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The Effects of Different Levels of Saturated and Unsaturated Fats and Their Composition in Growing and Finishing Periods on Productive Performance and Blood Lipids of Broilers

Research Article

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ABSTRACT

This experiment was conducted to investigate the effects of different levels of saturated and unsaturated fats and their composition in growing and finishing periods on performance, carcass traits and blood lipids level in broiler chickens. In this experiment, 432 Ross 308 broilers were used from 11 up to 42 days in 9 treatments, 4 replicates and 12 birds in each replicate in growing (11-24 days) and finishing (25-42 days) periods in a completely randomized design. Treatments included: 1) control group (without fat), 2) 2% canola oil, 3) 4% Canola oil, 4) 2% beef tallow, 5) 4% beef tallow, 6) 2% canola oil + 2% beef tallow, 7) 4% canola oil + 2% beef tallow, 8) 2% canola oil + 4% beef tallow and 9) 4% canola oil + 4% beef tallow. In the growing period, different levels of fat sources had no significant effects on the performance of broilers. In the finishing period, the higher amounts of daily weight gain and final live weight were obtained in group 8 ($P<0.05$). In the whole feeding period, the best feed conversion ratio and final live weight were observed in group 8 ($P<0.05$). The lowest amount of intestine, abdominal, gizzard and liver weights belonged to control group ($P<0.05$). However, a difference was observed between the control group and group 8 in these respects. Using different levels of saturated and unsaturated fat in growing and finishing periods had no significant effect on the blood lipids level of broilers ($P>0.05$). The overall results indicated that in broilers, using mixing of saturated and unsaturated fats have beneficial effects on their performance.

KEY WORDS beef tallow, blood lipids, broiler chickens, canola oil, performance.

INTRODUCTION

Fats and oils can be used as an alternative energy source in place of prime energy feed ingredients in broiler production. The dietary metabolizable energy (ME) increased through supplementation of fat in broiler rations and significantly increased their body weight gain (Leeson and Atteh, 1995). The cholesterol content of the food products especially from animal sources becomes the prime area of consumer's concern because of the increased awareness on higher dietary cholesterol and the incidence of coronary heart diseases. In poultry and other monogastric animals, the fatty acid composition of tissue lipids depends on the dietary fatty acids (Lopez Ferre *et al.* 1999). 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 the higher accumulation of intramuscular, mesenteric and abdominal fat in broilers (Sanz *et al.* 1999; Crespo and Esteve-Garcia, 2002). Many factors influence the absorption of fats. The chemical char-

acter of the fat itself is important. Absorption will be influenced by whether the fatty acids are free fatty acids (FFA) or triglycerides (Garrett and Young, 1975). The position of the fatty acids in the triglyceride molecule affects absorption (Renner and Hill, 1961a). The digestibility of free fatty acids decreases with the increasing length of the carbon chain and saturation (Renner and Hill, 1961b). An increase in the content of unsaturated fats in relation to saturated fats the absorption of the saturated fatty acids increased (Young and Garrett, 1963). Oils added to the rations of animals are effective on the fatty acid composition and amount of abdominal fat. In fact, fatty acids composition of oils used in poultry rations are reflected in the animal products because dietary fatty acids are incorporated with little change into the bird body fats (Scaife *et al.* 1994). Thus, the type of fat used in the feed, influence the composition of broiler body lipids. Abdominal fat is a good indicator of chicken body fats because it is very sensitive to changes in dietary fatty acid composition (Yau *et al.* 1999). In this context, reported that broiler chickens fed with diets enriched with polyunsaturated fatty acids have less abdominal fat or total body fat deposition than do broiler chickens fed diets containing saturated fatty acids (Sanz *et al.* 2000a). There are different kinds of fats in the market. Canola oil and beef tallow are the most important of them. Canola oil has been recognized as adequate mixture of essential fatty acids, unsaturated fatty acids such α-linolenic acid (C18:3) that can improve broiler performance, also linolenic acids can be converted to longer chain omega-3 fatty acids (Sim *et al.* 1990; Young *et al.* 1963) that is an important factor in animal feeding and is for promote of health (Bezard *et al.* 1994). Adding 3% of canola oil and poultry fat resulted in significant improvement in body weight and better feed conversion ratio than other groups, no significant different were found in liver, breast and thigh weights between groups fed lipid in comparison with the control group. Addition 6% poultry fat caused significant increasing on abdominal fat and gizzard weight was significantly higher in control group (Shahryar *et al.* 2011). It has been accepted that dietary canola oil is excellent supplement for commercial fish such as salmon (Huang *et al.* 2007).

