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Research Article

Effects of vegetable oil supplementation on growth performance and carcass characteristics in broilers

Islam, M.M.[1] and M. C. Sumy[2]*

[1]Department of Animal Science and Nutrition, [2]Department of Agricultural Economics and Social Sciences, Chittagong Veterinary and Animal Sciences University, Chittagong-4225, Bangladesh

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** Corresponding Author :*
Cell: +88 01712736518
E-mail:mrislamcvasu@gmail.com

ABSTRACT

The study was conducted to compare the vegetable oil supplementation on growth performance and carcass characteristics in broilers. A total of 150 day old Cobb 500 broiler chicks were divided in to three treatment groups: T_0 = Control (basal diet), T_1: Soybean oil (basal diet + 2% soybean oil on DM basis) and T_2: Palm oil (basal diet + 2% palm oil on DM basis) consisting 5 replications having 10 birds in a completely randomized design. The results of this study showed that dietary vegetable oil supplementation increased average weekly live weight (AWLW) at 3rd, 4th and 5th week of age (P<0.05). Although average weekly feed intake (AWFI) remained unchanged until 2nd week, it was significantly reduced at 4th and 5th week both in soybean and palm oil supplementation (P<0.05). Weekly feed conversion ratio (FCR) of broilers (feed/gain) was decreased in soybean and palm oil supplementation and mostly in palm oil supplementation (P<0.05). Carcass characteristics of broiler meat remained unchanged in different treatment groups except for wing meat weight, dressed weight, drumstick meat weight and digestive tract weight (P<0.05). Highest dressed weight (DW) found in soybean oil group compared to control and palm oil at 5th week of age (P<0.05). Whereas increased digestive tract weight (DTW) was observed in soybean oil relative to control and palm oil group (P<0.05). Net return (NR) and Benefit Cost Ratio (BCR) were also higher in vegetable oil supplemented groups compared to control (P<0.05). In conclusion, dietary supplementation of vegetable oil increased growth performance, dressed weight and profitability in broiler rearing.

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1. INTRODUCTION

Fat or lipid is the major sources of energy for both in human food as well as in the ingredients for animal nutrition (Kerr et al., 2015). The addition of fat to diets, besides supplying energy, improves the absorption of fat-soluble vitamins, diminishes the pulverulence, increases the palatability of the rations, and increases the efficiency of the consumed energy (lower caloric increment). Furthermore, it reduces the passage rate of the digesta in the gastrointestinal tract, which allows a better absorption of all nutrients present in the diet. Oils also help in absorption of vitamin A, vitamin E and Ca in turkey (Anderson and Young, 2003).

Broilers fed diets low in apparent metabolizable energy (AMEn) have exhibited higher feed conversion and caloric conversion compared with birds fed diets with higher energy density to achieve maximum responses (Leeson et al., 1996; Saleh et al., 2004a,b).

Feed mills in Bangladesh are mostly using soybean oil to accelerate energy level particularly in broiler diet, which results in high feed price. Palm oil contains high source of saturated fatty acid. The use of palm oil in broiler diets is attractive, because it is a saturated source that may be associated with a positive influence on meat firmness (Rahman et al., 2010). Palm oil is relatively cheaper compared to other imported fats and it possesses many good qualities including more vitamin E (antioxidant) content, which makes it more stable (Pesti et al., 2002).

Therefore, the present study was designed to compare the growth performance and carcass characteristics supplemented with different vegetable oil sources in broilers.

2. MATERIALS AND METHODS

The study was conducted at the experimental shed under the department of Animal Science and Nutrition from 15th August to 15th October, 2012, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh.

2.1 Birds, diet, and experimental design

A total of 150 day-old chicks (Cobb 500 strain) of mixed sex (43.79 ± 0.84g average live weight) were randomly distributed in to 3 treatment groups: T_0 = Control, T_1: soybean oil (basal diet + 2% soybean oil on DM basis) and T_2: palm oil (basal diet + 2% palm oil on DM basis) consisting of 5 replications having 10 birds in each replication in a completely randomized design. Rations were formulated as starter (1-10 days), grower (11-21 days) and finisher (22-35 days) to meet or exceed the nutrient requirements of broiler chickens according to NRC (1994). All three rations (T_0, T_1 and T_2) were prepared iso-nitrogenous and iso-caloric.

