ORIGINAL ARTICLE

EFFECT OF THE DIETARY FAT SOURCES AND LEVELS ON BROILER PERFORMANCE AND CARCASS-SERUM LIPIDS

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ABSTRACT

Background: Current commercial hybrids with high performance require high energy diets, which would enable the maximum exploitation of their genetic potential. Increasing demands for energy in growing chickens can be satisfied by the addition of fat to the feeding mixtures. **Objectives:** the experiment designed to study the effect of dietary formulation on broiler performance, and carcass serum lipids. **Methods:** The birds used in the experiment were commercial unsexed hybrid broiler strain (Ross 308), purchased at day-old from a local hatchery in Khartoum (coral). They were reared in an open deep litter experimental house in the poultry unit of the faculty of Animal Production. A number of 210 uniform chicks were selected and assigned at random to each of the twenty one experimental pens, at the rate of ten chicks per pen. The experimental diets were randomly assigned to the experimental units (pens) at the rate of three replicates per treatment in a completely randomized design arrangement. The diets were fed for an experimental period of six weeks. Feed and water were supplied ad libitum, and records were kept for weekly feed intake, live weight and daily mortality. As a fat source and level, beef tallow was added to three of dietary treatments at the rate of 2.0, 4.0, and 6.0 percent; while vegetable oil (sunflower) was similarly added to other three dietary treatments. The seventh experimental diet was used as a control diet (without addition of fat). **Results:** The results of the first experiment showed a significant interaction effect between dietary fat source and level on overall broiler performance parameters. It is noted that while beef tallow at all incorporated dietary levels significantly improved the overall broiler performance parameters, the sunflower oil reflected a depressing effect at higher level (6%). In contrast to the dietary fat source and levels was significantly decreased the overall broiler performance. Dietary fat source and levels provoked significant increase on liver, heart, and abdominal fat pad and thus they induced a significant improve in carcass quality by depriving the body fat toward abdominal fat and blood serum, whereas the higher dietary energy increments decreased the carcass quality by increasing carcass cholesterol. Dietary fat source revealed no significant effect on cholesterol and triglycerides of carcass, serum or abdominal fat pad. **Conclusions:** We can conclude that lean broiler meat can be achieved through genetics, and or nutritional practices where special consideration should be given to the amount of energy intake, and the dietary energy protein ratio.

Keywords: *broiler, energy, fat, performance, cholesterol.*

1. INTRODUCTION:

The broiler industry has been developed worldwide to the most intensive and efficient model in comparison to other animal production sectors. The rapid growth, efficient utilization of feed, tender meat production, the ability of the stock to grow, thrive and produce under varied environmental conditions have been achieved through advanced genetic improvement of the modern broiler chicken. The energy intake of the fast growing broiler chickens, fed ad-libidum, is estimated to reach two or three times greater than their maintenance needs and so carcass fat deposition increases, causing broiler metabolic and skeletal disorders, beside its undesirable effect for human health. The consumer has been aware of the health problems associated with consuming the broiler chickens, carcass fat, and so a demand for leaner birds. Accordingly, the poultry industry has been faced with the problem of producing leaner birds and reducing fat deposition in the broiler carcasses in order to meet the consumer demand. Azman (2005) noted that Final body weight was not significantly affected by dietary fat sources. Daily weight gain and daily feed intake was significantly higher in the beef tallow group, compared to the other groups. The feed conversion ratio of the poultry grease group was better compared to the other groups. In the soybean oil supplemented group, the amount of long-chain polyunsaturated fatty acids was significantly higher in thigh skins, breast muscle and abdominal fat pad. In the thigh and breast muscle of the poultry grease fed group oleic acid content was significantly higher, and beef tallow caused increased accumulation of saturated fatty acid in thigh skins and abdominal fat pad [1]. Rondelli et al (2004) proved that dietary fat composition affected significantly the concentration of all fatty acids in broiler abdominal fat [2]. The metabolic basis for diminishing