On the other hand, canola oil contains less than 2% of erucic acid (docosanoic acid, C22:1, (-9) in relation to the total fatty acids and less than 30 moles of glucosinolates per gram of free oil on seed dry matter basis. In birds, the adverse effects of adding erucic acid to the diets are reflected on intake, feed growth performance and the apparent digestibility of total lipid and individual fatty acids (Leeson and summers, 2001). Using 2% of canola oil in broiler diets positively improved their performance and carcass traits (Nobakht *et al.* 2012). In broiler diets inclusion 5% canola oil improved their weight gain and increased blood triglyceride (Kiani *et al.* 2016). Using canola oil up to 5% in native turkeys had no effects on blood lipids concentration (Salamatdoust Nobar *et al.* 2010). In laying hens, incorporating 2% canola oil in diets improved their performance and reduced their egg and blood cholesterol level (Ismail *et al.* 2013). Inclusion up to 5% beef tallow to broiler diets had positive effects on their performance (Nasiri Moghaddam *et al.* 2000). In laying hens using 4% beef tallow could not affect their performance, egg traits and blood parameters (Safamehr *et al.* 2011).

As in young birds, the digestive tract not fully complicated and the amount of secreted enzymes and other juices are not considerable, it thought that in this period, the birds have several difficulties in digestion and absorption of some feed ingredients such as saturated fats. In the current study, the effects of different levels of saturated and unsaturated fats and several compositions of them in growing and finishing breeding periods of broilers on their performance, carcass traits and blood lipids had been investigated.

MATERIALS AND METHODS

In this experiment, 432 Ross 308 broilers were used from 11 up to 42 days in 9 treatments, 4 replicates and 12 birds in each replicate in growing (11-24 days) and finishing (25-42 days) periods in a completely randomized design. Treatments included: 1) control group (without fat), 2) 2% canola oil, 3) 4% Canola oil, 4) 2% beef tallow, 5) 4% beef tallow, 6) 2% canola oil + 2% beef tallow, 7) 4% canola oil + 2% beef tallow, 8) 2% canola oil + 4% beef tallow and 9) 4% canola oil + 4% beef tallow. The diets were formulated to meet the requirements of birds established by the Aviagen (2014) for broilers in grower (11-24 days) and finisher (25-42 days) periods are shown in Tables 1 and 2.

In all experimental periods, the diets and water were provided *ad libitum* for birds. The lighting program during the experimental periods consisted of a period of 23 hours light and 1 hour of darkness. House temperature was gradually decreased from 33 ˚C to 25 ˚C on day 21 and was then kept constant. Body weight, feed intake and feed conversion ratio were determined at the end of each experimental period on bird bases. Mortality was also recorded if it occurred. At the end of the experiment, two birds from each replicate were randomly chosen for blood collection and approximately 5 mL blood samples were collected from the brachial vein of randomly chosen birds. The blood was centrifuged to obtain serum for determining the blood lipids which included cholesterol, triglyceride, low density lipoprotein (LDL) and high density lipoprotein (HDL). Kit packages (Pars Azmoon Company; Tehran, Iran) were used for determining the blood biochemical parameters using Anision-300 auto-analyzer system (Nazifi, 1997).

