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Effect of Crude Soybean Oil Sediment as a Substitute for Refined Soybean Oil in Broiler Diet

Research Article

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ABSTRACT

Four hundred fifty day old unsexed broiler chicks were used in a 35-day trial at Chittagong veterinary and animal sciences university farm to find out the effect of using crude soybean oil sediment (CSOS) as a substitute for refined soybean oil (RSO) in broiler diet. The experiment was carried out following completely randomized design. The chicks were randomly distributed in three treatment groups having three replications per treatment. Each replication had 50 birds. The house was divided by wire net into nine compartments to maintain desired replication. Birds were fed three types of diet i.e. diet without CSOS and RSO (T_0), diet containing RSO (T_1) and diet containing CSOS (T_2). All birds had free access to *ad libitum* feeding. Results indicated that no variations ($P<0.05$) were observed in weight gain of birds for the 1st and 2nd week except at 3rd, 4th and 5th week irrespective of dietary treatments. At 5th week, average weight gain was maximum (73.7±2.1 g/d) in birds fed diet containing RSO (T_1) and minimum (65.6±2.7 g/d) in birds fed diet without CSOS and RSO (T_0). Similar to weight gain, average feed intake differed ($P<0.01$) and the mean values were 55.3 ± 2.1, 50.5 ± 1.9 and 53.4 ± 2.0 g at 2nd week, 92.5 ± 3.1, 83.4 ± 2.3 and 84.4 ± 2.2 g at 3rd week and 116.4 ± 2.3, 114.5 ± 1.9 and 120.4 ± 2.7 g at the 4th week for T_0, T_1 and T_2 treatment groups, respectively. Feed conversion ratio (FCR) differed ($P<0.05$) only at 5th week and the mean values were 2.03 ± 0.12, 1.80 ± 0.11 and 1.90 ± 0.09 for T_0, T_1 and T_2 treatment groups, respectively. Best feed FCR (1.80±0.11) was found in birds fed diet containing RSO (T_1) and comparatively poor FCR (2.03±0.12) was found in birds fed diet without CSOS and RSO (T_0). It could therefore be inferred that, RSO may be replaced by CSOS in broiler diet.

KEY WORDS broiler, crude soybean oil sediment, feed conversion ratio, intake, weight gain.

INTRODUCTION

Birds require feed for body maintenance, growth and production and reproduction. Genetically any strain of birds may possess higher productive potentiality but until and unless optimum nutrition is offered this potentiality will never be expressed. Oils and oil by products are important components of broiler ration since they are the richest source of metabolizable energy, essential fatty acids and fat soluble vitamins. Studies on adding oil and oil by-products to the poultry diets started in the 1950s and the latest studies showed that up to 7% oil could be added to the broiler rations successfully (Cullision and Lowrey, 1987). Incorporation of oils to poultry diets has some additional benefits like diminished pulverulence, increased palatability of diet and improved efficiency of energy utilization. The dietary energy value of fats is variable which depends upon their chemical composition (Wiseman, 1997). A wide range of studies have demonstrated the influence of different dietary fats and oils on performance of broilers (Hulan *et al.* 1984;

Cmiljanic *et al.* 1997; Panja, 1997; Zollitsch *et al.* 1997; Danicke *et al.* 2000; Lopez Ferrer *et al.* 2001). Other reports, however, were contradictory which did not find consistent differences in performance of broilers fed different types of fat with different degrees of saturation (Atteh *et al.* 1989; Sklan and Ayal, 1989; Olomu and Baracos, 1991; Pinchasov and Nir, 1992; Lopez Ferrer *et al.* 1999; Krasicka *et al.* 2000).

It was evident that energy utilization by birds is affected by the level and the sources of energy in the diet (Bartov, 1987; Cmiljanic *et al.* 1987; Ketels and De Groote, 1989; Atteh *et al.* 1989). Although refined soybean oil (RSO) contains very high amount of ME (Larbier and Leclerco, 1992), it does not contain crude protein, vitamin and mineral like crude soybean oil sediment (CSOS). Moreover, RSO is very expensive nowadays in developing countries. Like RSO, CSOS is easily digestible, locally available, comparatively economic and easy to mix with other feed ingredients.

