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Full Length Research Paper

Beneficial effects of canola oil on breast fatty acids profile and some of serum biochemical parameters of Iranian native turkeys

R. Salamatdoust Nobar[1]*, A. Gorbani[1], K. Nazeradl[1], A. Ayazi[2], A. Hamidiyan[2], A. Fani[2], H. Aghdam Shahryar[1], J. Giyasi ghaleh kandi[1] and V. Ebrahim Zadeh Attari[3]

[1]Department of Animal Science, Islamic Azad University, Shabestar Branch, Shabestar, Iran.
[2]Agriculture and Natural Resources Animal Science Department, East Azerbaijan Research Center, Tabriz, Iran.
[3]Department of Biochemistry and Nutrition, Tabriz University of Medical Science, Tabriz, Iran.

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During many years, the main objective of the poultry meat industry was to improve body weight and feed efficiency of the birds. However, in the modern poultry industry, there are other parameters that need to be taken into consideration such as low cholesterol and improved fatty acid profile. For this purpose, an experiment was conducted to evaluate canola oil effects on the Iranian native Turkey's serum parameters and breast meat fatty acid. Ninety male turkey chicks were randomly distributed into three experimental (0, 2.5 and 5%) with three replicate for each group. Diets were isonitrogenous and isoenergetic were given to turkey chicks throughout four periods of breeding (4 - 8, 8 - 12, 12 - 16 and 16 - 20th). The blood sample was taken at the end of the breeding period and serum parameters calculated by Friedewald method. Two pieces from each pen randomly selected and slaughtered with cutting the neck vessels and experimental samples from each breast meat sample prepared and pattern of fatty acids of breast samples was determined by gas chromatography. Serum values were not found to be significantly different ($P < 0.05$) in triglycerides and VLDL and in CHOL, LDL and HDL ($P < 0.05$) was significantly different compared to the control group. n-3 Fatty acids used as α-linoleic acid using canola oil had positive effect on the values and amount of this fatty acid in the control of 3.5562% reached to 6.7994 and 8.2447%, respectively in the experimental treatments ($P < 0.05$). Finally, our results illustrated that canola oil had significant impact on lipid metabolism in native turkey and could improve their serum lipid profile.

Key words: Turkey, canola oil, cholesterol, triglyceride, HDL, LDL.

INTRODUCTION

Turkeys are raised all over the world to produce meat and their meat production is currently developed in Iran. Oils are commonly been used as energy sources in the diets of poultry especially in grower and finisher. Studies have shown that type of dietary lipids of poultry can drastically alter the fatty acids profile of meat (Balnave, 1970; Scaife et al., 1994; Hrdinka et al., 1996; Lo´pez-Ferrer et al., 1999a, b; Salamatdoust et al., 2007). Thus, alter the biochemical parameter such as cholesterol, triglyceride, and LDL and HDL content very important to human health. Canola oil has been recognized as the rich plant source of linolenic acid (C18:3). Linolenic acid can be converted to longer chain omega-3 fatty acids, such as Eicosapentaenoic (EPA, C20:5), Docosahexaenoic (DPA, C22:5) and docosahexaenoic (DHA, C22:6) acids in poultry through an elongation and desaturation pathway, thus enriching the broiler meat with omega-3 fatty acids (Sim, 1995; Crespo and Esteve-Garcı´a, 2001, 2002a,b; Hrdinka et al., 1996). Omega-3 fatty acids have many health benefits including the ability to cardiovascular disease (Cherian and Sim, 1991; Grobas et al., 2001), antithrombic (Herod and Kinsella, 1986) and rheumatoid arthritis. Health recommendations have encouraged a reduction in the consumption of total lipids, saturated fatty acid and cholesterol but to increase the proportion of mono unsaturated and polyunsaturated fatty

*Corresponding author. E-mail: r.salamatdoust@gmail.com.

acids (PUFA) in human diets (Walsh et al., 1975; Temple, 1996; Grundy, 1980) found that dietary mono- unsaturated fatty acids (e.g. oleic acid) were very effective in lowering blood cholesterol concentration and may be important in preventing coronary heart disease (Howard et al., 2006). Grundy (1980) found that dietary mono-unsaturated fatty acids (e.g. oleic) were very effective in lowering blood cholesterol concentration and may be important in preventing coronary heart disease. Poultry species, age and breeding condition is known to affect cholesterol deposition (Hargis, 1988; Halle, 1996, 2001). The objective of this research was to determine the effects of feeding canola oil on serum biochemical parameters and breast meat fatty acids profile of Iranian native turkeys.

