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Effect of dietary soy acid oil on growth performance, nutrient utilization and haemato-biochemical parameters in Ven cobb broiler chicken

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ABSTRACT

Day-old Ven cobb broiler chicks (360) were randomly allocated to 6 treatment groups with 4 replicates of 15 chicks in each to see the effect of different levels of soy acid oil on growth performance, nutrient utilization and haemato-biochemical parameters of them. The starter (0–14 d), grower (14–28 d) and finisher (28–42 d) diets contained 23, 21.5 and 20% CP and 2,900, 3,025 and 3,100 kcal ME/kg, respectively. Group T_1 was control, T_2–T_6 contained graded level (1, 1.5, 2, 2.5 and 3% of diet, respectively) of soy acid oil (SAO). Body weight and feed intake at 6 week were significantly higher in birds fed diet with 2.5 and 3% SAO. The FCR was significantly better in group T_5. The level of SAO in the diet of broiler chickens did not influence the per cent metabolizability of dry matter, however the apparent metabolizable energy value was significantly higher in the birds fed diet with higher level of SAO. Incorporation of SAO did not influence the nitrogen, calcium and phosphorus balance. The inclusion of SAO at different levels did not significantly influence the haemoglobin and PCV values amongst the birds of different groups. The increase in the level of SAO resulted into non significant increase in the activity of ALP and SGPT and serum cholesterol and HDL cholesterol concentration. It is concluded that soy acid oil can be incorporated in the diet of broiler chicken without affecting the performance.

Key words: Broiler, Growth performance, Nutrient utilization, Soy acid oil

The production cost of broiler varies with the demand and availability of high energy feed ingredients, which in turn affects the profit margin to the poultry producers. Among the various energy rich ingredients, fats and oils are the most concentrated source of energy however, the use of refined oils in feed formulation increases the cost. The use of soy acid oil (acidulated soybean soapstock) a byproduct of soybean oil refinery is a common practice in many areas of the world but unknown in many poultry producing countries. Well processed soapstocks contain approximately 60% free FA and 45 to 50% linoleic acid, depending on origin and the conditions applied during the process. Thus, its energy and nutritive value is high and its use in laying hens is recommended (Mateos *et al*. 2012). The corrected apparent metabolizable energy values of acidulated soybean soapstock as determined by regression analysis and difference method was 9,232 kcal/kg and 7,951 kcal/kg respectively (Pena *et al*. 2014). So the acid oil may be utilized as an alternative to conventional oil as the energy source without affecting broiler performance (Bilal *et al.* 2001). With this in view, the present study was planned to see effect of different levels of soy acid oil on growth performance, nutrient utilization and haemato-biochemical parameters in Ven cobb broiler chicken.

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MATERIALS AND METHODS

Day old Ven cobb 400 strain broiler chicks (360) were wing banded, weighed and distributed randomly into 6 treatment groups, each group had 4 replicates of 15 chicks in each. The chicks were reared under deep litter system. The study was divided into 3 phases, starter (0–14 d), grower (14–28 d) and finisher (28–42 d). The diets were formulated using commonly available feed ingredients, viz. maize, deoiled soybean cake, deoiled rice bran, maize gluten, meat and bone meal, dicalcium phosphate, limestone powder, mineral and vitamin premix. The starter (0–14 d), grower (14–28 d) and finisher (28–42 d) diets contained 23, 21.5 and 20% CP and 2,900, 3,025 and 3,100 kcal ME/kg, respectively. Group T_1 was control, T_2–T_6 contained graded level of soy acid oil (1, 1.5, 2, 2.5 and 3% of diet, respectively). Levels of inclusion in all the dietary treatment in starter, grower and finisher stage remained same. All the diets were made iso caloric and iso nitrogenous. Throughout the experiment, all the test groups received similar management practices like vaccination, lighting and watering.

