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Production Performance and Carcass Traits of Broilers Fed with Sunflower Acid Oil*

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Abstract: The influence of sunflower acid oil (SFAO) usage on production performance, carcass traits and economics of broilers were studied. SFAO was analyzed for its ME value by conducting metabolic trial and result revealed that the AME and TME value of SFAO were 4.398 and 4.453 kcal/g, respectively. The feeding trial was conducted by using two hundred commercial, straight run day-old broiler chicks. These chicks were randomly grouped into five treatments with four replicates of ten chicks each and fed basal diet (T_1), basal diet with 1 (T_2), 2 (T_3), 3 (T_4) and 4 (T_5) percent of SFAO for a period of six weeks. The results revealed that there was no significant difference in body weight gain, cumulative feed consumption, cumulative feed conversion ratio and livability between treatment groups from first week till the end of the experiment. The carcass yield, abdominal fat pad weight and thickness also did not differ significantly between treatments. Inclusion of SFAO at 1, 2 and 3 percent in broiler diet increased the net profit per kg live weight by 2.8, 1.8 and 3.7 percent, respectively as compared to control group. It was concluded that 3 percent SFAO can be safely included in broiler diet without affecting production performance with increase in net profit per kg live weight.

Key words: Sunflower acid oil, broilers, production performance, carcass traits

Introduction

Energy sources contribute a major portion in feed formulation and there has been high demand for energy source throughout the year. The production cost of broiler varies with the demand and availability of high energy feed ingredients, which inturn affects the profit margin to the poultry producers.

Fats and oils can be used as high energy source ingredients in broiler feed. However use of refined oils in feed formulation as energy source increases the cost of feed. The edible oil refinery by-product, the soapstock accounts 3-4 percent of crude oil. This soapstock from sunflower seed is treated with sulphuric acid, washed several times in distilled water and then a substance called acidulated sunflower soapstock (acid oil) is obtained in an amount of 0.5 percent (Balevi *et al*., 2001). These acid oils are not fit for human consumption and mostly used for soap production.

Acid oil usually had high proportion of free fatty acids (Wiseman and Salvador, 1991) and good level of polyunsaturated fatty acids (Balevi *et al*., 2001). The acid oil may be utilized as alternative to conventional oil energy source (Inal *et al*., 1994) without affecting broiler performance (Bilal *et al*., 2001). The acid oils were also used to produce healthy lean meat since it had high level of omega-3 fatty acids (Balevi *et al*., 2001), which are known to be very important for human health. The market price of acid oil is also lower. Hence, the present study was undertaken to evaluate the inclusion of sunflower acid oil (SFOA) in the broiler ration effectively as energy source for economical broiler production.

Materials and Methods

Metabolic trial: SFOA was purchased from local edible oil refinery factory and assessed for its metabolizable energy (ME) content using roosters as per the method of Sibbald (1977). Twelve roosters were randomly divided into two groups of six each and housed in individual cages. The roosters were starved for 24 h. One group was force fed with 30 g of the basal diet. The other group was kept as control to calculate the endogenous loss. The excreta for 24 h period were collected individually in both groups homogenized, weighed and dried in an oven at 80ºC for 24 h for calculation of dry matter. The experiment was repeated after adding 6 percent SFAO to the basal diet.

The energy value of the basal diet and oil as well as the excreta was assayed in an adiabatic bomb calorimeter by adopting the standard procedure and the values were used to arrive at the apparent metabolizable energy

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Table 1: Percent ingredient and nutrient composition of broiler starter and finisher diet

