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Research Article
Effects of Canola Oil on Fatty Acids and Biochemical Traits of Blood Plasma in Broiler Chickens

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Abstract

Objective: Field trials were conducted to investigate the effects of canola oil on broiler chickens in terms of their fatty acid composition and biochemical traits, such as the concentrations of cholesterol, glucose and uric acid. **Materials and Methods:** The study was conducted using 120 individual Ross 308 broilers at the age of 21 days. The animals were randomly distributed into four equal groups. Canola oil was added to the diets at different concentrations of 0, 3 and 5%, which correspond to treatments T1, T2 and T3, respectively. The fatty acid composition and biochemical characteristics were tested. **Results:** Saturated fatty acids and blood glucose concentration decreased as the concentration of canola oil increased. There was also a significant increase in cholesterol and uric acid in the treatment groups in comparison to the control group as the concentration of canola oil increased. **Conclusion:** Canola oil administration decreases the concentrations of saturated fatty acids and blood glucose in broilers, especially at higher levels. However, more studies are needed to detect the mechanism involved.

Key words: Broilers, canola oil, cholesterol, fatty acids, glucose, uric acid

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Continuous increases in population have increased the demand for animal proteins, especially poultry because of their low prices compared to other animals. Therefore, poultry production is increasing significantly worldwide. However, the cholesterol in poultry has negative effects and causes cardiovascular diseases. Nevertheless, it is possible to control the level and quality of fatty acids in the blood and meat of birds by using certain diet regimes[1].

Oils are one of the most important sources of energy used in animal fattening. For optimal poultry productivity, protein and energy levels in diets should be higher than carbohydrate levels[2]. High levels of fats may negate the role of pelleting effects, however, which makes it difficult to measure of energy content. Therefore, it is necessary to add fat at a rate that meets the needs of birds while maintaining a low level of saturated fatty acids, which are difficult to digest, especially for small birds[3].

Animal fats and vegetable oils are usually added to fattening diets to increase energy and improve production performance. The digestion of dietary fats depends on the nature of the chemicals in the fatty acids[4]. Unsaturated fatty acids are digested and absorbed better than saturated fatty acids[5]. Canola oil is considered to have a suitable combination of essential fatty acids and unsaturated fatty acids such as linolenic acid (C18:3), which can improve the performance of broiler chickens and can be converted into longer-chain omega-3 fatty acids[6]. Oil represents 49% of the compounds in canola seed. It is one of the best vegetable oils used in human nutrition because of the high content of unsaturated fatty acids, low cholesterol level and glucosinolate acids. Furthermore, it contains only 6% saturated fatty acids[7].

Studies conducted in Canada, Finland, Sweden and the United States have found that canola oil is as effective as vegetable oils rich with polyunsaturated fatty acids (PUFA) in reducing total blood levels of low-density lipoprotein (LDL) cholesterol. These studies found that canola oil, along with sunflower, soybean and safflower oils, is effective in lowering total cholesterol and LDL cholesterol levels in people with normal blood lipid levels. All diets resulted in a significant reduction in total plasma cholesterol. This decrease in total cholesterol was primarily due to a decrease in LDL cholesterol[8]. Canola seeds are classified as the most common plant protein source[9]. Therefore, experiments were performed to examine the fatty acid profile changes and biochemical traits of the blood plasma of Roos 308 broiler chickens that were fed different concentrations of canola oil.

MATERIALS AND METHODS

All processes performed in this study were approved by the Animal Ethics Committee in the Department of Animal Production, Faculty of Agriculture, University of AL-Qadisiyah, Al-Diwaniyah, Iraq. The experiments were performed using 120 individual broilers (Ross 308 strain), which were divided into three treatments groups with two replicates (20 birds in each replicate). In the T1 group, no canola oil was fed to the chickens (control treatment). In the T2 group, a diet containing 3% canola oil by weight was provided. In the T3 group, canola oil comprised 5% of the diet.