The experiment was carried out for 35 days (5 weeks). An experimental poultry shed with floor size 20x30=600 square feet was selected and prepared for rearing broilers. After cleaning and disinfecting, the house was left for week for drying. All windows were opened for proper ventilation. After one week the floor was divided into 15 pens of equal size (6 ft X 7 ft) by using wire net and bamboo splits. The height of wire net was 2.5 feet and floor space for each bird was 1.6 sq. ft. Lime was spread on the floor and around the shed for bio-security. Over the lime, fresh dried saw dust litter materials was spread on floor of different pens at a depth primarily of about 4-5 inches. The feeders and drinkers were fixed in such a way so that the birds were able to eat and drink conveniently. Formulated feed and fresh clean drinking water were supplied ad-libitum to the birds throughout the experimental period.

Table 1. Ingredients and chemical compositions (g/kg feed basis) of basal diets

Item	Starter diet (1 to 10 days)	Grower diet (11-21 days)	Finisher diet (22-35 days)
Ingredients			
Corn grain	575.8	575.8	606.4
Soybean meal	268.0	268.0	249.0
Corn gluten	50.0	50.0	35.0
Soybean oil	22.0	22.0	22.0
Animal fats	45.0	45.0	50.0
Salt	2.5	2.5	2.5
Dicalcium phosphate	21.4	21.4	20.0
Limestone	9.2	9.2	8.8
Vit.-Min. premix1	3.0	3.0	3.0
Choline	0.8	0.8	0.7
L-lysine HCl (78%)	2.4	2.4	1.6
DL-Methionine	2.0	2.0	1.0
Calculated composition (% DM)			
ME (MJ/kg)	13.02	13.02	13.43
Crude protein (g/kg)	228.9	228.9	201.4
Ether extract (g/kg)	47.5	47.5	30.2
Crude fibre (g/kg)	44.4	44.4	38.1
Crude ash (g/kg)	55.3	55.3	56.2
Calcium (g/kg)	10.5	10.5	8.1
Available phosphorus (g/kg)	5.5	5.5	4.5
Lysine (g/kg)	14.5	14.5	11.0
Methionine (g/kg)	5.3	5.3	4.5

[1]Vitamin-mineral mixture provided the following nutrients per kilogram of diet: vitamin A, 15,000 IU; vitamin D3, 1,500 IU; vitamin E, 20.0 mg; vitamin K3, 0.70 mg; vitamin B12, 0.02 mg; niacin, 22.5 mg; thiamine, 5.0 mg; folic acid, 0.70 mg; pyridoxine, 1.3 mg; riboflavin, 5 mg; pantothenic acid, 25 mg; choline chloride, 175 mg; Mn, 60 mg; Zn, 45 mg; I, 1.25 mg; Se, 0.4 mg; Cu, 10.0 mg; Fe, 72 mg; Co, 2.5 mg.

2.2 Measurements and analysis

Body weights were measured on weekly basis from the initial day to the final day of the experiment and average weekly feed intake (AWFI) was calculated. Feed intake was determined by measuring feed residue on weekly basis from the beginning of the experiment up to end. Feed conversion ratio (FCR) was calculated as feed per gain based on the weight of feed consumed divided by body weight gain per pen.

2.3 Meat sampling and analysis

At the end of the feeding trial (day 35), three birds per replicate pen (10 broilers per treatment) were randomly selected and slaughtered by cervical dislocation according to dissection following the method of Jones (1984) to separate different body parts as well as organs and recorded individual weight.

2.4 Data analysis

All data were subjected to analysis of variance (ANOVA) by using SAS 9.1 version and Microsoft Excel. The pen was used as the experimental unit to analyze growth performance, whereas three birds from each replicate pen was used as the experimental unit for analysis of carcass characteristics as well as organs weight. Statistically significant effects were further analyzed, and means were compared using Duncan's multiple range tests. Probability values of $P<0.05$ were considered as statistically significant.