Therefore, supplementation of CSOS to diets, besides supplying energy, may improve absorption of fat-soluble vitamins, diminishes pulverulence, increases palatability of ration, improve efficiency of consumed energy and reduce the passage rate of digesta in the gastrointestinal tract similar to RSO. So, as an additional source of ME, if CSOS is used in broiler diet it would improve broiler production and help in subsidizing the price of RSO.

Despite very little interesting speculations, no systematic consistent experimental evidence has so far been done to explain the effects of CSOS on performance of commercial broiler under Bangladesh perspective. Therefore, current study aimed at observing the effect of using crude soybean oil sediment as a substitute for refined soybean oil in broiler diet.

MATERIALS AND METHODS

Birds and housing

Four hundred fifty day old, unsexed, commercial broiler chicks were purchased from the chicken hatchery for the study purpose. A bamboo house (30×15×9 cft) was constructed for rearing broiler. The house was covered with corrugated sheet. 1.5 feet of the sidewall from floor was made of bamboo and the remaining portion was made of wire net to facilitate proper ventilation. The floor of the house was made of bamboo splits. The house was divided by wire net into nine compartments to maintain desired replication. Birds were brooded under single-tired electric brooder at 95 $^{\circ}$F, 90 $^{\circ}$F, 85 $^{\circ}$F and 80 $^{\circ}$F for the 1st, 2nd, 3rd and 4th week respectively. Room temperature and humidity was maintained using 200 watt incandescent lamps and exhaust fans.

Diets

Experimental diets were dry mash type. Birds had unrestricted access to feed and water by plastic hanging feeder and bell type drinker. All diets were prepared with maize, rice polish, soybean oil, soybean meal, protein concentrate and other trace nutrients. Three rations designated as T_0, T_1 and T_2 were formulated using locally available ingredients where T_0 was fortified without CSOS and RSO, T_1 with RSO and T_2 with CSOS. ME value in CSOS was estimated as per (Lodhi *et al.* 1976).

Theses rations were supplied to three groups of birds randomly. The chemical composition of the CSOS and RSO are given in Table 1. Detailed proportion of the feed ingredients in different rations is given in Table 2. Nutrient density in the experimental diet was maintained according to Singh (1980).

Table 1 Chemical composition of crude soybean oil sediment (CSOS) and refined soybean oil (RSO)

Components (g/100g)	CSOS[1]	RSO[2]
Moisture	0.01	0.010
Crude protein	4.58	-
Ether extract	90.3	99.99
Total ash	5.00	-
Free fatty acid	26.6	-
Ca	0.38	-
P	0.12	-

[1] CSOS: crude soybean oil sediment.
[2] RSO: refined soybean oil.

Vaccination and medication

The birds were vaccinated against New Castle and Gumboro disease on the 4th and 10th day followed by a booster dose on 20th and 25th day. Feed intake and mortality of chicks under different treatments and replications were recorded daily. Mortality rate of broiler chicks in treatment T_0, T_1 and T_2 were 4.5%, 2.5% and 3.0% respectively. No outbreak of infectious diseases was found throughout the whole experimental period.

Design of experiment

The experiment was carried out following completely randomized design (Gomez and Gomez, 1984). Birds were weighed and randomly divided into three treatment groups. Each treatment was divided into three replicates having 50 birds per replicate.

Statistical analysis

Data related to weight gain, feed intake and FCR were analyzed for ANOVA by using Stata (2009) and SPSS (2007). Means showing significant differences were compared by Duncan's new multiple range test (Duncan, 1955). Cost benefit analysis were carried out by using chi-square (X^2) test. Statistical significance was accepted at $P<0.05$.