the effect of PUFA on abdominal fat mass is poorly understood [3]. Replacement of dietary saturated fatty acids (SFA) by polyunsaturated fatty acids (PUFA) was neither significant nor has systematic effects on weight gain and feed: gain ratio, but the amount of body fat was reduced significantly when about 75% of the tallow was replaced by soybean oil, as absolute amount or percentage of intake, tended to enhance but was not significantly affected by the amount of soybean oil in the diet [4]. Najib and Yousef. Al-Yousef (2011) claimed that supplementing the broiler diet with different levels of flaxseeds showed a relatively higher consumption of feed, lower body weight, higher feed conversion when flax seed level in the diet was increased beyond 5%. However, feeding 15 % flaxseed increased the omega3 fatty acid (linolenic acid, DHA, EPA and DPA) sharply in the fat of dark meat (thigh) which makes this meat healthier to human [5]. El Yamany et al (2008) used different levels and sources of oil in growing japanese quail diets, the data revealed that no significant effect was recorded on both edible giblets (gizzard, liver and heart) and offal (blood, feather, legs, head and viscera) percentage [6]. Qureshi (2004) in study designed to evaluate the effects of high dietary fat on serum cholesterol in broilers, observed that the serum cholesterol values in chicks were significantly higher ($p<0.05$) in chicks fed on animal fat as compared to those fed on vegetable fat [7]. Malakian et al (2010) studied the effect of full fat sunflower seeds on broiler performance breast yield, thighs, gastrointestinal tract, liver, gizzard; abdominal fat pad percentage, triglycerides, total serum protein concentration, and the cholesterol content were not significantly affected by different SFS levels inclusion. Plasma (serum), total cholesterol was (190-210 mg/dl); muscle (meat) total cholesterol was 96-107% [8]. Monfaredi (2011) using tallow and sunflower oil with different level (2, 4%) on broiler chick diets found no significant effect on carcass thigh, breast, and liver weight. The response in cholesterol and GLU concentrations differed significantly between fat sources with serum cholesterol concentration increasing at a faster rate when beef tallow was added than with soybean oil [9]. Karamouz et al (2009) in study consist of three dietary replicate of food industrial residual oil found that serum parameters (cholesterol, triglycerides) were not affected by dietary treatment [10]. Navidshad (2010) in a study conducted to compare between enriching broiler diet with fish oil and soybean oil in levels (0, 3.5, 7%) observed that triglycerides and cholesterol were positively correlated with each other [11]. Tekeli (2012) in a study to investigate the effect of apricot kernel oil on selected performance, blood and carcass parameters. No statistical significant differences were observed in the treatment groups with respect to hot carcass, cold carcass weight, carcass yield, abdominal fat weight [12].

2. MATERIALS AND METHODS

2.1 Study design: A six week feeding trial was carried out, with day-old broiler chicks, to study the effect of two sources and four levels of dietary fat on performance and lipid profile in serum and carcass.

2.2 Experimental diets: The formulated diets employed in experiment and their calculated and determined chemical composition as shown in Table (1) were seven boiler chicks starter diets, supplemented with various levels of sunflower oil or beef tallow. The diets were formulated from local feed ingredients commonly used for poultry feeding in the Sudan.

Table 1: Ingredients formulation of the experimental diets (percent as fed).

Item	**control**	$BT_{2\%}$	$BT_{4\%}$	$BT_{6\%}$	$VO_{2\%}$	$VO_{4\%}$	$VO_{6\%}$
Sorghum	63.1	58.7	55.7	52	59	55	52.1
Groundnut meal	16.1	19.0	18.7	20.8	18.7	18.6	20.7
Sesame meal	9.6	9.0	10.5	10.0	9.0	11.0	10.0
Super concentrate	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Beef tallow	0.0	2.0	4.0	6.0	0.0	0.0	0.0
Vegetable oil (sunflower)	0.0	0.0	0.0	0.0	2.0	4.0	6.0
Wheat bran	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Dicalcium phosphate	2.7	2.7	2.7	2.7	2.6	2.5	2.7
Lysine	0.14	0.15	0.12	0.15	0.14	0.15	0.14
Methionine	0.05	0.06	00.04	0.06	0.05	0.10	0.05
Common salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total	100	100	100	100	100	100	100
Calculated analysis of the experimental diets:							
ME (Kcal/Kg	3199	3253	3323	3381	3289	3378	3463
Crude protein (percent)	22.90	23.40	23.50	23.70	23.30	23.60	23.70
Fat	3.21	5.05	7.09	9.07	5.55	7.27	9.54
Crude fiber	4.70	4.90	4.90	4.95	4.90	4.95	4.95
Calcium	1.45	1.46	1.47	1.48	1.42	1.44	1.48
Lysine	1.19	1.22	1.19	1.23	1.20	1.22	1.22

Methionine	0.49	0.50	0.49	0.50	0.49	0.55	0.49
Proximate analysis of the experimental diets:							
Moisture	1.00	1.50	1.00	1.00	1.50	1.23	1.00
Crude protein	22.80	22.9	22.92	22.90	22.95	22.90	22.87
Ether extract	3.40	5.00	7.00	8.97	4.98	7.10	9.00
Crude fiber	3.01	4.00	4.20	4.01	4.00	4.30	4.00
ME Kcal/Kg	3150	3200	3297	3300	3259	3348	3403

BT: beef tallow VO: vegetable oilBroiler chicks super-concentrate (5% Nutristar) contain 40% crude protein, 1.44% crude fiber, 3.9% crude fat, 1950Kcal/Kg metabolizable energy, 10% lysine, 3% Methionine.