Table 1 The composition of broiler diets in growing period (11-24 days)

Feed ingredients	0%	2% canola oil	4% canola oil	2% beef tallow	4% beef tallow
Corn	62.83	49.83	44.46	50.10	45.02
Soybean meal (42% CP)	33.17	42.31	43.70	42.35	43.57
Fat	0.00	2.00	4.00	2.00	4.00
Inert (sand)	0.27	0.56	3.55	1.33	3.10
Oyster shell	0.25	0.23	0.21	0.24	0.21
Bone meal	2.11	2.65	2.68	2.65	2.68
Salt	0.40	0.41	0.41	0.41	0.41
Vitamin premix[1]	0.25	0.25	0.25	0.25	0.25
Mineral premix[2]	0.25	0.25	0.25	0.25	0.25
DL-methionine	0.28	0.31	0.31	0.31	0.31
L-lysine hydrochloride	0.19	0.20	0.18	0.21	0.20
Calculated composition					
Metabolizable energy (kcal/kg)	3000	3000	3000	3000	3000
Crude protein (CP) (%)	20.63	20.63	20.63	20.63	20.63
Calcium (%)	0.80	0.80	0.80	0.80	0.80
Available phosphorus (%)	0.39	0.39	0.39	0.39	0.39
Sodium (%)	0.19	0.19	0.19	0.19	0.19
Lysine (%)	1.02	1.02	1.02	1.02	1.02
Methionine + cysteine (%)	0.81	0.81	0.81	0.81	0.81
Tryptophan (%)	0.19	0.19	0.19	0.19	0.19

[1] Vitamin premix per kg of diet: vitamin A (retinol): 2.7 mg; vitamin D_3 (cholecalciferol): 0.05 mg; vitamin E (tocopheryl acetate): 18 mg; vitamin K_3: 2 mg; Thiamine: 1.8 mg; Riboflavin: 6.6 mg; Panthothenic acid: 10 mg; Pyridoxine: 3 mg; Cyanocobalamin: 0.015 mg; Niacin: 30 mg; Biotin: 0.1 mg; Folic acid: 1 mg; Choline chloride: 250 mg and Antioxidant 100 mg.
[2] Mineral premix per kg of diet: Fe ($FeSO_4.7H_2O$, 20.09% Fe), 50 mg; Mn ($MnSO_4.H_2O$, 32.49% Mn), 100 mg; Zn (ZnO, 80.35% Zn), 100 mg; Cu ($CuSO_4.5H_2O$), 10 mg; I (K_1, 58% I), 1 mg; Se ($NaSeO_3$, 45.56% Se): 0.2 mg.

Table 2 The composition of broiler diets in finishing period (25-42 days)

Feed ingredients	0%	2% canola oil	4% canola oil	2% beef tallow	4% beef tallow
Corn	66.38	61.10	56.76	61.68	55.93
Soybean meal (42% CP)	30.22	33.53	33.86	32.97	34.74
Fat	0	2.00	4.00	2.00	4.00
Inert (sand)	0	0.04	2.05	0	2.00
Oyster shell	0.24	0.27	0.24	0.26	0.24
Bone meal	2.07	2.04	2.07	2.05	2.07
Salt	0.37	0.39	0.39	0.39	0.39
Vitamin premix[1]	0.25	0.25	0.25	0.25	0.25
Mineral premix[2]	0.25	0.25	0.25	0.25	0.25
DL-methionine	0.18	0.13	0.14	0.15	0.13
Calculated composition					
Metabolisable energy (kcal/kg)	3050	3050	3050	3050	3050
Crude protein (CP) (%)	19.54	19.54	19.54	19.54	19.54
Calcium (%)	0.81	0.81	0.81	0.81	0.81
Available phosphorus (%)	0.40	0.40	0.40	0.40	0.40
Sodium (%)	0.17	0.17	0.17	0.17	0.17
Lysine (%)	1.01	1.01	1.01	1.01	1.01
Methionine + cysteine (%)	0.78	0.78	0.78	0.78	0.78
Tryptophan (%)	0.24	0.24	0.24	0.24	0.24

