

Effects of Different Oils on Productive Performance of Broiler

Research Article

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ABSTRACT

Six hundred day old unsexed broiler chicks were used in a 42-d trial at Chittagong Veterinary and Animal Sciences University Poultry Farm to find out the effects of different oils on productive performance of broilers. The chicks were randomly distributed following a completely randomized design in four treatment groups having three replications per treatment. Each treatment had 150 birds, with 50 birds per replicate. Four diets were formulated using locally available ingredients as diet without oil, or diets containing 2.5% soybean oil, 2.5% palm oil and 2.5% fish oil. Results indicated that supplementation of diets with different types of oil significantly ($P<0.05$) improved live weight gain and feed consumption of broilers from the 3rd to the 5th wk. However, supplementation caused no significant ($P>0.05$) impact on feed conversion of broilers during 1-5 wk. Feed conversion improved ($P<0.05$) only during the 6th wk. Out of all carcass parameters, only feather weight, dressed weight, digestive tract weight and head weight differed ($P<0.05$) at the 4th wk. The survivability of broilers fed different types of oil was similar. It could, therefore, be inferred that the inclusion of soybean oil, palm oil and fish oil had a positive impact on weight gain, feed consumption and feed conversion in commercial broilers.

KEY WORDS broiler, diet, feed, oil, performance.

INTRODUCTION

Fats used for human and poultry consumption are relatively expensive when compared to other rendered products. One of the major concerns related to fat usage is the actual ME value that should be assigned to each fat source. This number is often difficult to determine in a practical sense and may have little practical value in diet formulation. The type of fat added to the diet has a significant influence on the profile of fatty acids of the abdominal fat. It was evident that inclusion of saturated fats produces higher accumulation of intramuscular, mesenteric and abdominal fat in broilers (Sanz *et al.* 1999; Crespo and Esteve-Garcia, 2002). Additionally, it incurs extra cost for equipment needed to add fat. Therefore, there is a need to explore an

alternative source of fat like palm oil or fish oil. The fats usually used in poultry feeds are tallow and vegetable oils such as soybean oil, rapeseed oil, coconut oil or corn oil. In Bangladesh, palm oil and fish oil are cheaper than corn oil or soybean oil. Palm oil possesses many good qualities such as a high level of ME (kcal/kg), as well as vitamin A and E (antioxidant agent), which makes it more stable. Fats are a dense source of energy and have the highest caloric value among all the ingredients. These are included in poultry diets to increase the energy density (Pinchasov and Nir, 1992). Investigations related to the addition of single or mixed fats on performance and accumulation have been published. It was found that the addition of fat increased performance as well as deposition of body fat (Bavelar and Beynen, 2003; Glaser *et al.* 2004). In addition to the above

advantages, inclusion of fat or oil in starter and grower diets can improve feed efficiency (Baiao and Lara, 2005). Although much work has been done on the utilization of animal fats, reports on the use of vegetable oil and marine fish oil in poultry feeds are limited. Therefore, the present experiment was to determine the effect of supplementing different oils on production performance of broilers.

MATERIALS AND METHODS

Six hundred one day-old unsexed broiler chicks were used in a 42-d trial at Chittagong Veterinary and Animal Sciences University Poultry Farm to carry out this experiment. The experiment was conducted following a completely randomized design (CRD). The broilers were randomly distributed in four treatment groups having three replications per treatment. Each replication had 50 broilers. The experiment was in a well-ventilated poultry shed (floor size 914×7621×604 cm³) that was divided into 12 wire-netted pens and had a concrete floor. Floor space for each broiler was 941 square cm. The shed was hygienically cleaned for the experiment. Four diets were formulated using locally available ingredients and designated as T₀ (without oil), T₁ (2.5% soybean oil), T₂ (2.5% palm oil) and T₃ (2.5% fish oil). All diets were isonitrogenous; however, diets T₁, T₂ and T₃ were iso-energetic (Table 1), while T₀ was slightly lower in energy, as that group was without oil. The detailed composition of diets is given in Table 1. The broilers were provided with dry mash feed throughout the experimental period. Feed and fresh clean water were supplied *ad libitum* to the broilers. The broilers were brooded in their respective pens at a temperature of 32-35 °C. The broilers were exposed to continuous lighting. Fresh dry rice husk was used as litter material at a depth of 4.5 cm. At 15-day intervals old litter material was removed from the pen and new litter was replaced. Feed intake, weight gain and feed efficiency were measured weekly. The broilers were vaccinated against Newcastle and Gumboro diseases as per schedule. At the end of 4th, 5th and 6th wk of the experiment one broiler from each replication weighing close to the average of the pen was selected and slaughtered for processing. Feeders and drinkers were withdrawn from the pens 12 hours prior to slaughtering to empty the digestive system with less chance of damaging the intestines and contaminating the carcass with fecal material. After bleeding, the slaughtered broilers were immersed in hot water at 50 °C for 120 seconds in order to loosen the feathers of the carcasses. After bleeding and removing feathers from the broilers, they were subjected to dissection following the method of Jones (1984). The data were analyzed for analysis of variance in a CRD using SPSS (2007) and Stata (2009). Means showing significant differences were compared by Dun-

