

Effects of Safflower Seed on Performance, Carcass Traits and Blood Parameters of Broilers

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Abstract: This study was designed to evaluate the effect of various levels of Full-Fat Safflower seed (FFSS) on performance in broiler chickens. Diets containing various levels of FFSS (0, 5, 10, 15 and 20%) were given to broilers from 21-42 day of age. About 350,21 day old broiler chickens were weighted and distributed randomly to 5 treatments with 5 replicates (14 chicks in each replicate) in each treatment. Blood parameters and carcass traits were determined at 42 days of age. FFSS levels did not significantly affect weight gain, feed intake and Feed Conversion Ratio (FCR). Breast yield, thighs, gastrointestinal tract, liver and gizzard weight percentages were not affected by dietary treatments and abdominal fat pad percentage did not significantly decrease. Triglyceride and total serum protein concentrations were not affected by FFSS levels but cholesterol concentration was significantly decreased ($p < 0.05$). The results of the current study indicated that FFSS could be used up to 20% of broiler diets without any adverse effects on performance or other parameters of chickens.

Key words: Safflower seed, broiler, carcass, blood parameters, dietary treatments, serum protein

INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is a member of the family Compositae or Asteraceae. It is an annual herbaceous plant, cultivated mainly for its seed which is used as edible oil and as bird seed. Oilseeds are one of the best and common energy sources in poultry nutrition (Dajue and Mundel, 1996). Current trends toward formulating high-energy diets for broiler chickens make it necessary the inclusion of fats and oils up to 10% in broiler feeds. Fats and oils are rich sources of energy, containing 39.29 MJ kg⁻¹ gross energy but are more costly on a weight basis and may contain impurities. As an alternative to fats and oils, full-fat oilseeds (Ajuyah *et al.*, 1993) such as soybean seed are used to replace the supplemented fats and oils in broiler diets. However, soybean seed has anti-nutritional factors such as trypsin inhibitors which need further processing, thus increasing the cost of soybean seed. Among the various oilseeds available on the market, Full-Fat Safflower Seed (FFSS) contains more Ether Extract (EE) and is available at a relatively low price. This high EE content contributes to a high Metabolic Energy (ME) per unit or high energy density of feed. Several studies were carried out to evaluate the use of unextracted whole seed as a feed ingredient in pig and poultry diets, without negative effects on digestion or on meat quality (Oguz and Oguz, 2007). FFSS is a source of magnesium, lysine, pyridoxine, biotin, panthothenic acid and choline (Oguz and Oguz,

2007). FFSS contains about 15-19% crude protein, 28-35% ether extract, 15-19% crude fibre, 30- 32% Acid Detergent Fibre (ADF) and 40-45% Neutral Detergent Fibre (NDF) (Hill and Knowles, 1968). Safflower oil is rich in linoleic acid (75-78%) which plays an important role in reducing blood cholesterol level (Oguz and Oguz, 2007). Also, FFSS is a source of dietary Monounsaturated Fatty Acids (MUFA) and inclusion of it in monogastric diets can be particularly valuable to increase the degree of unsaturation of intramuscular fat, without the negative effect of lipid oxidation associated with dietary Polyunsaturated Fatty Acids (PUFA) (Hill and Knowles, 1968). The objective of this study was to study the effect of various levels of FFSS (0, 5, 10, 15 and 20% diet) on performance, blood parameters and carcass traits of broiler chickens.

MATERIALS AND METHODS

This study was carried out at the experimental farm of the University of Zanjan, Iran. Samples of FFSS were analyzed for dry matter, crude protein (N×6.25), crude fibre and ash following the AOAC (1995) procedures as shown in Table 1. From hatching to 20 days of age, all birds were fed a starter (Table 2), followed by the experimental diets. About 5 experimental isoenergetic (ME) and isonitrogenous diets were formulated to contain 0, 5, 10, 15 and 20% of FFSS (Table 2). The diets were formulated to meet the nutritional requirements of broiler chicks

Table 1: Determined analysis of full-fat safflower seed (on dry matter basis except dry matter)

Components	Values
Dry matter	94.40
Crude protein	17.90
Ether extract	32.80
Ash	2.00
Crude fiber	16.40
Available phosphours	0.84
Calcium	0.34
Lysine	2.30
Methionine	0.65
Metabolizable energy (MJ kg ⁻¹)	14.42

Table 2: Ingredients (%), chemical composition (%DM except dry matter) and energetic value (MJ kg⁻¹) of the basal and experimental diets