[1] Vitamin premix per kg of diet: vitamin A (retinol): 2.7 mg; vitamin D_3 (cholecalciferol): 0.05 mg; vitamin E (tocopheryl acetate): 18 mg; vitamin K_3: 2 mg; Thiamine: 1.8 mg; Riboflavin: 6.6 mg; Panthothenic acid: 10 mg; Pyridoxine: 3 mg; Cyanocobalamin: 0.015 mg; Niacin: 30 mg; Biotin: 0.1 mg; Folic acid: 1 mg; Choline chloride: 250 mg and Antioxidant 100 mg.
[2] Mineral premix per kg of diet: Fe ($FeSO_4.7H_2O$, 20.09% Fe), 50 mg; Mn ($MnSO_4.H_2O$, 32.49% Mn), 100 mg; Zn (ZnO, 80.35% Zn), 100 mg; Cu ($CuSO_4.5H_2O$), 10 mg; I (K_1, 58% I), 1 mg; Se ($NaSeO_3$, 45.56% Se): 0.2 mg.

Also, at 42 days of age, two birds from each replicate randomly chosen based on the average weight of the group and sacrificed. Dressing yield was calculated by dividing eviscerated weight by live weight. Abdominal fat, gizzard, liver, spleen, breast and thigh were collected, weighed and calculated as a percentage of carcass weight.

The data were subjected to one-way analysis of variance procedures as completely randomized design using the General Linear Model procedures of SAS (2005). Means were compared using the Duncan test (Valizadeh and Moghaddam, 1994). Statements of statistical significance were based on ($P<0.05$).

RESULTS AND DISCUSSION

Performance

The effects of different levels of saturated and unsaturated fats on the performance of broilers in growing period are shown in Table 3. Different levels and composition of saturated and unsaturated fats in growing period had no significant effects on performance of broilers (P>0.05).

The effects of different levels of saturated and unsaturated fats on the performance of broilers in the finishing period are summarized in Table 4. In the finishing period, different levels of saturated and unsaturated significantly changed the amounts of daily weight gain and final live weight (P<0.01). The highest amounts of daily weight gain (71.07 g) and final live weight 2346.33 g were observed in group 8 (contained 2% canola oil+4% beef tallow), whereas the lowest value of them, 63.02 g and 2182.33 g belonged to group 4 with 4% beef tallow. The values of daily feed intake and feed conversion ratio were not significantly different between treatments (P>0.05).

The effects of different levels of saturated and unsaturated fats on performance of broilers in whole feeding period are shown in Table 5.

Different levels and composition of saturated and unsaturated fats in whole feeding period significantly affected the performance of broilers (P>0.01). In whole feeding period, the highest amounts of daily feed intake and weight gain were observed in control group, whereas the amounts of these parameters not different between other treatments (P>0.05). In this period such as finishing period the final live weight belonged to group 8. There were not any significant difference between treatment about feed conversion ratio, livability, and production index (P>0.05).

Carcass traits

The effects of different levels of saturated and unsaturated fat on carcass traits of broilers are shown in Table 6. Using different levels of saturated and unsaturated fats in growing and finishing periods significantly affected the carcass traits of broilers (P<0.05). The lowest values for abdominal fat, gizzard and liver percentages were observed in control group, however there were not any significant difference between control group and group 8 about this organs values (P>0.05). Carcass, breast and thigh percentages were not affected by using different levels of saturated and unsaturated fats (P>0.05).

Blood lipids

The effects of different levels of saturated and unsaturated fats in growing and finishing periods of blood lipids in broilers are summarized in Table 7.

Different levels of saturated and unsaturated fats in growing and finishing periods had no significant effects on blood lipids of broilers (P>0.05).