The heat of combustion or gross energy value of soy oil, soy acid oil, feed and excreta was determined by bomb calorimeter. The body weight and feed intake of individual

bird was recorded weekly, and feed conversion ratio was calculated. Metabolism trial of 4 days collection period was conducted between 30–35 d to determine the dry matter metabolizability and nutrient balance (energy, N, Ca and P) in broilers. During this 4 d period, a weighed quantity of feed was offered to each bird daily and left over feed was recorded to calculate the net feed intake by the birds. The excreta voided over the same period were collected quantitatively from each bird and dried at 80°C in a hot air oven to a constant weight. The dried and pooled feed samples, residues and faecal materials were ground and stored in air tight containers to determine the DM metabolizability and apparent metabolizable energy. The sample of feed and excreta were also analysed for nitrogen (AOAC 1995), Ca (Talapatra *et al*. 1940) and P (Fiske and Subba Rao 1925) to know the N, Ca and P balance.

For haematological studies, blood samples were collected from 3 birds randomly selected from each replicate in heparinised vials (heparin @10 IU/ ml of blood) on 35th day of experiment. Haemoglobin was estimated by cyanmethemoglobin method using Drabkin's solution (Dacie and Lewis 1968). Packed cell volume (PCV) was determined by micro haematocrit method (Jain 1986). For biochemical parameters, blood was collected in non heparinised and clean test tubes from 3 birds randomly selected from each replicate on 35th day of experiment. The serum was separated and analysed same day for alkaline phosphatase, serum glutamate pyruvate transaminase, cholesterol and HDL- cholesterol in semi-automated analyzer using diagnostic kits. For interpretation of the results, the data were subjected to completely randomized design as suggested by Snedecor and Cochran (1994) and analysed by ANOVA one way classification using SPSS package (SPSS ver. 10.0)

RESULTS AND DISCUSSION

The level of SAO accrued significant variation in weekly body weight of broiler (Table 1). Overall, the body weight at 6 week was significantly high in birds fed diet with 2.5 and 3% SAO (T_5 and T_6). Birds of group T_2 (1% SAO) attained significantly (P<0.05) lower weight as compared to other groups, however, no significant difference was observed among T_1, T_3 and T_4 groups. Pardio *et al*. (2001) and Vieira *et al*. (2006) also reported increased body weight when acidulated soybean soapstock was included in broiler diet. However Balevi *et al*. (2001) and Jayalakshmi *et al*. (2006) reported no significant difference in the body weight of broilers when acidified sunflower soapstock was incorporated in the diet.

The cumulative feed intake from 0–42 d was significantly lower in group T_2 as compared to control and groups fed diet with SAO at 2% level or above. Significantly (P<0.05) higher feed was consumed by groups T_5 and T_6 as compared to all other groups (Table 1). The findings corroborate with Balevi *et al*. (2001) who observed highest feed consumption in the broilers fed diet with acidulated soapstock. The overall FCR at 6 week was significantly better in group T_5 (SAO- 2.5%) as compared to T_2 (SAO-1%), however the variation between other groups was non-significant. The findings are in agreement with those of Lon-Wo and Rodriguez (1983) and Jayalakshmi *et al*. (2006) who observed no variation in FCR when sunflower acid oil was included in broiler diet. In contrast, Balevi *et al*. (2001) and Pardio *et al*. (2001) found highest value for FCR in the birds fed diet with acidulated sunflower soapstock or acidulated soybean soapstock respectively.

The level of SAO in the diet of broiler chickens did not influence the per cent metabolizability of dry matter and the difference amongst the groups were non significant (Table 2). The apparent metabolizable energy value was significantly higher in the birds fed diet with higher level of SAO (T_4, T_5 and T_6), however, the difference among the groups T_1, T_2 and T_3 was not significant. The findings corroborate with Vila and Esteve-Garcia (1996) who reported that AMEn of the diets was significantly affected by acid oil and its inclusion rate. Incorporation of SAO did not influence the intake or excretion of nitrogen and calcium, all the birds were in positive balance and the per cent N and Ca retention in different groups did not differ significantly (Table 2). Atteh and Leeson (1985) observed no significant effect of fatty acid supplementation on Ca