Ingredients	Starter (0-21 days)	Level of FFSS (%)				
		0	5	10	15	20
Maize	56.19	66.63	62.61	57.89	53.96	49.60
Soybean meal	33.96	26.74	26.12	25.95	24.98	24.42
FFSS	-	-	5.00	10.00	15.00	20.00
Soybean oil	3.00	1.20	1.00	1.00	1.00	1.00
Fish meal	3.00	2.00	2.00	2.00	2.00	2.00
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Limestone	1.28	1.40	1.38	1.36	1.34	1.32
Dicalcium phosphate	1.38	0.96	0.91	0.86	0.82	0.77
Vitamine premix*	0.25	0.25	0.25	0.25	0.25	0.25
Mineral premix ^o	0.25	0.25	0.25	0.25	0.25	0.25
L-Lysine	0.09	0.08	0.04	0.04	-	-
DL-Methionine	0.20	0.09	0.04	-	-	-
Vitamin E	0.10	0.10	0.10	0.10	0.10	0.10
Chemical composition						
Dry matter (%)	89.8	89.31	89.87	89.88	90.16	90.45
Crude protein	21.30	18.75	18.75	18.75	18.75	18.75
Crude fibre	3.63	3.36	4.04	4.72	5.39	6.06
Ether extract	5.48	4.04	5.26	6.73	8.22	9.68
Lysine#	1.10	1.24	1.20	1.17	1.16	1.12
Methionine#	0.57	0.52	0.53	0.54	0.54	0.54
Calcium#	1.01	1.04	1.05	1.07	1.08	1.09
Available P#	0.45	0.46	0.44	0.48	0.48	0.49
Metabolizable energy (MJ kg ⁻¹)	12.54	12.54	12.54	12.54	12.54	12.54

*Supplied per kilogram: Vitamin A 8000 U; Vitamin D3 8560 U; Vitamin E 95 U; Vitamin B12 4.5 mg; Biotin 0.2 mg; Niacin 50 mg; Panthotenic acid 15 mg; Pyrodoxin 4 mg; Riboflavin 10 mg; Thiamin 3 mg; ^oSupplied per kilogram: Copper (Cupric sulfate pentahydrate); 7 mg; Iodine (Calcium iodate) 1 mg; Iron (Ferrous sulfate monohydrate) 50 mg; Manganese (Manganese sulfate monohydrate); 100 mg; Selenium (Sodium selenite) 0.15 mg; Zinc (Zinc sulfate monohydrate) 75 mg. #Calculated using NRC (1994) and analytical chemists values in Zanjan University

recommended by National Research Council (NRC, 1994). About 350,21 day old male chicks (Arbor Acres strain) were weighed and distributed randomly into 5 treatments with 5 replicates (14 chicks in each replicate) in each treatment. Water and feed were provided *ad libitum*. At the end of the experiment (42 days of age), 10 birds per treatment (two from each replicate) were randomly selected and slaughtered by cervical dislocation and blood was collected by heart puncture. Serum was separated and analyzed to determine cholesterol, triglycerides and total serum protein concentrations. At same time, 2 birds from each replicate were selected and slaughtered to measure the weight of thighs, breast, gastrointestinal tract, liver, abdominal fat and gizzard.

Statistical analysis: The study design was Completely Randomized (CRD) with 5 treatments and 5 replicates in each treatment. Data of this study were subjected to analysis of variance using GLM procedures (SAS, 2005). When significant differences were detected, means were compared by the Duncan's multiple range tests at 5% probability.

RESULTS AND DISCUSSION

Table 3 shows the effects of different levels of FFSS on performance parameters of broiler chickens. In the current study feed intake, weight gain and FCR were not significantly affected ($p>0.05$) by the FFSS levels when compared to the control group. In the whole period, the highest and the lowest numerically feed intake were observed in 5% FFSS and in the control group (143.2 vs. 136.7 g/bird/day), respectively. These results are in accordance with those obtained by Oguz and Oguz (2007). The highest and the lowest body weight gain was observed in 5% FFSS (g/bird/day) and 20% FFSS (70.73 vs. 66.99 g/bird/day). It might be due to the higher fiber content of the 20% FFSS diet which could have consequently decreased the density of the diet. This result is in agreement with Oguz and Oguz (2007) who showed that the average body weight gain was not significantly affected in broiler chickens fed 0, 10 and 20% FFSS diets. These results were in contrast to Mohan *et al.* (1984) who reported that average body weight gain was significantly reduced in chickens fed diets containing 23, 35 and 48% safflower meal. The feed conversion ratio determined during the study was better for 10% FFSS and the highest value was observed in 20% FFSS that might be due to the highest crude fibre in 20% FFSS diet. These results are in contrast to those found by Oguz and Oguz (2007), because they showed FCR determined during the study was improved in 20% FFSS broiler chickens diet. These results are in contrast with Arija *et al.* (1998), who showed that performance parameters were reduced when FFSS was added to the diets. Selvaraj and Purushothaman (2004) used various levels of FFSS (0, 5, 10, 15 and 20%) and reported that weight gain and feed consumption were not affected by the FFSS inclusion. The results relative to the weight of the different carcass parts to live body weight are shown in Table 4. The relative weight of the breast yield, thighs, gastrointestinal tract, liver, gizzard and abdominal fat pad were not affected by dietary FFSS levels. However, the relative weight of liver was not significantly decreased in birds fed diets containing FFSS in comparison to those fed the control diet. In the current study, the lower abdominal fat pad and the larger breast muscle showed that the levels of FFSS