In growing period in contrast to finishing period, the amount of feed intake is low, this caused the performance not to be change significantly. Whereas in finishing period the amount of daily feed intake is high, so, it caused the amounts of daily weight and final live weight changes significantly, the highest amount is occurred in group 8 with mixing of 2% canola oil + 4% beef tallow. High performance in group 8 may be related to positive corporation combination between saturated and unsaturated fat sources.

Canola oil more than energy is a rich source of essential fatty acids and fat soluble vitamins. Using it in corporation with beef tallow by supplying optimum levels of nutrients supported broiler performance and improved the amount of their weight gain.

The current results are in line with the reports of Nobakht and Mehmannavaz (2012) and Poorghasemi *et al.* (2013) who indicated that a combination of vegetable and animal fat sources in laying hens and broiler diets supported positively of their performance. Achieving to the high amount of daily feed intake and daily weight gain in group without fat sources (control group), may be related to the absent of fat sources, as the fats can easily supply considerable amount of energy (Leeson and summers, 2001), in contrast, other energy sources can reduce the amount of feed intake and vest versa. In this relation, as other groups contain fats, so the amounts of daily feed intake and weight gain, had not been changed significantly, whereas the highest amount of live final weight belonged to group 8 with combination 2% canola oil + 4% beef tallow. This result is in agree with the experiment results of Nobakht and Mehmannavaz (2012) and Poorghasemi *et al.* (2013) reported that combination of vegetable and animal fat sources in laying hens and broilers diets supported positively their performance. Changes in the amounts of daily feed intake and weight gain, could not alter feed conversion ratio, that it is not in agree with Jeffri *et al.* (2010) reported that by increasing fat sources to broiler diet, the feed conversion ratio was improved.

The results showed that no significant changes took place on feed conversion ratio in this experiment. There are conflicting reports on the effect of fat supplementation on feed conversion ratio of broiler.

Al Athari and Watkins (1988) found no difference in the feed conversion ratio 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 feed conversion ratio in broiler when dietary polyunsaturated fatty acid intake increased.

Table 3 The effects of saturated and unsaturated fats on performance of broilers in growing period (11-24 days)

Treatments	Weight gain (g/d/h)	Feed intake (g/d/h)	Feed conversion ratio	Final weight (g)
1) control (without fat)	69.19	97.58	1.42	1168.67
2) 2% canola oil	65.85	95.54	1.46	1177.33
3) 4% canola oil	61.68	93.28	1.52	1173.33
4) 2% beef tallow	64.25	96.58	1.51	1155.67
5) 4% beef tallow	63.86	94.01	1.48	1174.33
6) 2 canola oil + 2% beef tallow	64.27	92.65	1.44	1183.67
7) 4 canola oil + 2% beef tallow	62.41	92.93	1.50	1171.33
8) 2 canola oil + 4% beef tallow	63.27	91.66	1.45	1182.67
9) 4 canola oil + 4% beef tallow	62.96	90.56	1.44	1141.67
SEM	2.14	2.47	0.2	10.80
P-value	0.4174	0.5581	0.0881	0.2105

SEM: standard error of the means.

Table 4 The effects of saturated and unsaturated fats on the performance of broilers in finishing period (25-42 days)

Treatments	Weight gain (g/d/h)	Feed intake (g/d/h)	Feed conversion ratio	Final weight (g)
1) control (without fat)	65.65^{bcd}	121.39	1.85	2243.33^{dc}
2) 2% canola oil	64.43^{d}	120.69	1.88	2213.00^{de}
3) 4% canola oil	64.93^{dc}	124.86	1.93	2212.33^{de}
4) 2% beef tallow	64.22^{d}	119.41	1.86	2188.67^{de}
5) 4% beef tallow	63.02^{d}	121.30	1.93	2182.33^{e}
6) 2 canola oil + 2% beef tallow	66.16^{bcd}	125.52	1.90	2242.00^{dc}
7) 4 canola oil + 2% beef tallow	68.98a^{bc}	127.39	1.85	2282.67^{bc}
8) 2 canola oil + 4% beef tallow	71.07^{a}	128.45	1.81	2346.33^{a}
9) 4 canola oil + 4% beef tallow	69.72^{ab}	128.45	1.85	2297.67^{ab}
SEM	1.27	4.92	0.6	17.22
P-value	0.0026	0.8288	0.8324	0.0001

SEM: standard error of the means.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).