can's New Multiple Range Test (Duncan, 1955). Statistical significance was accepted at $P < 0.05$.

RESULTS AND DISCUSSION

Live weight gain

The responses of broilers to different types of oil on the live weight gain of broilers at different ages are presented in Table 2. Supplementation of diets with different types of oil improved live weight gain of broilers ($P < 0.05$) from the 3rd to the 5th wk of age.

However, no differences ($P < 0.05$) were evident from 1st to 2nd wk of age. It was evident that in early stages of growth the trend for increased weight gain of broilers was not consistent; however, in later stages it was consistent, which was reflected at the 6th wk when the values were significantly different ($P < 0.01$).

It is interesting to note that at the 6th wk of age there was a decrease in weight gain compared to those of broilers at earlier stages of growth. The decrease was significant in the group with no oil supplementation. Weekly body weight gains for the fish oil treatment were highest during the 3rd-5th wk but were similar to those from other oils in the 1-6 wk period. It has been reported that soybean oil stimulated the growth rate of broilers when included in certain types of poultry diets (Carew *et al.* 1961). The addition of fats or oils to diets causes a tendency for increased feed consumption and, consequently, increased energy and other nutrient consumption, which leads to increased live weight gain in broilers (Ensminger *et al.* 1990; Manilla *et al.* 1999). Increase in live weight gain is mostly due to higher ME consumption in same unit of diets by chickens. The inclusion of fish oil in poultry diets has also been reported to result in higher weight gain of broilers (Huang *et al.* 1990) but caused no statistical improvement in weight gain in the present research. The results of weight gain of broilers agree with Newman *et al.* (1998), Crespo and Esteve-Garcia (2001), Crespo and Esteve-Garcia (2002) and Lopez Ferrer *et al.* (2001). Fish oil is rich n-3 fatty acids that reduced the catabolic response induced by immune stimulation and may effectively promote growth (Chin *et al.*, 1994).

Similar to weight gain, supplementation of oil caused a positive trend in cumulative live weight gain (g/broiler) of broilers at different ages (Table 2). Cumulative live weight gain varied ($P < 0.05$) in broilers aged 1-5 wks and 1-6 wks. There was a trend of highest cumulative weight gain in the case of the fish oil-receiving group at all ages. Significant ($P < 0.05$, $P < 0.01$) increase in cumulative live weight gain in both 1-5 and 1-6 wks of age of the oil-supplemented broilers indicates that supplementation has a greater effect close to market age of the broilers.