Table 3: Effect of full-fat safflower seed on performance parameters of broiler

FFSS (%)	Feed intake (g/bird/days) 21-42	Weight gain (g/bird/days) 21-42	Feed conversion ratio
0	136.70	68.30	2.01
5	143.20	70.70	2.02
10	136.90	68.20	2.00
15	138.90	68.00	2.03
20	139.10	67.00	2.07
SEM	2.58	1.50	0.03

Table 4: Effect of different levels of full-fat safflower seed inclusion on weight of some organs determined at 42 days of age (percentage of live body weight)

FFSS (%)	Gastrointestinal tract					Abdominal fat
	Breast	Thigh	Liver	Gizzard	fat	
0	20.03	10.04	13.01	2.31	2.11	2.42
5	21.54	10.71	15.47	2.20	2.04	1.98
10	21.08	10.22	13.63	2.25	2.23	2.15
15	20.10	10.54	13.96	2.12	2.34	2.26
20	21.06	10.69	12.72	2.19	2.47	2.34
SEM	0.71	0.54	0.72	0.11	0.13	0.16

were increased but these effects were not significant. Several studies reported that feeding polyunsaturated fatty acids to broiler chickens results in reduced abdominal and total carcass fat as compared to that in birds fed saturated fatty acid sources (Sanz *et al.*, 2000). This effect is in accordance with the results of Halminski *et al.* (1991). Thus the reduction in abdominal fat pad for the broilers fed FFSS diets presumably reflects a lower total body fat content and may demonstrate the importance of fatty acids in modulating body fat. In addition, the lower fat pad in chickens consuming FFSS was associated with an increase in lipid oxidation (Sanz *et al.*, 2000). This finding is consistent with the results showing preferential mobilization and/or oxidation of more unsaturated lipids (Halminski *et al.*, 1991). The effects of various levels of FFSS on blood parameters of broiler chicks were shown in the Table 5. The plasma triglyceride concentration tended to be lower in the birds fed higher levels of FFSS but this effect was not significantly different ($p>0.05$). This result is in agreement with the findings of several researchers (Sanz *et al.*, 2000). The lower values of triglycerides found in the chickens fed the highest level of FFSS in their diets may also be a response to the action of specific fatty acids to stimulate enzymes of the β -oxidative pathway. Furthermore, the use of sunflower oil stimulates the activity of both carnitine palmitoyltransferase-1 and S-3-hydroxyacyl-CoA dehydrogenase in chickens (Sanz *et al.*, 2000). Thus, an increase in carnitine palmitoyltransferase-1 activity would render fatty acids more available for β -oxidation. Total cholesterol concentration was significantly different between the control treatment group and that of the diet enriched with 20% FFSS. An *et al.* (1997) reported dietary safflower

Table 5: Effect of increasing levels FFSS on blood parameters of broiler chickens in 42 days of age

FFSS (%)	Triglycerides (mg dL ⁻¹)	Cholesterol (mg dL ⁻¹)	Total protein (g dL ⁻¹)
0	116.60	121.00 ^a	3.39
5	116.60	114.60 ^{ab}	3.11
10	112.00	115.80 ^{ab}	3.80
15	106.20	107.60 ^{ab}	3.65
20	107.20	103.20 ^b	3.90
SEM	9.55	4.83	0.09

^{a,b}within the same column; means with different letters are significantly different ($p<0.05$)

phospholipids may be a valuable ingredient to layers for reducing serum cholesterol without any adverse effects. Also in rats, Moon *et al.* (2001) reported the use of diets including FFSS reduced serum cholesterol. These results are in contrast with those of Oguz and Oguz (2007) in which the serum total cholesterol was not affected when 0, 10 and 20% of FFSS in the diet of broiler chickens was included. Also Selvaraj and Purushothaman (2004), reported no significant effect on serum parameters of poultry fed diets characterized by the inclusion of different levels of FFSS. In accordance with Oguz and Oguz (2007), the serum total protein was not significantly affected by the different level of FFSS.

CONCLUSION

FFSS was proven to be a good source of CP and ME in broiler diets. The results obtained from current experiments indicated that substitution of FFSS for corn, soybean meal up to 20% of diet had no negative effects on performance parameters of broiler chickens.

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