Sanz *et al*. (2000b) confirmed that the source and level of different fats and the rates of use did not affect the feed conversion of broilers. Not improving in feed conversion ratio in the current study may be related to proportion between daily feed intake and weight gain.

The lowest amount of abdominal fat was observed in control group (diet without fat) and the highest it related to group with 4% canola oil. As fats are the reach sources of energy in diets, so using them (especially at high levels), not only can supply enough energy for supporting of performance, but also more of it can be changed to body fat and save in different forms such as abdominal fats (Leeson and summers, 2001), as oils in contrast to fats have highly amount of unsaturated fatty acids, the digestion and supplying of energy is in high amount, so by feeding 4% of canola oil, not only the amount of energy requirement for growth can be available, but also, more than it, can be changed to body fat and reserve different forms such as abdominal fat, whereas in control group the digestible energy supplied by other ingredients without fat sources mainly supported performance and tissue growth. In contrast to the present study, high amount of abdominal fat was reported by using 4% tallow in broiler diet (Duraisamy *et al.* 2013).

Such as abdominal fat, the highest and the lowest amounts of gizzard and liver related to control group and group contained 4% canola oil. As the gizzard and liver contain highly amount of fat, the size of them can be related to the amount of abdominal fat, as the amount of abdominal fat is low and high in groups 1 and 3, it could affect the size of these organs. Our results in the present study in consist with Crespo and Esteve-Garcia (2000) reports, that using 4% sunflower oil in broiler diets reduced the amount of abdominal fat. There suggested that reduction of abdominal fat in broilers fed a diet supplemented with oil seems to be a consequence of higher lipid oxidation despite the higher synthesis of endogenous fatty acids. Among available fat sources in poultry nutrition, it has been recognized that canola oil is an adequate combination of essential fatty acids, unsaturated fatty acids (such α-linolenic acid) that can improve broiler performance, and also linolenic acid can be converted to longer chain omega-3 fatty acids that are important factors in animal feeding as health promoter (Bezard *et al.* 1994).

Shahryar *et al*. (2011) found that the addition 6% animal fat caused a significant increase in abdominal fat weight compared to control groups.

Table 5 The effects of saturated and unsaturated fats on performance of broilers in whole feeding period (11-42 days)

Treatments	Weight gain (g/d/h)	Feed intake (g/d/h)	Feed conversion ratio	Final weight (g)	Livability (%)	Production index
1) control (without fat)	67.52^{a}	109.21^{a}	1.62	2243.33^{dc}	97.22	320.46
2) 2% canola oil	50.44^{b}	80.75^{b}	1.60	2213.00^{de}	97.22	319.88
3) 4% canola oil	49.59^{b}	81.19^{b}	1.65	2212.33^{de}	94.45	302.67
4) 2% beef tallow	49.86^{b}	80.42^{b}	1.62	2188.67^{de}	97.22	313.98
5) 4% beef tallow	49.48^{b}	80.08^{b}	1.62	2182.33^{e}	97.22	312.03
6) 2 canola oil + 2% beef tallow	50.52^{b}	81.21^{b}	1.61	2242.00^{dc}	97.22	322.74
7) 4 canola oil + 2% beef tallow	50.87^{b}	81.70^{b}	1.61	2282.67^{bc}	94.45	319.00
8) 2 canola oil + 4% beef tallow	51.62^{b}	81.71^{b}	1.59	2346.33^{a}	94.45	332.00
9) 4 canola oil + 4% beef tallow	50.88^{b}	81.02^{b}	1.60	2297.67^{ab}	94.45	329.06
SEM	0.80	1.99	0.03	17.22	3.21	8.81
P-value	0.0001	0.0001	0.9219	0.0001	0.9853	0.4464

SEM: standard error of the means.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).