MATERIAL AND METHODS

Animal and diet

The investigation was performed on 90 male native Iranian turkeys in their fattening period (from 4th to 20th week of age). The turkey chicks with completely randomized design of 3 treatments, with 3 repetitions and 10 chicks in each box were fed experimental diets containing 0% CO(T1) , 2.5% CO(T2) and 5%CO (T3) in the fattening period. The experimental diets formulated isonitrogenouse and isoenergetic, accordance with the 1994 recommendations of the National Research Council (NRC). The birds were given access to water and diets ad-libitum. The composition and calculated nutrient composition of the treatment diet is shown in Table 1. Four birds in 20th week of age from each replicate after two hour fasting were taken blood and after separate serum, translated to the lab for analyses a cholesterol and triglyceride content. At the end of the growing period the number of two pieces from each pen randomly selected and slaughtered with cutting the neck vessels and experimental samples from each breast meat samples prepared and sent to the laboratory at temperature - 20℃ below zero were stored.

Biochemical serum analysis

Total serum cholesterol, triglycerides and High density lipoprotein cholesterol was assayed using a commercial kit supplied by (Pars azmoon Co., Ltd.) and detected by (Alison 300) autoanalyser system. Very low density lipoprotein cholesterol is estimated as [Triglycerides/5] (Friedewald et al., 1972). Low density lipoprotein cholesterol is estimated using the Friedewald equation [Low density lipoprotein cholesterol = Total cholesterol – [High density lipoprotein cholesterol – Trigylcerides/5] (Friedewald et al., 1972).

Gas chromatography of fatty acids methyl esters

Sample preparation

Fatty acids: Total lipid was extracted from breast and thigh according to the method of Folch et al. (1957). Approximately 0.5 g of meat weighed into a test tube with 20 mL of (chloroform: methanol = 2:1, vol/vol), and homogenized with a polytroon for 5 - 10 s at high speed. The BHA dissolved in 98% ethanol added prior to homogenization. The homogenate filtered through a Whatman filter paper into a 100 mL graduated cylinder and 5 mL of 0.88% sodium chloride solution added, stopper, and mixed. After phase separation, the volume of lipid layer recorded, and the top layer completely siphoned off. The total lipids converted to fatty acid methyl esters (FAME) using a mixture of boron-trifluoride, hexane, and methanol (35:20:45, vol/vol/vol). The FAME separated and quantified by an automated gas chromatography equipped with auto sampler and flame ionization detectors, using a 30 m, 0.25 mm inside diameter fused silica capillary column, as described. A (Model 6890N American Technologies Agilent) (U.S.A) Gas chromatography used to integrate peak areas. The calibration and identification of fatty acid peak carried out by comparison with retention times of known authentic standards. The lipid composition was determined by gas chromatography (Model 6890N American Technologies Agilent). The Pattern of fatty acids of breast samples was determined by gas chromatography (Model 6890N American Technologies Agilent). The composition of breast meat samples fatty acid of supplemented lipids is shown in Tables 3 data were statistically analyzed using one-way ANOVA, and means with significant F ratio were compared by Duncan multiple range test.

Statistical analyses

Data were analyzed in a complete randomized design using the GLM procedure of SAS version 8.2 (SAS Inst. Inc., Cary, NC).

$y_{ij} = \mu + a_i + \varepsilon_{ij}$

Where

$y_{ij} =$ All dependent variable

$\mu =$ Overall mean

$a_i =$ The fixed effect of oil levels (I = 1, 2 and 3)

$\varepsilon_{ij} =$ The random effect of residual

Duncan multiple range tests used to compare means.

RESULTS AND DISCUSSION

The effect of canola oil on biochemical serum levels was shown in (Table 2). According to results were none significantly different on triglycerides and VLDL content in serum, while total cholesterol, HDL and LDL were significantly affected with dietary manipulation ($P > 0.05$). Cholesterol content has been descending rate and affected canola oil and from 148.83 mg/dl in the control group (T1) significantly reached to 114.0 mg/dl in T3 group, but compared with T2 (126.67 mg/dl) has not been significantly different. High density lipoprotein and very low density lipoprotein positively affected with CO and HDL content significantly increase in treatment contain with 5% CO (61.00 mg/dl) compared the control group, and for LDL results show that treatment with CO (T2 and T3) have lower content of LDL and significantly deferent compared with control group($P > 0.05$). The present findings showed that substitution canola oil in dietary reduced the serum cholesterol concentration by 5%, whereas an addition of 2.5% decreased serum cholesterol but not significant. Canola contains 65 - 75% monoenic fatty acids and 9 - 30% polyunsaturated fatty acids (Ackman, 1990). Monounsaturated fat has also been shown to lower cholesterol (Grundy, 1988; Mensink and Katan, 1989).

Table 1. Percentage composition of experimental diets in four periods.