RESULTS AND DISCUSSION

Live weight

Initial weight was similar for all birds at first day, however, it differed (P<0.01) at 2nd, 3rd, 4th and 5th weeks and the mean values were 418.4 ± 1.5, 428.2 ± 3.0 and 425.7 ± 2.3 g at 2nd week, 704.4 ± 2.5, 746.4 ± 4.0 and 743.5 ± 3.5 g at 3rd week, 1001.1 ± 4.4, 1109.3 ± 5.0 and 1095.7 ± 2.5 g at 4th week and 1560.4 ± 5.1, 1625.5 ± 3.2 and 1608.7 ± 4.9 g at the 5th week for T_0, T_1 and T_2 treatment groups respectively (Table 3).

Average live weight was maximum (1625.5±3.2 g) in birds fed diet containing RSO (T_1) and minimum (1560.4±5.1 g) in birds fed diet without CSOS and RSO (T_0). Similar results were obtained by Abas *et al.* (2004); Alparslan and Özdogan (2006); Anigbogu (2001); Baiao and Lara (2005); Bobadoye *et al.* (2006).

Feed intake

Average feed intake differed (P<0.01) and the mean values were 55.3 ± 2.1, 50.5 ± 1.9 and 53.4 ± 2.0 g for the 3rd week, 92.5 ± 3.1, 83.4 ± 2.3 and 84.4 ± 2.2 g for the 4th

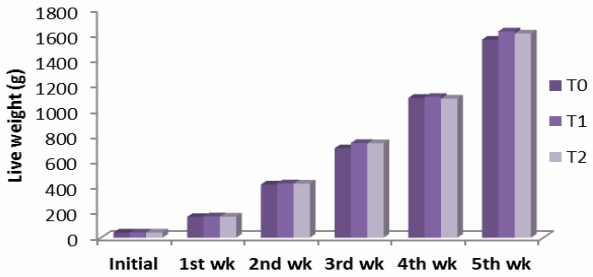

Figure 1 Live weight of broiler fed diet supplemented with RSO and CSOS compared with diet without oil

Table 2 Ingredient composition of the rations

Feed Ingredients (%)	T_0		T_1		T_2	
	Starter (0-21)	Finisher (22-35)	Starter (0-21)	Finisher (22-35)	Starter (0-21)	Finisher (22-35)
Maize	56.75	60.25	54.75	58.25	54.75	58.25
Rice polish	11.00	11.00	11.00	11.00	11.00	11.00
Soybean meal	23.00	20.00	23.00	20.00	23.00	20.00
Meat and bone meal	7.50	7.00	7.50	7.00	7.50	7.00
CSOS	-	-	-	-	2.00	2.00
RSO	-	-	2.00	2.00	-	-
DCP	1.15	1.15	1.15	1.15	1.15	1.15
Common salt	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin. premix	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100	100
Analytical value						
ME (kcal/kg)	2941.13	2974.74	3052.95	3086.56	3011.27	3044.88
CP (%)	20.92	19.62	20.73	19.43	20.73	19.43
Crude fibre (%)	3.55	3.43	3.51	3.39	3.51	3.39
Ether extract (%)	4.54	4.50	6.49	6.45	6.49	6.45
Calcium (%)	0.80	0.77	0.80	0.77	0.80	0.77
Phosphors (%)	0.83	0.82	0.82	0.81	0.82	0.81
Avail phos (%)	0.40	0.39	0.40	0.39	0.40	0.39
Lysine (%)	1.13	1.04	1.13	1.03	1.13	1.03
Methionine (%)	0.39	0.37	0.39	0.37	0.39	0.37
Met + Cys (%)	0.73	0.69	0.72	0.68	0.72	0.68
Tryptophan (%)	0.26	0.24	0.26	0.24	0.26	0.24

T_0: diet without crude soybean oil sediment (CSOS) and refined soybean oil (RSO); T_1: diet containing RSO; T_2: diet containing CSOS.
CSOS: crude soybean oil sediment; RSO: refined soybean oil; DCP: dicalcium phosphate; ME: metabolizable energy and CP: crude protein.