Table 6 The effects of saturated and unsaturated fats on carcass traits (carcass %) of broilers (42 days)

Treatments	Carcass	Abdominal fat	Gizzard	Liver	Breast	Thigh
1) control (without fat)	69.77	3.62^{c}	4.04^{c}	2.90^{c}	34.57	27.85
2) 2% canola oil	73.85	4.03^{abc}	4.40^{abc}	3.07^{bc}	34.23	28.35
3) 4% canola oil	68.42	4.41^{a}	4.75^{a}	3.47^{a}	35.96	30.36
4) 2% beef tallow	70.95	4.19^{ab}	4.53^{abc}	3.32^{ab}	34.43	28.57
5) 4% beef tallow	69.64	4.08^{abc}	4.60^{ab}	3.34^{ab}	36.21	30.00
6) 2 canola oil + 2% beef tallow	71049	3.68^{bc}	4.01^{c}	3.04^{bc}	33.87	28.02
7) 4 canola oil + 2% beef tallow	69.66	3.93^{abc}	4.30^{abc}	3.15^{abc}	34.99	29.22
8) 2 canola oil + 4% beef tallow	70.35	4.13^{abc}	4.42^{abc}	3.08^{bc}	34.75	28.62
9) 4 canola oil + 4% beef tallow	70.97	3.82^{bc}	4.18^{bc}	3.09^{bc}	33.34	27.53
SEM	1.82	0.16	-	0.10	1.37	1.52
P-value	0.6734	0.0497	-	0.0187	0.8747	0.9063

SEM: standard error of the means.
The means within the same column with at least one common letter, do not have significant difference (P>0.05).

Table 7 The effects of saturated and unsaturated fats on blood lipids (mg/dL) of broilers (42 days)

Treatments	Cholesterol	Triglyceride	LDL	HDL
1) control (without fat)	115.75	87.09	57.67	40.39
2) 2% canola oil	142.59	62.41	46.12	75.79
3) 4% canola oil	124.75	98.95	45.40	76.97
4) 2% beef tallow	136.73	94.06	65.33	56.90
5) 4% beef tallow	139.57	85.77	51.00	74.34
6) 2 canola oil + 2% beef tallow	126.53	89.85	40.90	59.63
7) 4 canola oil + 2% beef tallow	155.39	94.04	40.78	68.41
8) 2 canola oil + 4% beef tallow	136.03	93.63	57.67	66.86
9) 4 canola oil + 4% beef tallow	125.23	95.03	49.73	69.72
SEM	11.43	25.08	10.54	12.11
P-value	0.4219	0.8160	65.43	0.5211

SEM: standard error of the means.
LDL: low density lipoprotein and HDL: high density lipoprotein.

Moreover, adding 3% of canola oil and poultry fat mixture resulted in significant enhancement in organs' weight, whereas no differences were found in liver, breast and thigh weights between groups fed fat in comparison with control group.

Blood lipids composition had not changed in experimental groups. Not changes in the blood lipids in our study can have some reasons such as the length of experimental diets using, the amounts and composition of fats in diets, other diets ingredients, birds strain, performance and health status of birds.

The present results is in line with Salamatdoust Nobar *et al.* (2010) report that using canola oil up to 5% of native turkeys diets had no effects on their blood lipids, whereas on the base of Ismail *et al.* (2013) reported using 2% canola oil in laying hens diets reduced their egg and blood cholesterol content.

CONCLUSION

The overall results indicated that using combination of oil and fat such as group 8 (2% canola oil+4% beef tallow) in

growing and finishing diets of broilers can improve their performance.

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