Ingredients'	4 - 8 week			8 - 12 week			12 - 16 week			16 - 20 week		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Corn	42.50	38.00	36.00	45.60	43.00	35.00	56.64	48.50	40.00	64.41	58.00	48.00
SBM[1]	34.40	36.00	31.15	28.25	27.30	28.24	26.00	27.00	27.50	21.00	21.00	21.00
Oil	0.00	1.25	2.50	0.00	2.50	5.00	0.00	2.50	5.00	0.00	2.50	5.00
Fish	4.80	3.70	6.60	8.00	8.00	8.00	2.64	1.82	1.50	0.65	0.70	0.67
Starch	3.10	3.22	1.56	7.46	3.32	3.37	6.57	6.51	6.50	7.10	5.56	6.71
Alfalfa	3.47	5.00	6.00	3.00	5.00	6.00	1.50	4.00	6.00	1.00	3.80	6.00
DCP[2]	1.38	1.52	1.11	0.63	0.61	0.62	1.03	1.15	1.18	1.17	1.15	1.15
Met[3]	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Lys[4]	1.50	1.50	1.50	1.50	1.50	1.50	1.40	1.50	1.50	1.50	1.50	1.50
Oyster	1.02	1.02	0.86	0.73	0.67	0.62	0.92	0.87	0.82	0.90	0.81	0.73
wheat bran	2.00	3.00	6.00	2.50	5.00	6.00	1.00	3.00	6.00	0.00	1.70	5.00
Vit supp[5]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Min supp[6]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Sand	3.58	3.54	4.47	0.08	0.85	3.40	0.05	0.90	1.75	0.02	1.03	1.99
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated nutrient content												
ME kcal/kg	2755	2755	2755	2850	2850	2850	2945	2945	2945	3040	3040	3040
Crude protein (%)	24.7	24.7	24.7	20.9	20.9	20.9	18.1	18.2	18.1	15.7	15.7	15.7
Calcium (%)	0.95	0.95	0.95	0.81	0.81	0.81	0.71	0.71	0.71	0.62	0.62	0.62
Available P (%)	0.48	0.48	0.48	0.40	0.40	0.40	0.36	0.36	0.36	0.31	0.31	0.31
ME/CP	112	112	112	136	136	136	163	162	163	194	194	194
Ca/P	2	2	2	2	2	2	2	2	2	2	2	2

1-Soy Bean Meal 2-Di calcium phosphate 3- Methionine 4- Lysine 5Vitamin content of diets provided per kilogram of diet: vitamin A,D, E and K.
6 Composition of mineral premix provided as follows per kilogram of premix: Mn, 120,000mg; Zn, 80,000 mg; Fe, 90,000 mg; Cu, 15,000 mg; I, 1,600 mg; Se, 500 mg; Co, 600 mg

Canola oil is an excellent source of monounsaturated fat, contains intermediate amounts of the precursor omega-6 and omega-3 polyunsaturated fatty acids linoleic acid (LA) and alfa-linoleic acid (ALA) respectively and is very low saturated fat. Canola oil as a source of phytosterols. Phytosterols (plant sterols) are structural analogs of the cholesterol found in animals and humans.

The consumption of phytosterols has been shown in numerous studies to lower blood cholesterol levels and may therefore, help reduce the risk of cardiovascular disease (Ling and Jones, 1995). Unsaturated oil could decrease the amount of harmful low-density lipoprotein (LDL) cholesterol in the serum (Mensink and Katan, 1989; Katan et al., 1995). Studies have shown that consumption of monoenic fatty acids effectively lowers serum cholesterol concentrations (Mattson and Grundy, 1985; Sirtoni et al., 1986; Mensink and Katan, 1989; Dreon et al., 1990; Valsta et al., 1992; Grundy et al., 1988).The reduction of serum cholesterol by monoene-nich rapeseed oil agrees with earlier observations with monounsaturated fatty acids (Mattson and Grundy 1985; Sirtoni et

Table 2. Least square means for serum biochemical parameter.

	Treatment				
	T1	**T2**	**T3**	**SEM**	**P value**
TAG[1] (mg/dl)	77.75	76.66	79.50	10.769	0.9586
CHOL[2] (mg/dl)	148.83 [a]	126.67 [ab]	114.00 [b]	14.394	0.0264
VLDL[3] (mg/dl)	15.55	15.332	15.9	1.8987	0.9682
HDL[4] (mg/dl)	41.41 [b]	48.33 [ab]	61.00 [a]	7.189	0.0127
LDL[5] (mg/dl)	91.87 [a]	63.00 [b]	57.10 [c]	13.619	0.0003

[1]Triglycerides; [2]Total cholesterol; [3]Very low density lipoprotein cholesterol; [4]High density lipoprotein cholesterol; [5]Low density lipoprotein cholesterol. Values in the same row with no common superscript are significantly different.

Table 3. Least square means of fatty acid profile of breast meat turkey.