Name of the ingredient	Starter diet					Finisher diet				
	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
Corn	51.00	49.00	47.00	45.00	43.00	64.50	62.70	60.50	58.30	56.40
Sunflower acid oil	-	1.00	2.00	3.00	4.00	-	1.00	2.00	3.00	4.00
Soybean meal (SE)	21.00	21.00	21.00	21.00	21.50	17.50	17.50	17.80	18.00	18.00
De-oiled Groundnut cake (DOGN)	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Fish meal – 45% CP	10.00	10.00	10.00	10.00	10.00	5.00	5.00	5.00	5.00	5.00
Deoiled rice bran (DORB)	6.00	7.00	8.00	9.00	9.50	0.00	1.00	2.00	3.00	4.00
Di-calcium phosphate (DCP)	-	-	-	-	-	1.50	1.20	1.10	1.10	1.00
Calcite	2.00	2.00	2.00	2.00	2.00	1.50	1.60	1.60	1.60	1.60
Vitamin AB_2D_3K mix (Hyblend) [1]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vitamin B-complex (Meriplex) [2]	0.02	0.02	0.02	0.02	0.02	0.05	0.05	0.05	0.05	0.05
Choline chloride 60%	-	-	-	-	-	0.04	0.04	0.04	0.04	0.04
Trace mineral mixture (Ultra-TM) [3]	0.10	0.10	0.10	0.10	0.10	0.14	0.14	0.13	0.13	0.12
Salt	0.27	0.27	0.27	0.27	0.27	0.37	0.37	0.37	0.36	0.36
Lysine	0.13	0.13	0.12	0.12	0.11	0.13	0.13	0.13	0.12	0.12
Methionine	0.23	0.23	0.23	0.23	0.23	0.11	0.11	0.11	0.11	0.12
Anti-oxidant (Endox Dry)[4]	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Toxin binder (CURATOX)[5]	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Nutrients										
Dry matter	89.40	89.40	89.80	89.00	89.60	90.00	90.20	89.00	89.60	89.00
Crude protein	23.12	23.14	23.00	23.19	23.14	20.00	20.16	20.00	19.96	19.72
Crude fibre	4.65	4.73	4.81	4.89	4.95	3.88	3.96	4.04	4.12	4.20
Ether extract	3.40	4.30	5.46	6.16	7.19	2.96	4.04	4.84	5.84	6.67
Calcium	1.19	1.20	1.18	1.21	1.22	1.2	1.21	1.20	1.18	1.23
Available phosphorus	0.50	0.50	0.50	0.51	0.51	0.48	0.50	0.49	0.52	0.50
Lysine*	1.20	1.20	1.20	1.20	1.20	1.00	1.00	1.00	1.00	1.00
Methionine*	0.58	0.58	0.58	0.58	0.58	0.41	0.41	0.41	0.41	0.41
Metabolizable energy (kcal/kg)*	2800	2800	2800	2800	2800	2900	2900	2900	2900	2900

Calculated values: [1]One gram of vitamin AB_2D_3K supplement contained 82500 IU of vitamin-A, 50 mg of vitamin-B_2, 12000 IU of vitamin-D_3 and 10 mg of vitamin-K. [2] One gram of B-complex supplement contained 8 mg of vitamin-B_1, 16 mg of vitamin-B_6, 80 mcg of vitamin B_{12}, 80 mg of vitamin-E, 120 mg of niacin, 8 mg of folic acid, 80 mg of calcium pantothenate and 86 mg of calcium. [3]One gram of trace minerals contained 54 mg of manganese, 52 mg of zinc, 20 mg of iron, 2 mg of iodine and 1 mg of cobalt. [4]Ethoxyquin, BHT and chelating agents. [5]Hydrated sodium calcium alumino silicate (HSCAS), organic acids, vinylpyrrolidone homopolymer, mannanoligosaccharide (MOS), activated charcoal and lipotrophic factors.

(AME) and true metabolizable energy (TME) of the sample using following formulae:

AME (kcal/g) = [(Gef.X) -Yef / X]
TME (kcal/g) = [(Gef.X) – (Yef –Yec) / X]

Where,
Gef: the Gross energy of the test material. (kcal/g)
Yef: the energy voided as excreta by the test material fed bird.
Yec: the energy voided as excreta by the unfed bird.
X: the weight (g) of the test material fed.
The AME and TME of sunflower acid oil were calculated by subtracting the energy value of basal diet from energy value of basal diet with sunflower acid oil.