Table 3 live weights (g) of broiler fed diet without oil (T_0) and diets supplemented with refined soybean oil (T_1) or crude soybean oil sediment (T_2)

Live weight (g/bird)	Dietary treatment			SEM	Significant
	T_0	T_1	T_2		
Initial wt	40.5±0.9	41.1±0.7	40.6±0.7	0.27	NS
Live wt at 1st wk	163.3±1.8	167.3±2.0	165.6±2.2	0.67	NS
Live wt at 2nd wk	418.4^{b}±1.5	428.2^{a}±3.0	425.7^{a}±2.3	0.76	**
Live wt at 3rd wk	704.4^{b}±2.5	746.4^{a}±4.0	743.5a±3.5	1.09	**
Live wt at 4th wk	1101.1^{ab}±4.4	1109.3^{a}±5.0	1095.7^{b}±2.5	1.33	**
Live wt at 5th wk	1560.4±5.1	1625.5^{a}±3.2	1608.7^{b}±4.9	1.47	**

NS: non significant; ** (P<0.01) and SEM: standard error of means.
The means within the same row with at least one common letter, do not have significant difference (P>0.01).

week and 116.4 ± 2.3, 114.5 ± 1.9 and 120.4 ± 2.7 g for the 5th week for T_0, T_1 and T_2 treatment groups, respectively (Table 4). Feed intake was maximum (168.7±2.7 g) in birds fed diet without CSOS and RSO (T_0) and minimum (159.5±2.3 g) in birds fed diet containing RSO (T_1). Skrivan *et al.* (2000) carried out another study to observe the influence of dietary fat source and copper supplementation on broiler performance, fatty acid profile of meat, depot fat and on cholesterol content in meat and found similar

Table 4 Feed intake of broiler fed diet without oil (T_0) and diets supplemented with refined soybean oil (T_1) or crude soybean oil sediment (T_2)

Feed intake (g/bird/day)	Dietary treatment			SEM	Significant
	T_0	T_1	T_2		
Feed intake at 1st wk	19.5±0.9	18.5±0.7	18.6±0.8	0.31	NS
Feed intake at 2nd wk	55.3^a±2.1	50.5^b±1.9	53.4^b±2.0	0.67	**
Feed intake at 3rd wk	92.5^a±3.1	83.4^b±2.3	84.4^b±2.2	0.83	**
Feed intake at 4th wk	116.4^b±2.3	114.5^b±1.9	120.4^a±2.7	0.77	NS
Feed intake at 5th wk	168.7±2.7	159.5±2.3	165.4±2.4	0.82	NS
Feed intake up to 4th wk	1985.9^a±10.8	1868.3^c±8.9	1937.6^b±9.9	3.29	**
Feed intake up to 5th wk	3166.8^a±12.5	2984.8^c±10.8	3095.4^b±12.9	4.01	**

NS: non significant; ** (P<0.01) and SEM: standard error of means.
The means within the same row with at least one common letter, do not have significant difference (P>0.01).

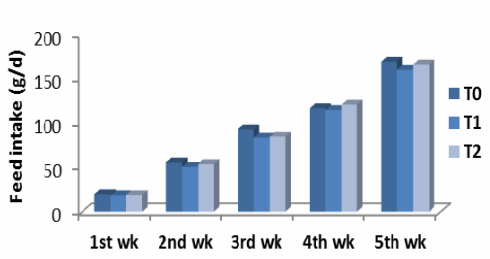

Figure 2 Feed intake (g/d) of broiler fed diet supplemented with SO and CSOS compared with diet without oil

feed intake. Scaife *et al.* (1994) fed broilers with rations containing different sources of lipids (beef tallow, soybean oil, canola oil, and marine fish oil) and observed that feed intake was significantly higher when soybean oil was used. In this study, no adverse effects related to feed intake were evident due to addition of crude soybean oil sediment. In another study, Griffiths *et al.* (1977) evaluated broiler rations containing 0, 4 and 8% of soybean oil and acidulated soybean oil soap stock, and observed a reduction in feed intake of birds fed with acidulated soybean oil soap stock when inclusion level was increased from 4 to 8%. The feed consumption was not significantly improved by a higher percentage of polyunsaturated fatty acids in the diets as has been described by Pinchasov and Nir (1992). The use of higher PUFA levels in diets and the effect on the performance parameters of broiler chickens, e.g., higher feed intake and feed: gain ratio has been described elsewhere (Zollitsch *et al.* 1997) but the results were not always consistent (Ayjuah *et al.* 1993). It was concluded (Abas, 2004) that sources of fats and oils had a significant effect on feed intake of broiler. A combination of vegetable oil with other fat sources had a marked beneficial effect because of synergistic effect for combining fatty acids which enhanced their intestinal absorption (Abas, 2004).