Table 1 Composition of the diets

Feed ingredient ²	¹ T ₀		¹ T ₁		¹ T ₂		¹ T ₃	
	Starter	Finisher	Starter	Finisher	Starter	Finisher	Starter	Finisher
Maize	61.00	68.25	58.00	61.91	61.01	65.75	58.00	62.50
Rice polish	4.67	0.67	4.67	3.66	2.36	0.67	4.67	3.17
Soybean oil ²	0	0	2.50	2.50	0	0	0	0
Palm oil ³	0	0	0	0	2.50	2.50	0	0
Fish oil ⁴	0	0	0	0	0	0	2.50	2.50
Soybean meal	28.50	22.80	29.00	25.80	27.00	22.80	29.00	25.50
Meat and bone meat	0	2.10	0	1.50	0	2.10	0	1.50
Protein concentrate ⁵	3.50	4.00	3.50	2.30	4.80	4.00	3.50	2.50
Limestone	1.10	0.95	1.10	1.10	1.10	0.95	1.10	1.10
Dicalcium phosphate	0.50	0.50	0.50	0.50	0.50	0.5	0.50	0.50
L-Lysine	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
DL-Methionine	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Vitamin A (mIU)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vitamin D ₃ (mIU)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Vitamin E (g)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Vitamin K ₃ (g)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Vitamin B ₁ (g)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Vitamin B ₂ (g)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Vitamin B ₆ (g)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Vitamin B ₁₂ (g)	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Niacin (g)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Folic acid (g)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Biotin (g)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Iron (g)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Zinc (g)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Manganese (g)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Copper (g)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Iodine (g)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Selenium (g)	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Antioxidant	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Common salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calculated values								
DM (g/100g)	89.89	89.89	89.90	89.90	89.90	89.90	89.91	89.91
ME (kcal/kg)	2895.00	2952.00	3027.00	3051.00	3023.00	3052.00	3022.00	3051.00
CP (g/100g)	21.09	20.15	21.04	19.93	21.04	19.92	21.04	19.91
EE (g/100g)	3.25	2.99	5.69	5.63	5.51	5.42	5.68	5.58
CF (g/100g)	3.41	2.94	3.38	3.18	3.17	2.90	3.37	3.14
Ca (g/100g)	0.89	0.94	0.89	0.88	0.89	0.94	0.89	0.89
P (g/100g)	0.67	0.65	0.65	0.63	0.66	0.65	0.66	0.63
Lysine (g/100g)	1.11	1.02	1.12	1.01	1.13	1.01	1.11	1.02
Methionine (g/100g)	0.37	0.35	0.37	0.35	0.36	0.35	0.36	0.35

¹T₀: diet without oil; T₁: diet containing 2.5% soybean oil; T₂: diet containing 2.5% palm oil; T₃: diet containing 2.5% fish oil.

²g/100g or otherwise stated and ME: 8900 kcal/kg.

³ME: 7300 kcal/kg.

⁴ME: 8800 kcal/kg.

⁵DM: 92.5%; ME: 2900 kcal/kg DM; CP: 60.0%; CF: 3.0%; EE: 13.0%; Ash: 24.0%; Ca: 6.5%; P: 2.5%; Lysine: 7.0% and Methionine: 2.0%.

DM: dry matter; ME: metabolizable energy; CP: crude protein; EE: ether extracts and CF: crude fibre.

Among the supplemented groups of broilers, there was no significant variation in their cumulative weight gains. Therefore, it might be inferred that soybean oil, palm oil and fish oil play an important role in weight gain, and it was indicated that supplementation of diet with different types of oil increased cumulative live weight gain of broiler.

Feed consumption

Effect of supplementation of diets with different types of oil on average feed consumptions of broilers at different ages is presented in Table 3.

There was no difference in feed consumption among the groups of broilers up to the 2nd wk of age. However, after that there were ($P < 0.05$) differences in the remaining experimental period (3-6 wk). The overall feed consumption of the broilers was increased by inclusion of oils. When compared with the group fed no added oil, significant differences were found for the fish oil, palm oil and soybean oil groups.

It clearly indicates that young broilers were not affected by the type of dietary oil. However, as the age increased, sources of oil affected voluntary feed intake from 3-6 wks of age.

Table 2 Weekly and cumulative live weight gain (g/broiler) of broilers at different ages fed diets supplemented with different types of oil

Age (wk)	Dietary treatment groups				SEM	Significant
	T ₀	T ₁	T ₂	T ₃		
1	85.13	104.47	101.17	109.46	12.00	NS
2	199.34	197.81	204.96	194.89	4.98	NS
3	334.24 ^b	344.70 ^b	336.66 ^b	383.25 ^a	8.93	*
4	350.56 ^c	407.78 ^a	390.71 ^{ab}	385.86 ^b	9.64	*
5	389.39 ^b	397.60 ^b	407.17 ^b	426.82 ^a	11.60	*
6	286.49 ^c	359.34 ^a	326.88 ^{ab}	319.89 ^{bc}	19.07	*
1-4	995.49 ^c	1054.75 ^{ab}	1033.50 ^b	1073.30 ^a	16.52	*
1-5	1344.88 ^b	1452.35 ^b	1440.67 ^b	1500.06 ^a	18.84	*
1-6	1631.37 ^c	1812.02 ^a	1767.55 ^b	1819.95 ^a	25.31	**

T₀: diet without oil; T₁: diet containing 2.5% soybean oil; T₂: diet containing 2.5% palm oil; T₃: diet containing 2.5% fish oil.

