Inclusion of full-fat safflower seed (*Carthamus tinctorius L.*) in broiler diet

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Abstract

This study was conducted to evaluate the use of various levels of full-fat safflower seed (FFSS) on performance and carcass characteristics of broiler chickens from Arbor Acres strain. Diets containing various levels of FFSS (0, 5, 10, 15 and 20%) were given to broilers from 21 to 42 day of age. Before experiment beginning, starter feed was given to chicks for 3 weeks. Then, three hundred fifty 21-day-old broiler chickens were weighted and distributed randomly to 5 treatments with 5 replicates (14 chicks in each replicate) in each treatment. Water and feed were provided ad libitum. Blood parameters and carcass characteristics 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, empty gastrointestinal tract, liver and gizzard weight percentages were not affected by dietary treatments, but 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.

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 (Dajue and Mündel, 1996). Oilseeds are one of the best and common energy sources in poultry nutrition (Pinchasov and Nir, 1992; Scott et al., 1998; Sanz et al., 1999a). Also, oilseeds are a practical and economical means to increase energy levels in poultry diets (Latour et al., 1994; Peebles et al., 1997). 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 gross energy, but are more costly on a weight basis and may contain impurities (Blair and Potter, 1988). 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; Williams and Danils, 1973). FFSS is a source of magnitude, 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; Weiss, 1983). This difference may be due to genetic, varietal, soil and climatic conditions as suggested by Vaughan (1970). 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) (Smith, 1996). In human, there is increasing evidence that dietary monounsaturated fatty acid enrichment has a positive effect on cardiovascular health, decreasing low-density lipoprotein cholesterol but not high-density lipoprotein cholesterol in blood plasma, and decreasing the susceptibility of low-density lipoprotein to oxidation (Grundy, 1986; Roche, 2001). The objective of this experiment was to study the effect of various levels of FFSS (0%, 5%, 10%, 15% and 20% diet) on performance, blood parameters and carcass characteristics of broiler chickens.

Materials and methods

This experiment 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 procedures (1999), as reported in Table 1.

From hatching to 20 days of age, all birds were fed a starter (Table 2), followed by the experimental diets. Five 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 recommended by National Research Council (1994). Three hundred fifty 21-days-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 (1.5×1 m experimental pen). The animals were housed in pen, water and feed were provided ad libitum. The temperature was controlled and gradually reduced from 32°C for the first 5 d of life to 20°C on d 40. The lighting cycle was 24 h/d from day 1 to 3, 18 h/d from day 4 to 20, 21 h/d from day 21 to 35 and 23 h/d from day 36 to 42. At the end of the experiment (42 days of age), 5 birds per treatment (one 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 (Zlatkis et al., 1953), triglycerides (Fossati and Prencipe, 1982), and total serum protein (Doumas et al., 1997) concentrations. At same time, one bird from each replicate (representative in terms of average weight of each group) was selected and slaughtered to measure the weight of thighs, breast, gastrointestinal tract, liver, abdominal fat and gizzard.

Statistical analysis
The experimental design was completely randomized (CRD), with 5 treatments and 5 replicates in each treatment. Data of this experiment were subjected to analysis of variance using GLM procedures (SAS institute, 2001). When significant differences were detected, means were compared by the Duncan’s multiple range tests at 5% probability (Duncan, 1955).

Results and discussion
Performance parameters
Table 3 shows the effects of different levels of FFSS on performance parameters of broiler chickens. In the current study, the feed intake, the weight gain and the 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 Raj et al. (1983) and Oguz and Oguz (2007), but they are in contrast to the study of Rehman and Malik (1986).

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 fibre 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 those reported by Rehman and Malik (1986) and 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 experiment (for 3 weeks) was better for 10% FFSS (2.00) and the highest value was observed in 20% FFSS (2.07). This effect 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 experiment (for 4 weeks) was improved in 20% FFSS broiler chickens diet. These results are in contrast with Arja et al. (1998), who showed that performance parameters were reduced when FFSS was added to the diets. Rodriguez et al. (1998) reported not significant differences in weight gain, feed intake and feed utilization among the chicks receiving control diet and those fed diets with increasing level of FFSS (from 5-25% of diet). Daghir et al. (1980) observed that feeding 15 and 25% FFSS to broilers depressed both body weight gain and feed intake. However, Elangovan et al. (2000) showed that live weight gain, feed intake, nutrient retention and carcass characteristics of quails did not show significant differences (P>0.05), when FFSS meal increased in the diets. Selvaraj et al. (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.

Physiological effects
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. Similarly, Cheva-Isarakul and Tangtaweewipat
Table 3. Effect of full-fat safflower seed on performance parameters of broiler.

<table>
<thead>
<tr>
<th>FFSS, %</th>
<th>Feed intake, g/bird/d</th>
<th>Weight gain, g/bird/d</th>
<th>Feed conversion ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>114.0b</td>
<td>128.6</td>
<td>167.6</td>
</tr>
<tr>
<td>5</td>
<td>123.6</td>
<td>131.1</td>
<td>174.9</td>
</tr>
<tr>
<td>10</td>
<td>116.8ab</td>
<td>124.4</td>
<td>169.3</td>
</tr>
<tr>
<td>15</td>
<td>120.8</td>
<td>130.3</td>
<td>165.6</td>
</tr>
<tr>
<td>20</td>
<td>119.1ab</td>
<td>128.8</td>
<td>169.2</td>
</tr>
<tr>
<td>SEM</td>
<td>2.49</td>
<td>2.52</td>
<td>4.11</td>
</tr>
</tbody>
</table>

ab within the same column, means with different letters are significantly different (P<0.05).

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

<table>
<thead>
<tr>
<th>FFSS, %</th>
<th>Breast</th>
<th>Thigh</th>
<th>Gastrointestinal tract</th>
<th>Liver</th>
<th>Gizzard</th>
<th>Abdominal fat</th>
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<tbody>
<tr>
<td>0</td>
<td>20.03</td>
<td>10.04</td>
<td>13.01</td>
<td>2.31</td>
<td>2.11</td>
<td>2.42</td>
</tr>
<tr>
<td>5</td>
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<td>10.71</td>
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<td>2.25</td>
<td>2.23</td>
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<tr>
<td>15</td>
<td>20.10</td>
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<td>13.96</td>
<td>2.12</td>
<td>2.34</td>
<td>2.26</td>
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<td>20</td>
<td>21.06</td>
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<td>12.72</td>
<td>2.19</td>
<td>2.47</td>
<td>2.34</td>
</tr>
<tr>
<td>SEM</td>
<td>0.71</td>
<td>0.54</td>
<td>0.72</td>
<td>0.11</td>
<td>0.13</td>
<td>0.16</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>FFSS, %</th>
<th>Triglycerides, mg/dL</th>
<th>Cholesterol, mg/dL</th>
<th>Total protein, g/dL</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>116.6</td>
<td>121.0b</td>
<td>3.39</td>
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<tr>
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<td>112.0</td>
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<td>15</td>
<td>106.2</td>
<td>107.6ab</td>
<td>3.65</td>
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<td>20</td>
<td>107.2</td>
<td>103.2b</td>
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<td>SEM</td>
<td>9.55</td>
<td>4.83</td>
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</table>

ab within the same column, means with different letters are significantly different (P<0.05).

Conclusions

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.

References


9.01. SAS Institute, Inc., Cary, NC, USA.