; 12(2):271-288.
19. Ntambi JM. Dietary regulation of stearoyl-CoA desaturase 1 gene expression in mouse liver. Journal of Biological Chemistry 1992; 267(15):10925-10930.
20. Olomu JM, Baracos VE. Influence of dietary flaxseed oil on the performance, muscle protein deposition, and fatty acid composition of broiler chicks. Poultry science 1991; 70(6):1403-1411.
21. Sanz M, Lopez-Bote CJ, Menoyo D, Bautista JM. Abdominal fat deposition and fatty acid synthesis are lower and β-oxidation is higher in broiler chickens fed diets containing unsaturated rather than saturated fat. The Journal of Nutrition. 2000; 130(12):3034-3037.
22. Saricicek BZ, Ocak N, Garipoglu AV. A study on utilizing fish oil in broiler diets. Ziraat Fakultesi Dergisi 1997; 12(1):33-42.
23. Simopoulos AP. Omega-3 fatty acids in health and disease and in growth and development. The American

journal of clinical nutrition. 1991; 54(3):438-463.
24. Simopoulos AP. N− 3 fatty acids and human health: Defining strategies for public policy. Lipids. 2001; 36(1):83-89.
25. Simopoulos AP. Evolutionary Aspects of the Dietary Omega–6: Omega–3 Fatty Acid Ratio: Medical Implications. In A Balanced Omega-6/Omega-3 Fatty Acid Ratio, Cholesterol and Coronary Heart Disease. 2009; 100:1-21.
26. Wilson MD, Blake WL, Salati LM, Clarke SD. Potency of polyunsaturated and saturated fats as short-term inhibitors of hepatic lipogenesis in rats. The Journal of nutrition. 1990; 120(6):544-552.
27. Zelenka J, Schneiderová, D, Mrkvicová E. Linseed oils with different fatty acid patterns in the diet of broiler chickens. Czech Journal of Animal Science. 2006; 51(3):117.
28. Zelenka J, Schneiderova D, Mrkvicova E, Dolezal P. The effect of dietary linseed oils with different fatty acid pattern on the content of fatty acids in chicken meat. Veterinarni medicina-praha. 2008; 53(2):77.