3. RESULTS AND DISCUSSION

3.1 Average weekly live weight

Average weekly live weight (AWLW) of broilers in supplementing soybean oil and palm oil at different ages is presented in Table 2. No significant variation ($P>0.05$) was found on AWLW until 2nd week in different treatments. However, significant difference ($P<0.01$) was observed in the subsequent weeks from 3 to 5 weeks. At 3rd week, the highest live weight was observed in soybean oil group and lowest in control group which was supported by Nitsan et al. (1997). They claimed that the 'extra caloric' effect of added soybean oil is reflected in improved body weight gain, food utilization, metabolizable energy or net energy deposition in the body. The highest AWLW was also found in soybean oil group at 4th week where there was a significant difference from control and palm oil group. The final AWLW was significantly increased in palm oil group compared to control and soybean oil group ($P<0.01$). Similar effects were also observed by Das et al. (2014) and Nwoche et al. (2003). There was a tendency for body weight of the chicks to increase with increasing palm oil content in the diets. The increase in body weight was mostly due to higher metabolizable energy (ME) consumption in the vegetable oil supplemented groups.

Table 2. Average weekly live weight (g/bird) of broilers at different ages

Age	Dietary treatment groups			SEM	Level of Significance
	T_0	T_1	T_2		
Day old	43.23	45.07	43.13	0.84	NS
1st week	131.41	133.87	131.95	1.40	NS
2nd week	274.00	278.62	279.80	1.64	NS
3rd week	643.62^a	705.01^c	668.88^b	0.89	**
4th week	1127.11^a	1152.60^b	1136.29^a	4.54	*
5th week	1647.067^a	1703.53^b	1743.82^c	0.23	**

The mean values having different superscripts differ significantly

NS = Non-significant, * = Significant at 5%, ** = Significant at 1%

T_0 : Control; T_1 : Soybean oil (basal diet + 2% soybean oil on DM basis); T_2 : Palm oil (basal diet + 2% palm oil on DM basis)

3.2 Weekly feed consumption

Effect of supplementing vegetable oils on weekly feed consumptions at different ages is presented in Table 3. No significant differences in feed consumption were observed among treatment groups up to 2nd week of age. However, feed intake of broiler at 3rd, 4th and 5th week of age differed significantly (P<0.01). At 3rd week, the highest weekly feed intake was observed in T_2 group whereas the lowest feed intake was in T_0 group. In both 4th and 5th week of age, feed intake of broilers reduced significantly in vegetable oil groups compared to control group (P<0.01), while the lowest intake was in T_2 group. It might be due to dejecting effect of increasing level of palm oil in the diets, thus enabled the chicks to decrease voluntary intake (Panja, 1996). Similar effects were also observed by Das et al. (2014) and Nwoche et al. (2003).

Table 3. Average weekly feed intake (g/bird) of broilers at different ages

Age	Dietary treatment groups			SEM	Level of Significance
	T_0	T_1	T_2		
1st week	90.27	94.29	93.08	1.70	NS
2nd week	211.40	214.23	215.89	1.50	NS
3rd week	619.20^a	661.19^c	636.22^b	1.68	**
4th week	841.41^c	794.74^b	773.58^a	0.24	**
5th week	1042.19^c	1010.43^b	990.59^a	1.17	**

The mean values having different superscripts differ significantly
NS = Non-significant, * = Significant at 5%, ** = Significant at 1%
T_0 : Control; T_1 : Soybean oil (basal diet + 2% soybean oil on DM basis); T_2 : Palm oil (basal diet + 2% palm oil on DM basis)

3.3 Feed conversion ratio

The feed conversion ratio (FCR) of birds during different stages of growth is shown in Table 4. There was no significant effect (P>0.05) on FCR in vegetable oils supplemented groups up to 2nd week of age. FCR was significantly reduced at 3rd week in soybean and palm oil supplementation compared to control group (P<0.05). The final FCR at 5th week was differed significantly in vegetable oil supplementation compared to control (P<0.05) the lowest was observed in soybean oil group (P<0.05). The reduction of FCR can be explained as the reduction of feed consumption and increased weight of broiler in vegetable supplementation (Firman et al., 2010).

Table 4. Average weekly FCR of broilers at different ages

Age	Dietary treatment groups			SEM	Level of Significance
	T_0	T_1	T_2		
1st week	1.03	1.06	1.05	0.033	NS
2nd week	1.31	1.32	1.31	0.012	NS
3rd week	1.52^c	1.47^a	1.51^b	0.006	**
4th week	1.62^b	1.59^a	1.57^a	0.006	*
5th week	1.75^c	1.67^b	1.59^a	0.004	**

The mean values having different superscripts differ significantly
NS = Non-significant, * = Significant at 5%, ** = Significant at 1%
T_0 : Control; T_1 : Soybean oil (basal diet + 2% soybean oil on DM basis); T_2 : Palm oil (basal diet + 2% palm oil on DM basis)

3.4 Carcass characteristics

Different carcass characteristics of broilers feeding vegetable oils are presented in Tables 5. At 5th week, most of the carcass parameters were statistically non-significant (P>0.05) except for wing meat weight, heart weight, dressed weight, drumstick meat weight and digestive tract weight which were varied significantly (P<0.05).