Table 1. Growth performance of broilers fed different levels of soy acid oil

Particulars	Period	Treatments					
		T_1	T_2	T_3	T_4	T_5	T_6
Body weight	14 d	424.17^{ab}±6.50	440.68^{bc}±6.34	438.2^{bc}±5.94	434.14^{bc}±5.32	411.93^{a}±5.21	449.65^{c}±5.54
	28 d	1306.88±17.59	1301.82±16.59	1306.44±16.17	1287.27±17.06	1283.13±13.52	1320.1±10.77
	42 d	2205.91^{b}±28.42	2110.96^{a}±26.63	2202.33^{b}±34.78	2226.89^{bc}±33.63	2344.31^{d}±35.67	2309.78^{cd}±31.74
Feed intake	14 d	538.58^{b}±3.49	551.77^{b}±4.85	535.50^{b}±6.92	540.66^{b}±5.38	506.62^{a}±16.72	533.23^{b}±3.74
	28 d	1974.64±19.64	1971.36±21.47	1988.53±20.96	2023.45±24.98	2020.67±24.99	2015.22±14.72
	42 d	4106.79^{b}±57.79	3998.10^{a}±53.52	4046.74^{ab}±33.41	4109.43^{b}±58.01	4260.52^{c}±45.94	4208.75^{c}±53.40
Feed conversion ratio	14 d	1.43^{b}±0.02	1.40^{ab}±0.02	1.37^{ab}±0.01	1.40^{ab}±0.03	1.39^{ab}±0.05	1.33^{a}±0.02
	28 d	1.57^{a}±0.02	1.57^{a}±0.01	1.58^{ab}±0.01	1.63^{b}±0.04	1.64^{b}±0.03	1.58^{ab}±0.02
	42 d	1.90^{ab}±0.02	1.93^{b}±0.03	1.87^{ab}±0.03	1.88^{ab}±0.05	1.85^{a}±0.03	1.86^{ab}±0.02

T_1, control diet; T_2 , SAO 1%; T_3, SAO 1.5%; T_4 , SAO 2%; T_5, SAO 2.5%; T_6 , SAO 3%. Means in the same row with different superscript a, b, c are significantly different (P < 0.05).

Table 2. Effect of different levels of soy acid oil on DM metabolizability, energy, N, Ca and P balance

Particulars	Groups/ treatment					
	T_1	T_2	T_3	T_4	T_5	T_6
DM metabolizability (%)	73.05±0.59	72.11±3.14	73.65±2.44	71.33±1.66	69.68±2.30	75.06±3.13
Energy balance						
GE intake (kcal/d)	641.57^{ab}±4.20	638.35^{a}±5.62	646.71^{b}±4.28	678.24^{c}±10.56	682.07^{c}±15.86	680.71^{c}±12.82
GE excreted (kcal/d)	220.72±5.24	223.43±5.62	213.75±8.54	222.13±12.48	226.18±7.68	221.37±6.54
AME	420.85^{b}±3.26	414.92^{a}±8.54	425.96^{b}±9.24	456.11^{c}±2.22	455.89^{c}±2.52	459.34^{c}±4.23
AME (%)	65.59^{a}±0.51	65.00^{a}±0.48	65.86^{a}±0.68	67.24^{b}±0.52	66.83^{b}±0.54	67.48^{b}±0.46
N balance						
N intake (g/d)	3.37±0.07	4.05±0.27	3.70±0.18	3.40±0.38	4.02±0.44	3.54±0.32
N voided (g/d)	1.77±0.52	2.09±0.16	1.66±0.12	1.87±0.23	2.01±0.12	1.84±0.36
N balance (g/d)	1.60±0.04	1.95±0.28	2.05±0.14	1.53±0.22	2.01±0.34	1.84±0.36
N retention (%)	47.84±1.03	47.99±4.76	53.94±2.37	44.01±4.05	47.48±3.24	49.11±4.94
Ca balance						
Ca intake (g/d)	1.37±0.02	1.54±0.10	1.42±0.07	1.28±0.14	1.51±0.16	1.37±0.12
Ca voided (g/d)	0.99±0.02	1.07±0.07	0.94±0.10	0.90±0.06	1.06±0.05	0.88±0.15
Ca balance (g/d)	0.37±0.01	0.47±0.11	0.48±0.13	0.38±0.11	0.45±0.11	0.48±0.04
Ca retention (%)	27.67±1.01	28.86±6.9	30.03±8.34	26.68±6.32	24.19±4.8	35.82±5.93
P balance						
P intake (g/d)	0.84±0.01	0.94±0.06	0.99±0.05	0.97±0.11	1.11±0.12	0.96±0.09
P voided (g/d)	0.52±0.02	0.59±0.05	0.50±0.04	0.52±0.06	0.59±0.04	0.52±0.13
P balance (g/d)	0.32^{a}±0.02	0.35^{ab}±0.06	0.49^{ab}±0.05	0.45^{ab}±0.05	0.52^{b}±0.08	0.44^{ab}±0.04
P retention (%)	38.61±2.97	35.77±6.04	46.78±4.69	45.17±1.43	42.84±3.86	47.11±7.92