The means within the same row with at least one common letter, do not have significant difference (P>0.05).

NS: non significant and SEM: standard error of means.

* P<0.05 and ** P<0.01.

Table 3 Weekly and cumulative feed consumption (g/broiler) of broiler at different ages fed diets supplemented with different types of oil

Age (wk)	Dietary treatment groups				SEM	Significant
	T ₀	T ₁	T ₂	T ₃		
1	128.95	148.47	141.34	155.67	13.99	NS
2	316.55	330.27	313.95	327.87	11.05	NS
3	554.16 ^c	594.85 ^b	589.03 ^b	679.33 ^a	16.54	*
4	734.20 ^c	839.50 ^a	781.27 ^b	827.33 ^a	14.55	*
5	838.26 ^c	912.17 ^b	920.48 ^b	1003.74 ^a	10.31	*
6	1050.09 ^{bc}	1104.78 ^a	1066.67 ^{ab}	1087.15 ^{ab}	24.35	*
1-4	1733.85 ^d	1913.08 ^b	1825.59 ^c	2003.45 ^a	17.27	*
1-5	2572.13 ^d	2825.25 ^b	2746.07 ^c	2993.86 ^a	21.05	*
1-6	3622.21 ^d	3930.04 ^b	3812.74 ^c	4081.00 ^a	33.53	*

T₀: diet without oil; T₁: diet containing 2.5% soybean oil; T₂: diet containing 2.5% palm oil; T₃: diet containing 2.5% fish oil.

The means within the same row with at least one common letter, do not have significant difference (P>0.05).

NS: non significant and SEM: standard error of means.

* P<0.05.

All the groups of broilers that were fed on oil supplemented diets showed (P<0.05) higher feed intake than the group having no oil in the diet. Among the broilers of oil supplemented groups, fish oil groups had higher feed intake than the groups fed soybean oil and palm oil supplemented diets. These results indicate that addition of fish oil in the broiler diets does not depress feed intake; rather, it improves it.

Similar to weekly intake, from 1-4 wk the maximum and minimum cumulative feed consumptions (g/broiler) were found in broilers supplemented with fish oil and the no oil group. Similarly, on 1-5 wk the maximum and minimum cumulative feed consumptions (g/broiler) were found in broilers supplemented with fish oil or no oil. Again, from 1-6 wks the maximum and minimum cumulative feed consumptions (g/broiler) were found in broilers supplemented with fish oil or no oil. The inclusion of fish oil in poultry diets has been reported to have no effect on consumption of feed (Huang *et al.* 1990). Pesti *et al.* (2002) demonstrated that the average live weight of broilers consuming a diet with soybean oil was not different from those consuming a diet of animal or vegetable blend and poultry grease. Scaife *et al.* (1994) and Al Athari and Watkins (1988) have reported higher feed consumption in broilers fed on dietary tallow than rapeseed oil diets.

Therefore, in the present study, it is indicated that feed consumption increased each wk and that cumulative feed consumption was greater (P<0.05) for diets with soybean oil, palm oil and fish oil.

Feed conversion

The feed conversion (FC) of broilers fed on different diets during different stages of growth is given in Table 4. Supplementation of diets with different types of oil revealed no significant impact on feed conversion during 1-5 wk. However, supplementation of oil improved (P<0.05) FC significantly at 6 wk. Best FC was found in broilers fed diets supplemented with soybean oil, which differed significantly from those fed a diet with no added oil. Broilers of different oil groups showed statistically similar FC values (Table 4). Since supplementation of diets with different types of oil did not influence (P>0.05) FC of broilers up to 5 wk of age, it can be inferred that the type of dietary oil has little effect up to 5 wk of age of broilers. The reason for no improved FC up to 5 wk of age of broilers could have been due to poor utilization of diets due to oil supplementation. However, FC of the broilers of different groups fed supplemented diets at 6 wks of age indicates that at a later stage of growth the efficiency of utilization of feed was less than at an earlier stage of growth.