Feeding trial: Two hundred straight run day-old, commercial broiler chicks belonging to single hatch were purchased from local poultry hatchery. The chicks were wing banded, weighed and randomly grouped into five treatments with four replicates of ten chicks each. The experimental diet was formulated according to the standards prescribed in Bureau of Indian Standards (B.I.S., 1992) and fed basal diet (T_1), basal diet with 1 (T_2), 2 (T_3), 3 (T_4) and 4 (T_5) percent of SFOA for a period of six weeks. The levels of various ingredients were adjusted to have isocaloric and isonitrogenous diet. The ingredients and nutrient composition of the experimental broiler starter and finisher ration is presented in Table 1. The chicks were reared in broiler cages in a gable roofed, open sided house. All the chicks were provided with uniform floor, feeder and waterer space and were reared under standard managemental conditions throughout the experimental period of six weeks. Data on body weight and feed consumption were recorded every week and mortality was recorded at occurrence. From the above data body weight gain, feed conversion ratio and livability were calculated. At the end of the experiment, three males and three females totally six birds per each treatment group were randomly picked up and slaughtered. The pre-slaughter weight, eviscerated carcass weight, giblets weight, ready-to-cook carcass percentage, abdominal fat pad weight and thickness were recorded.
Relative economics of rearing broiler fed with diets containing graded levels of SFAO was worked out. The

Table 2: Mean body weight gain (g), cumulative feed consumption (g/bird) and cumulative feed conversion ratio (± S.E.) of broilers from 1 to 6 weeks of age as influenced by dietary inclusion of sunflower acid oil

	T1	T2	T3	T4	T5
Body weight gain (g)I week	95.29±2.45	96.52±1.18	98.47±3.91	100.34±0.59	98.00±3.78
II Week	285.09±11.46	274.12±8.51	279.54±7.14	296.30±3.68	288.95±7.83
III week	610.62±24.73	605.00±9.05	632.37±19.21	624.98±13.23	611.42±17.50
IV Week	1118.79±33.93	1102.23±13.88	1135.29±33.08	1111.02±27.47	1112.60±31.61
V week	1458.40±41.78	1427.73±20.80	1458.29±36.60	1452.27±34.34	1452.40±44.90
VI Week	1860.79±34.28	1855.53±5.48	1854.98±46.99	1880.27±33.25	1872.27±48.45
Cumulative feed consumption (g/bird)					
I week	108.70±2.21	107.28±1.48	106.38±2.89	107.29±1.10	107.34±2.68
II Week	385.65±10.48	387.81±4.76	388.19±5.79	388.98±3.88	387.64±4.03
III week	910.71±26.81	912.30±6.30	939.55±7.35	926.11±8.22	926.56±18.35
IV Week	1748.71±34.61	1716.63±11.31	1763.04±14.37	1749.05±21.10	1765.05±45.25
V week	2728.42±39.54	2657.14±14.21	2701.85±20.44	2702.92±33.26	2735.00±73.07
VI Week	3776.93±38.84	3710.50±23.14	3717.99±27.44	3749.07±41.62	3799.46±93.87
Cumulative feed conversion ratio					
I week	1.14±0.03	1.11±0.01	1.08±0.03	1.07±0.01	1.10±0.02
II Week	1.35±0.03	1.41±0.03	1.39±0.03	1.31±0.02	1.34±0.02
III week	1.49±0.02	1.51±0.02	1.49±0.04	1.48±0.02	1.52±0.02
IV Week	1.56±0.02	1.56±0.01	1.55±0.05	1.57±0.03	1.58±0.03
V week	1.87±0.03	1.86±0.03	1.85±0.06	1.86±0.03	1.88±0.04
VI Week	2.03±0.03	2.00±0.02	2.00±0.05	1.99±0.02	2.03±0.05

data collected on various parameters were subjected to completely randomized design as per the methods suggested by Snedecor and Cochran (1989). Angular transformation was applied to percentages wherever needed before carrying out statistical analysis.

Results

Metabolizable energy: The metabolic trial result revealed that the AME and TME value of SFAO were 4.398 ± 0.212 and 4.453 ± 0.355 kcal/g, respectively.