FCR

Feed conversion ratio differed (P<0.05) only at 5th week and the mean values were 2.03 ± 0.12, 1.80 ± 0.11 and 1.90 ± 0.09 for T_0, T_1 and T_2 treatment groups respectively (Table 5).

Table 5 Feed conversion ratio (FCR) of broiler fed diet without oil (T_0) and diets supplemented with refined soybean oil (T_1) or crude soybean oil sediment (T_2)

FCR	Dietary treatment			SEM	Sig
	T_0	T_1	T_2		
FCR at 1st wk	0.84±0.13	0.77±0.09	0.79±0.11	0.04	NS
FCR at 2nd wk	1.25^a±0.25	1.13^b±0.22	1.18b±0.23	0.06	NS
FCR at 3rd wk	1.66^a±0.27	1.43^b±0.24	1.47^b±0.26	0.09	NS
FCR at 4th wk	1.98^a±0.18	1.68^b±0.14	1.77^b±0.13	0.04	NS
FCR at 5th wk	2.03^a±0.09	1.80^b±0.07	1.90^b±0.08	0.03	*

NS: non significant; ** (P<0.01) and SEM: standard error of means.
The means within the same row with at least one common letter, do not have significant difference (P>0.01).
FCR: feed conversion ratio.

Table 6 Cost-benefit analysis of broiler fed diet supplemented with refined soybean oil (T_1) and crude soybean oil sediment (T_2) compared with diet without oil (T_0)

Parameter	T_0	T_1	T_2	P-value
Feed cost per kg	28.66	30.88	28.58	0.94
Feed cost per broiler	90.85	92.02	88.6	0.97
Chick cost	40	40	40	1.00
Overhead costs per broiler[1]	25	25	25	1.00
Total cost per broiler	155.9	157	153.6	0.98
Market price per kg broiler	110	110	110	1.00
Market price per broiler	171.6	179.3	177.1	0.91
Net profit per broiler	15.75	22.28	23.5	0.43
Net profit per kg live broiler	10.09	13.67	14.6	0.64

[1] Overhead costs: costs for housing, feeder, waterer, sanitation equipments, disinfectants, extra labor, electricity and depreciation cost of the building.

Comparatively better feed conversion ratio (1.80±0.11) was found in birds fed diet containing RSO (T_1) and comparatively poor feed conversion ratio (2.03±0.12) was found in birds fed diet without CSOS and RSO (T0).

Tabeidian *et al.* (2005) conducted another trial to observe the effect of dietary protein levels and soybean oil supplementation on broiler performance. At 3rd week he obtained the FCR 1.49 which is lower than the current study.

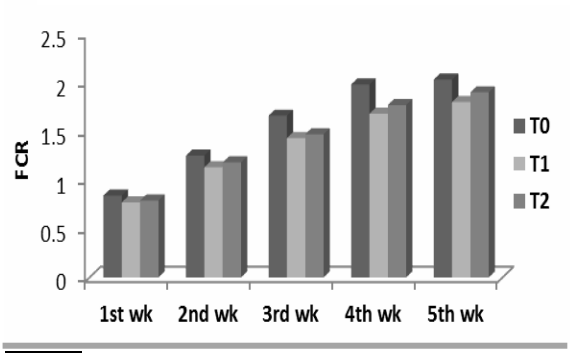

Figure 3 FCR of broiler fed diet supplemented with SO and CSOS compared with diet without oil

Alao and Balnave (1984) reported better feed conversion in birds fed diets containing vegetable oils. Similarly, Griffiths *et al.* (1977) observed improved feed conversion in birds fed soybean oil in comparison to acidulated soybean oil soap stock. It was suggested that the difference was a function of the fatty acid composition of the different vegetable oils.

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