The birds were fed on the finisher diet at the age of 21 days (Table 1) according to a published protocol[10] until they reached six weeks of age. On the last day of the experiment, five birds were randomly selected and blood samples were obtained from the brachial vein and centrifuged to separate the plasma samples, which were stored at -20°C until analysis. Lipids were extracted from blood serum by chloroform-methanol[11]. Biochemical characteristics such as cholesterol, glucose and uric acid concentrations were estimated using kits from the Spinreact Company according to the steps indicated by the manufacturer. A Complete Randomized Design (CRD) was used. Data were analyzed using the General Linear Models Procedure in SAS software[12]. Significant differences between the averages were compared by the Duncan's Multiple Range test.

RESULTS

The fatty acid profile of the plasma was affected by the different levels of canola oil, as shown in Table 2. The percentage of the saturated fatty acid C18:0 was not

Table 1: Components of the finisher diet

Components of diet	CO 0% (T1)	CO 3% (T2)	CO 5% (T3)
Yellow corn	62.80	57.80	52.80
Soybean gain	25.20	27.20	30.20
Protein concentrate	10.00	10.00	10.00
Canola oil	0.00	3.00	5.00
Di calcium and phosphorus	1.00	1.00	1.00
Lime stone	0.70	0.70	0.70
Table salt	0.30	0.30	0.30

CO: Canola oil

Chemical analysis	
Actress energy	3208
Raw protein	20.08
Calcium	1.12
Phosphorus	0.43
Fiber	3.50
Lysine	1.08
Methionine	0.31

Chemical analysis of nutrients was performed according to N.R.C (1994)

Table 2: Effect of use canola oil on fatty acid profile

Fatty acid (%)	T1 zero	T2 3%	T3 5%
C14:0	2.61±0.13[a]	2.54±0.08[ab]	2.25±0.06[b]
C16:0	28.75±0. 40[a]	25.81±1.06[b]	23.22±0.24[c]
C16:1	9.27±0.18	9.71±0.09	9.94±0.30
C18:0	3.56±0.05	3.58±0.04	3.89±0.9
C18:1	38.33±0.07[b]	38.51±0.06[b]	38.74±0.04[a]
C18:2	10.28±0.02[a]	10.49±0.11[a]	10.51±0.09[a]
C18:3	3.73±0.11[b]	3.99±0.3[b]	4.70±0.05[a]
C22:0	0.01±0.005[b]	0.01±0.009[b]	0.17±0.01[a]

[a-c]Values bearing different superscripts within the same row are significantly different (p<0.05)

Table 3: Effects of canola oil on biochemical traits

Trait	T1 (control)	T2	T3
Cholesterol	182.4±3.49[b]	189.8±2.37[ab]	199.2±1.09[a]
Glucose	182.7±1.54[a]	179.5±1.79[ab]	172.7±2.12[b]
Uric acid	7.2±0.11[b]	8.0a±0.35[b]	8.5±0.20[a]

[a-c]Values bearing different superscripts within the same row are significantly different (p<0.05)

significant among any of the groups. The percentages of C22:0 in the case of T3 were significantly higher than that of the other treatment groups. The percentages of unsaturated fatty acids C16:1 and C18:2 had no significant differences between groups. The percentages of C18:1 and C18:3 in the T3 group were significantly higher than that of the T1 and T2 groups.

The results for cholesterol, glucose and uric acid are shown in Table 3. Except for Glucose, the parameters were significantly affected by the canola treatments levels, especially T3. The T2 and T3 groups had significantly higher cholesterol and uric acid than the control.

DISCUSSION

Table 2 shows that there was a significant decrease in the acids C14:0 and C16:0, while C18:0 and C22:0 increased significantly (p<0.05). This is consistent with a previous study[13] that found a decrease in saturated fatty acids in all parts of the body when studying the effect of canola oil on fatty acids in the blood plasma of broiler chickens. The rate of increase and decrease of saturated fatty acids is partially consistent with some studies. One study found a decrease in the concentrations of saturated fatty acids C16:0 and C18:0 with the increase of the concentration of canola oil and saturated fatty acids in general[14].