Production parameters: The mean body weight gain, cumulative feed consumption and feed conversion ratio of broilers from 1 to 6 weeks of age as influenced by dietary inclusion of sunflower acid oil is presented in Table 2.

Statistical analysis revealed no significant difference in body weight gain of broilers due to dietary SFAO. The body weight gain at sixth week of age was 1880.27, 1872.27, 1860.79, 1855.53 and 1854.98 g in T_4, T_5, T_1, T_2 and T_3, respectively.

Analysis of data on cumulative feed consumption revealed no significant difference between treatment groups from first week to sixth week of age. The cumulative feed consumption was 3799.46, 3776.93, 3749.07, 3717.99 and 3710.50 g in T_5, T_1, T_4, T_3 and T_2, respectively at sixth week of age. Statistical analysis of data on feed conversion ratio revealed no significant difference due to dietary inclusion of SFAO and the mean feed conversion ratio of T_4, T_2, T_3, T_1 and T_5 were 1.99, 2.00, 2.00, 2.03 and 2.03, respectively at sixth week of age

Livability was 100 percent in all treatment groups except in 4 percent SFAO inclusion, where the livability was 97.50 percent from 4 to 6 weeks of age. Statistical analysis of data on livability revealed no significant difference due to dietary inclusion of SFAO.

Carcass characteristics: The mean carcass yield, abdominal fat pad weight, abdominal fat-pad thickness and net profit per kg live weight of broilers at 6 weeks of age as influenced by dietary inclusion of sunflower acid oil is presented in Table 3.

The carcass characteristics viz. pre-slaughter weight, New York dressed weight, eviscerated weight, ready-to-cook percentage and giblets weight of broilers at six weeks of age did not differ significantly between the treatment groups. Analysis of data on abdominal fat-pad weight and thickness of broilers did not differ significantly between the treatment groups.

Cost effectiveness: Inclusion of SFAO at 1, 2 and 3 percent in broiler diet increased the net profit per kg live weight by 2.8, 1.8 and 3.7 percent, respectively as compared to control group.

Discussion

Metabolizable energy: The AME and TME value of SFAO were 4.398 and 4.453 kcal/g, respectively. The observed value is closely related to findings of Vila and Esteve-Garcia (1996) who reported that metabolizable energy of sunflower acid oil as 19.14 MJ/kg, which is equivalent to 4575 kcal/kg. However, it is lower than the values of Sibbald and Kramer (1977) who recorded a TME value of 9.05 kcal/g for acidulated soapstock. The low metabolizable energy value might be due to presence of high free fatty acids in the soapstock (Blanch *et al.*, 1995).

Production parameters: Statistical analysis of data

Table 3: Mean carcass yield, abdominal fat-pad weight, abdominal fat-pad thickness (± S.E.) and net profit per kg live weight of broilers at 6 weeks of age as influenced by dietary inclusion of sunflower acid oil

Treat-ment groups	Pre-slaughter live weight (g)	New York dressed weight (g)	Eviscerated weight (g)	Giblets weight (g)	Ready-to- cook percentage	Abdominal fat-pad weight (g)	Abdominal fat-pad thickness (mm)	Net profit per kg live weight (Rs.)
T1	1830.23±76.03	1661.50±77.59	1309.15±63.85	91.15±0.81	76.51±1.20	17.10±0.91	1.85±0.20	7.36
T2	1862.40±80.62	1699.67±74.28	1336.54±58.25	91.17±1.97	76.66±0.43	20.30±1.66	1.79±0.28	7.56
T3	1924.13±85.06	1755.37±80.14	1397.85±70.91	90.07±0.78	77.33±0.77	14.90±1.74	1.53±0.07	7.49
T4	2001.77±77.30	1812.47±76.14	1461.80±66.31	88.77±0.54	77.46±0.62	19.38±2.60	1.49±0.12	7.63
T5	1909.23±107.52	1743.40±122.56	1379.00±89.01	89.57±0.50	76.92±0.51	14.97±1.79	1.39±0.15	6.47