	Control	**2.5 %**	**5 %**	**P value**	**SEM**
C14:0	0.7424[a]	0.8457[a]	1.0254[a]	0.2436	0.1068
C15:0	0.2114[a]	0.2562[a]	0.2917[a]	0.8880	0.1158
C16:0	28.590[a]	19.30[b]	16.94[c]	0.0001	0.4042
C16:1 n7	7.1100[a]	5.95[b]	4.83[c]	0.0001	0.1427
C18:0	8.9800[b]	9.26[b]	10.75[a]	0.0016	0.2000
C18:1 n9	17.430[a]	15.60[b]	15.30[b]	0.0134	0.3725
C18:1 Trans t11	0.2987[a]	0.2077[a]	0.4518[a]	0.5209	0.1447
C18:2	2.5059[a]	2.8915[a]	3.1760[a]	0.2014	0.2314
C18:2 Trans t12	0.5293[a]	0.3253[a]	0.5655[a]	0.7134	0.2168
C18:2n6Cis	4.4154[c]	8.2898[b]	9.3383[a]	0.0001	0.2439
C18:3 n-3	3.5562[c]	6.7994[b]	8.2447[a]	0.0001	0.1993
C20:0	1.3194[a]	1.2867[a]	1.2688[a]	0.9898	0.2536
C20:5n-3	1.3421[b]	2.3737[a]	2.1263[a]	0.0390	0.2230
C20:1n-9	0.6001[b]	1.3501[a]	1.6164[a]	0.0141	0.1718
C22:0	0.9369[b]	2.0205[a]	2.6262[a]	0.0054	0.2291
C22: 4n-6	8.8864[a]	10.1375[a]	10.6384[a]	0.1111	0.5019
C22:5 n-3	2.7250[c]	6.7263[b]	8.3857[a]	0.0002	0.4243
C22:6 n-3	1.9138[a]	2.5467[a]	2.4275[a]	0.2282	0.2436
PUFA	25.870[c]	40.090[b]	44.8120[a]	0.0001	1.1283
MUFA	25.453[a]	23.1271[b]	22.2077[b]	0.0059	0.4539

Different superscripts in each raw indicate significant difference.

al., 1986; Mensink and Katan 1989; Dreon et al., 1990; Valsta et al., 1992). The results of a Table 1 show that used of canola oil could influence mono unsaturated fatty acids in the control group and from 25.45% significantly reduced in treatments and reached, respectively, 23.12 and 22.20% ($P < 0.05$). About polyunsaturated fatty acids also influence the results and from 25.87% of control with significantly increased in treatments and reached to 40.09 and 44.81% ($P < 0.05$).

Results show that in Table 3 breast meat saturated fatty acids include Myristic acid (C14:0) and Arachidic acid (C20:0) no significant changes compared with the control group. However, Palmitic acid (C20:0) with decline and significant rate from 28.59% in the control group, respectively reached to 19.30 and 16.94% in experimental diets containing 2.5 and 5% was canola oil ($P < 0.05$). Stearic acid (C18:0) significantly from 8.97% of the control group respectively reached to 9.26 and 10.75 ($P < 0.05$). Also behenic acid (C22:0) increase with the use of canola oil in comparison to control group and values, respectively, reached to 2.0205 and 2.2662%. n-3 fatty acids as α-linoleic acid using canola oil had the positive effect on the values of this fatty acid and amount of this fatty acid in the control of 3.5562% reached to 6.7994 and 8.2447%, respectively in the experimental treatments ($P < 0.05$). Eicosapentaenoic acid (C20:5-3) also from 1.3421% in control treatment significantly reached to 2.3737 and 2.1263% in treatments and Docosohexaenoic acid (C22-n-3) in 1.9138 percent, respectively, significantly reached to 2.5467 and 2.4275% ($P < 0.05$). Some authors showed that the dietary polyunsaturation level of fat does not influence

intramuscular lipid content of breast (Scaife et al., 1994; Crespo and Esteve-Garcı´a, 2001), but Kirchgessner et al. (1993) and Ajuyah et al. (1991) found a higher fat content in breast muscle with increasing levels of PUFA in the diet that according with this research finding. However, other authors found lower lipid content of breast of chickens fed diets enriched with polyunsaturated oils (Sanz et al., 1999). Such discrepant findings in intramuscular fat content of breast muscles may be attributed to several factors, such as the analytical procedure used to extract fat from samples.

Recent studies showed that fat content of tissues in more polyunsaturated treatments was underestimated when lipid contents were analyzed using the AOAC (1995) methodology, suggesting total FA content as an estimator of crude fat in highly polyunsaturated samples (Villaverde et al., 2003). In general, modification of FA composition of intramuscular fat seems to be more limited (Pan and Storlien, 1993; Lo´pez-Bote et al., 1997). It may be due to the fact that FA in intramuscular fat is used mainly as components of cellular membranes, and the cell has to maintain its physical characteristics to ensure fluidity and permeability of different compounds.

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