There was a significant increase (p<0.05) in the concentration of monounsaturated fatty acids (MUFA) C18:1 and C16:1. This is consistent with a study[13] that found a significant increase in oleic acid (C18:1). A higher amount of canola oil in the diet can have proportionally decrease saturated fatty acids and cause an increase in MUFA, especially due to the oleic acid[15]. This is also consistent with the fact that birds mainly store fat as oleic acid[16]. This is also in accordance with a study on authentic Iranian turkeys, which found a decrease in MUFA[17].

As for polyunsaturated fatty acids (PUFA), there was a significant increase (p<0.05) in C18:3 (α-linolenic acid) and a slight increase in C18:2. This agrees with a previous study, which found that diets containing 6-15% canola oil significantly increased α-linolenic acid content in meat[18]. Although, the experimental diets did not contribute long-chain fatty acids, such acids were observed in the legs and breasts, indicating elongation of the chains in the liver as a result of the high-fat diet.

Canola oil positively affects immunity, which is thought to depend on the appropriate and efficient mix of essential fatty acids and unsaturated fatty acids[19]. Canola oil is considered as a suitable combination of unsaturated fatty acids such as α-linolenic acid, which improves broiler performance and can be converted long-chain omega 3 acid[20]. In general, increasing unsaturated fatty acids and delaying their absorption in the presence of canola oil delays the passage of food through the gastrointestinal tract, which allows the absorption of the largest amount of natural substances[21].

There was a significant increase in cholesterol (p<0.05) in the treatment groups in comparison to the control group as the concentration of canola oil increased (Table 3). This is in line with another study[22]. The increase was likely due to the high enzymatic activity of canola oil. However, these results did not agree with another study[23], where the concentration of cholesterol was 0.3929 in one of the treatment groups, which is a lower level than that of the control group.

Yet another study observed a significant decrease in cholesterol when increasing the concentration of canola oil as compared to the control group[24]. This is also consistent with a study that used canola oil at a rate of 2%, which reduced the concentration of cholesterol in eggs and blood[25]. In a study on Turkish cocks, there were no significant differences in the concentration of cholesterol when increasing the concentration of canola oil to 5% of the diet[26].

Uric acid levels, which are the result of nitrogen metabolism[27], increased significantly in the current study. High concentrations of canola oil are avoided in broiler production. There are arbitrary differences in biochemical traits of the blood due to some imbalances in liver and kidney function. This is expected to be mainly influenced by conditions of heat stress and their interaction with experiment coefficients more than the experiment itself[28]. This is consistent with a study that fed broilers a diet containing ISO and a high caloric diet with canola oil[28]. They explained the results by the high enzymatic activity of canola oil.

The concentration of glucose significantly decreased when canola oil was included in the diet (Table 3). This is consistent with a study that found that some vegetable fats are effective in lowering blood sugar in mice[29]. However, no significant differences in glucose concentration were observed in another study on the effect of canola oil and vitamin A in laying hens[30,31]. This was confirmed by another study which found that blood glucose concentration was not affected by levels of food enriched with polyunsaturated fatty acids[31]. In a similar case, there was no change in insulin and blood glucose when feeding fasted broilers sunflower or linseed oil, which suggested that PUFA has no obvious effect on insulin and glucose metabolism in birds[32-36].

CONCLUSION

In this study, canola oil administration resulted in significant decreases in saturated fatty acid composition and blood glucose levels, while it showed significant increases in unsaturated fatty acid composition. This most likely occurred through the oil's suitable combination of essential fatty acids and unsaturated fatty acids such as linolenic acid (C18: 3), which can improve the performance of broiler chickens. Furthermore, we observed increases in both cholesterol and uric acid concentrations with increasing canola oil levels. Thus, human health may adversely be affected when eating broilers fed a high concentration of canola oil.

SIGNIFICANCE STATEMENT

This study examined whether the use of canola oil can be beneficial for increasing the unsaturated fatty acid composition and decreasing the saturated fatty acid composition and blood glucose levels in broilers. A high level of canola oil administration in the diet caused an increase in both cholesterol and uric acid levels, which may be negative for chicken biomass and could have negative effects on humans who consume the meat. This study could help researchers to uncover the critical areas of canola oil in poultry diets that have not been explored previously. Thus, a new theory about the advantages and disadvantages of canola oil could be determined.

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