T_1, control diet; T_2 , SAO 1%; T_3, SAO 1.5%; T_4 , SAO 2%; T_5, SAO 2.5%; T_6 , SAO 3%. Means in the same row with different superscript a, b, c are significantly different ($P < 0.05$).

Table 3. Effect of different levels of soy acid oil on certain blood biochemical parameters

Particulars	Groups/ treatment					
	T_1	T_2	T_3	T_4	T_5	T_6
ALP (U/l)	478.2^{ab}±31.85	411.75^{a}±36.84	464^{ab}±33.31	486^{ab}±23.33	466^{ab}±26.79	522.75^{b}±13.36
SGPT (U/l)	4.50^{a}±0.30	6.50^{ab}±1.50	6.00^{ab}±0.70	5.70^{ab}±1.10	6.75^{ab}±0.75	8.25^{b}±1.20
Cholesterol (mg/dl)	118.3±20.61	102.55±16.04	114.9±6.08	129.65±11.13	127.72±6.96	135.10±1.19
HDL cholesterol (mg/dl)	82.07±2.89	84.65±4.73	82.22±1.13	78.87±6.40	85.87±0.98	80.95±1.94

T_1, control diet; T_2 , SAO 1%; T_3, SAO 1.5%; T_4 , SAO 2%; T_5, SAO 2.5%; T_6 , SAO 3%. Means in the same row with different superscript a, b, c are significantly different ($P < 0.05$).

retention in laying hen. The P balance (g/d) was significantly ($P<0.05$) higher in T_5 as compared to control, however per cent P retention did not reveal any significant difference between the groups.

The inclusion of SAO at different levels did not influence the haemoglobin and PCV values amongst the birds of different groups. No significant variation in Hb and PCV value has also been reported by Cetingul *et al.* (2008) in laying hen and by Edem (2009) in rat when different oil sources has been used in the diet.

The activity of alkaline phosphatase (ALP) increases with the increase in the level of SAO but difference amongst the group was non significant. The activity of serum glutamate pyruvate transaminase (SGPT) was more in all the birds fed diet with SAO at different levels, however, the differences were nonsignificant amongst the groups except T_6. The incorporation of soy acid oil in the diet did not affect serum cholesterol level in birds. Increase in the level of SAO increases the cholesterol content but the differences were not significant amongst the groups (Table 3).

Similarly the value of HDL- cholesterol also did not differ significantly amongst groups. These findings corroborate with the findings of Lechowski *et al.* (1999) who observed that the type of fat in the diet did not influence the cholesterol level in serum. However, Monfaredi *et al.* (2011) observed different response in the blood parameters when soybean oil and beef tallow was used in broiler diet. They reported that the rate of reduction in cholesterol and LDL and increase in TG, HDL and VLDL level was greater with soybean oil than with beef tallow (Table 3). From the study, it is concluded that the metabolizable energy content of soy acid oil is comparable to that of crude soy oil and

can be incorporated in the diet of broiler chicken @ 2.5% level without affecting the performance.

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