Table 4 Weekly and cumulative feed conversion of broiler at different ages fed diets supplemented with different types of oil

Age (wk)	Dietary treatment groups				SEM	Significant
	T ₀	T ₁	T ₂	T ₃		
1	1.52	1.42	1.39	1.42	0.03	NS
2	1.58	1.67	1.53	1.68	0.05	NS
3	1.66	1.73	1.73	1.77	0.08	NS
4	2.09	2.06	2.00	2.14	0.03	NS
5	2.22	2.30	2.27	2.35	0.25	NS
6	3.67 ^a	3.13 ^b	3.33 ^b	3.41 ^{ab}	0.25	*
1-4	1.81	1.81	1.76	1.85	0.03	NS
1-5	1.91	1.95	1.91	2.00	0.03	NS
1-6	2.22	2.17	2.16	2.14	0.04	NS

T₀: diet without oil; T₁: diet containing 2.5% soybean oil; T₂: diet containing 2.5% palm oil; T₃: diet containing 2.5% fish oil.

The means within the same row with at least one common letter, do not have significant difference (P>0.05).

NS: non significant and SEM: standard error of means.

* P<0.05.

The cumulative feed conversion during 1-4 and 1-5 wk revealed no significant differences. The results showed that no marked changes took place on cumulative FC in this experiment. There are conflicting reports on the effect of oil supplementation on FC of broiler. [Al Athari and Watkins \(1988\)](#) found no difference in the FC of broiler diets containing 5% added saturated fat or soybean oil. In contrast, [Pinchasov and Nir \(1992\)](#) and [Zollitsch *et al.* \(1996\)](#) reported an improved FC in broiler when dietary polyunsaturated fatty acid intake increased. [Sanz *et al.* \(2000\)](#) and [Abas *et al.* \(2004\)](#) confirmed that the source and level of different fats and the rates of use did not affect the feed conversion of broiler.

Meat yield characteristics

Out of all carcass parameters, only feather weight, dressed weight, digestive tract weight and head weight differed (P<0.05) at 4 wk of age. At 5 wk of age, the implication of supplementing different oils in the diets was that all carcass parameters were similar (P>0.05) except for drumstick meat weight, breast meat weight, dressed weight, skin weight and feather weight (P<0.05). At the age of 6 wk, only neck weight was affected (P<0.05) by supplementation of different oils.

It was evident that, dressed weight in soybean and palm oil treatments was positively increased at the age of 4, 5, and 6 wk of age. Highest skin weight was observed from those fed palm oil and soybean oil. For fish oil and without oil, skin weight was lower than those fed palm and soybean oil at 5 wk of age.

At the end of 4 wk of age, skin weight was higher in those fed soybean and palm oil. At 4 wk of age, increased feather weight was due to oil supplements, and the highest weight was found in the fish oil group, which might have been from more growth of feathers. A similar result was also found in the case of dressing weight of the broiler. The reason for better dressing yield in the soybean oil supplemented group of broilers is unknown.

Therefore, it may be said that at 4 wk of age, oil supplementation did not have positive effect on overall meat yields. Supplementation of soybean oil and fish oil has been observed to increase breast meat yield compared to broilers fed no supplemental oil; however, palm oil supplementation slightly decreased breast meat, when compared to broilers fed no supplemental oil. The reason is unknown. At the end of 5 wk of age, no significant differences were found in dressed yield. Because of the higher price of soybean oil and higher percentage of abdominal fat, dressed broiler marketing from those fed diets with palm and fish oil group would be more beneficial up to the end of 5 wk of age.

Survivability

The survivability of broilers fed different types of oil at different stages of growth was similar. However, it was interesting to note that the survivability of the broilers fed fish oil supplemented diets was 100%.

CONCLUSION

During the early life of broilers (1-2 wk), supplementation of oil had no effect on live weight gain, feed consumption and feed conversion. At the 6th wk of age, supplementation of soybean oil, palm oil and fish oil substantially increased weight gain and feed consumption and decreased FC compared to those fed no added oil. Supplementation of oil resulted in higher dressed weight, breast meat weight and skin weight but lower drumstick weight compared to those without added oil at 5 wk.

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