revealed no significant difference in body weight gain of broilers due to dietary inclusion of SFOA. This is in accordance with earlier findings of Balevi *et al.* (2001) who found no significant difference in live weight among crude sunflower oil, sunflower soapstock and acidulated sunflower soapstock fed groups at 42 days of age. Menge and Beal (1973), Camiruaga and Castro (1978), Lon-Wo and Rodriguez (1983) and Inal *et al.* (1994) also recorded no significant difference in body weight of broilers fed diet containing soapstock at different levels. On the contrary, Lon-Wo and Rodriguez (1986) reported that diet supplemented with acidified sunflower soapstock and non-acidified sunflower soapstock increased body weight. However, Senkoylu (1991) observed an inferior gain in soapstock supplemented groups in broilers. Such variations are attributed to the differences in strain, seasons and systems of rearing etc.

The analysis of variance of data on mean cumulative feed consumption and feed conversion ratio revealed no significant difference between treatment groups. The non-significant difference in feed intake and feed conversion ratio were also reported by Lon-Wo and Rodriguez (1983) who concluded that inclusion of non-acidulated sunflower soapstock at 0, 5, 10 and 15 percent levels did not influence the feed consumption and FCR significantly among treatments. Similarly, Camiruaga and Castro (1978) and Inal *et al.* (1994) expressed same opinion about the inclusion of acid oil in the chicken. On the contrary, Lon-Wo and Rodriguez (1986) reported that supplementation of acidified sunflower soapstock showed better feed conversion efficiency in male broilers from 2 to 8 weeks of age, while Balevi *et al.* (2001) recorded lower feed intake in broilers fed diet with 5 percent sunflower acid oil.

Livability was 100 percent in all the treatment groups except in 4 percent SFAO inclusion level, where the livability was 97.50 percent from 4 to 6 weeks of age, which was not significantly different from other groups. This is in agreement with Menge and Beal (1973) who observed no significant difference in mortality between groups fed with either neutralized dried soybean soapstock and animal and vegetable commercial feed fat in broilers. Lon-Wo and Rodriguez (1983) also expressed same opinion.

Carcass characteristics: The carcass characteristics viz. pre-slaughter weight, New York dressed weight, eviscerated weight, ready-to-cook percentage and giblets weight of broilers at 6 weeks of age did not differ significantly between the treatment groups by the inclusion of SFAO. This is in accordance with Vila and Esteve-Garcia (1996) who reported that carcass yield (carcass weight : live weight) were not significantly affected by sunflower, soy and tallow acid oil fed groups. Similarly, Osek *et al.* (2001) also reported that the kind of fat introduced into feed mixtures had no significant influence on dressing percentage.

The analysis of data on abdominal fat-pad weight and thickness of broilers did not differ significantly between the treatment groups by inclusion of SFAO. The same opinion was expressed by Vila and Esteve-Garcia (1996) who reported that the deposition of abdominal fat did not depend on rate of inclusion of SFAO. Griffiths *et al.* (1977) and Shrivastav and Panda (1993) also obtained similar results on inclusion of different sources of fat on abdominal fat-pad. However, Bilal *et al.* (2001) recorded reduced abdominal fat percentage in SFAO fed group than sunflower oil and animal tallow fed groups.

Cost effectiveness: From the results of the present study, it was observed that inclusion of SFAO at 1, 2 and 3 percent to broiler diet increased the net profit margin per kg live weight by 2.8, 1.8 and 3.7 percent, respectively as compared to control group. This finding is in agreement with earlier report of Murugesan (1997) who reported that the feeding of broilers with rice bran acid oil at 1 to 2 percent saved the feed cost of Rs.0.98 to 1.52 / kg weight gain. However, supplementation of SFAO at 4 percent level decreased the net profit by 12.1 percent than control group. This is contrary to the findings of Balevi *et al.* (2001) who reported that acidulated sunflower soapstock could be used upto 5 percent in broiler ration as energy source without affecting the cost per kg carcass production.

Based on the above results, it was concluded that dietary inclusion of SFAO did not affect the production performance and carcass traits of broilers including

abdominal fat pad weight and thickness. Sunflower acid oil can be safely included at 3 percent in broiler diet without affecting production performance with increase in net profit per kg live weight.

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