The highest wing meat weight was found in Palm oil group (P<0.05) compared to control and soybean oil groups. Dressed weight (DW) at 5th week differed significantly (P<0.01) among different groups. The highest DW observed in soybean oil group compared to control and palm oil supplemented group. Scaife et al. (1994) also supplemented feed for broilers with different sources of lipids (soybean oil, canola oil, marine fish oil or a mixture of these oils) and reported increased live weight. Rodriguez et al. (2002) stated that palm oil or mixtures of palm oil are sources of fatty acid can be replaced animal fats without any negative impact on carcass quality. Digestive tract weight (DTW) was increased significantly in soybean and palm oil supplementation compared to control (P<0.01).

Table 5. Carcass characteristics of broiler at 5th week of age

Parameters (g/100g LW)	Dietary treatment groups			SEM	Level of Significance
	T_0	T_1	T_2		
Wing meat weight	3.30[a]	3.44[a]	4.12[b]	0.16	*
Drumstick bone weight	1.97	1.65	2.04	0.11	NS
Thigh bone weight	1.28	1.29	1.27	0.06	NS
Neck weight	2.64	2.88	2.84	0.19	NS
Dressed weight	60.28[a]	63.74[c]	62.16[b]	0.24	**
Breast meat weight	15.08	14.83	14.60	0.69	NS
Thigh meat weight	8.28	8.550	8.71	0.45	NS
Drumstick meat weight	5.87[a]	6.40[a]	7.24[b]	0.27	*
Skin weight	7.78	7.52	7.11	0.36	NS
Abdominal fat weight	2.83	2.56	2.28	0.45	NS
Digestive tract weight	8.79[a]	10.26[b]	11.30[c]	0.12	**
Liver weight	2.57	2.42	2.68	0.13	NS
Gizzard weight	3.38	2.85	3.11	0.18	NS

The mean values having different superscripts differ significantly
LW = Live weight; NS = Non-significant, * = Significant at 5%, ** = Significant at 1%
T0 : Control; T1 : Soybean oil (basal diet + 2% soybean oil on DM basis); T2 : Palm oil (basal diet + 2% palm oil on DM basis)

3.5 Benefit-cost analysis

The analysis of Benefit Cost Ratios (BCR) are expressed in the Table 6. Although total cost was remained unchanged, total return (TR), net return (NR) and BCR were differed significantly (P<0.05) among treatment groups. Total return, NR and BCR were significantly higher in palm oil group compared to control which can be explained as increased growth performance with reduced FCR.

Table 6. Benefit-Cost analysis per bird in different treatment groups

Cost and return items (*BDT per bird)	Dietary treatment groups			SEM	Level of Significance
	T_0	T_1	T_2		
Total cost*	170.30	168.38	165.96	1.45	NS
Total return*	178.29[b]	182.42[ab]	186.88[a]	1.54	*
Net return*	8.00[b]	14.03[ab]	20.93[a]	2.37	*
BCR	1.05[b]	1.08[ab]	1.13[a]	0.02	*

The mean values having different superscripts differ significantly.
BCR = Benefit cost ratio; NS = Non-significant, * = Significant at 5%, * * = Significant at 1%
T_0 : Control; T_1 : Soybean oil (basal diet + 2% soybean oil on DM basis); T_2 : Palm oil (basal diet + 2% palm oil on DM basis)

4. CONCLUSION

The results showed that the highest final live weight was achieved in palm oil group and feed intake was reduced in oil supplemented group. FCR of broiler fed soybean oil and palm oil also reduced significantly compared to control group. Among carcass parameters wing meat weight, dressed weight, drumstick meat weight and digestive tract weight were increased. Final dressed weight increased significantly in soybean and palm oil supplemented groups where the highest result was observed in soybean oil compared to others. Net return and BCR were also highest in palm oil supplemented group. So it is clear that vegetable oil supplementation increased growth performance, carcass characteristics and net return for broiler production.

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