2.2 Experimental birds and management: The birds used in the experiment were commercial unsexed hybrid broiler strain (Ross 308), purchased at day-old on 23th July, 2007 from a local hatchery in Khartoum (coral). They were reared in an open deep litter experimental house in the poultry unit of the faculty of Animal Production. A number of 210 uniform chicks were selected were assigned at random to each of the twenty one experimental pens, at the rate of ten chicks per pen.

2.3 Experimental procedures: The experimental diets were randomly assigned to the experimental units (pens) at the rate of three replicates per treatment in a completely randomized design arrangement. The diets were fed for an experimental period of six weeks. Feed and water were supplied ad libitum, and records were kept for weekly feed intake, live weight and daily mortality. At the end of the experimental period, three birds were selected at random from each pen (9 birds per treatment). The selected birds were slaughtered by severing the throat, jugular veins, carotids, trachea and esophagus, and allowed to bleed. Blood samples were taken for plasma analysis; the birds were weighed, and then scalded by immersion into hot water at 65C for 30 minutes. They were then hand plucked, and thoroughly washed and drained. Each plucked carcass was weighed and its warm carcass weight was recorded. The head was removed, eviscerated, The following part of each carcass were weighed individually, The carcasses were then chilled, carcasses were cut into smaller parts, and deboned into meat and bone. The blood samples were centrifuged and serum samples were used for determination of plasma total protein, albumin, cholesterol, and triglycerides.

2.4 Experiment chemical analysis: Cholesterol concentration (mg/dl) was estimated by kit method named as Enzymatic Colorimetric Test (Cholesterol oxidase- Peroxidase (CHOD-PAP) with ATCS). The reagent and their concentrations are shown in Table (2).

Table (2) Reagent composition and concentrations:

COMPONENTS	concentration
Good´s buffer, pH 6.7	50 mmol/L
Phenol	5 mmol/L
4-Aminoantipyrine	0.3 mmol/L
Cholesterol Esterase	≥ 200 U/L
Cholesterol Oxidase	≥ 50 U/L
Peroxidase	≥ 3 KU/L

Triglycerides (mg/dl) were detected by kit method called GPPO-PAP with ATCS.

Table (3) The reagent concentration of the triglycerides test:

Reagent	concentration
PIPES [Piperazine-1.4-bis (2-ethane-sulfonic acid)]	50.0 mmol/L
EDTA	0.13 mmol/L
ATP (Adenosine-tri-phosphate)	1.65 mmol/L
Magnesium ions	0.5 mmol/L
4-Aminophenazone	0.6 mmol/L
4-Chlorophenol	1.55 mmol/L
GPO (Glycerophosphate-Oxidase)	≥ 2.5 KU/L
Glycerolkinase	≥ 1.0 KU/L

Detergent, Stabilizer, preservative. Standard : The Concentration as indicated on vial.

Fatty acids determined with 1g with mixture of chloroform-methanol and 0.88% NaCl in water bath at 50C under N_2 flow then adds boron-trifloride-methyl solution to covert fatty acids methyl ester which will be analyzed by gas liquid chromatography then fatty acid peaks (percent) determined by gas chromatograph were then used to calculate the amount of fatty acids (g/100 g fat) by theoretical response factors.

2.5 Statistical analysis: The data of weekly and overall experimental period performance parameters, carcass and visceral parts, carcass composition, and plasma composition were collected and statistically analyzed for a 2×3 factorial experiment for the determination of the main effect and interaction for source and level of dietary fat. Treatment differences were estimated by analysis of variance according to statistix computer programme using 2×3 factorial design, and the differences among treatment means were tested for significance using Duncan's Multiple Range Test (1985).

3. RESULTS

Table 4 showed the overall performance of the birds fed different source and levels of dietary fat. There were significant increase interaction (P<0.05) effect on the live body weight, feed intake, body weight gain, and feed conversion ratio. It can also be noted that beef tallow had significantly (P<0.05) higher effects on all the performance parameters except feed conversion ratio in which sunflower oil showed better but not significant (P<0.05) effect. Dietary fat levels significantly (P<0.05) decreased live body weight, feed intake, feed conversion ratio, but in contrast it significantly (P<0.05) increased body weight gain. The effects of dietary fat source and level on broiler carcass parameters were represented in Table 5. It is clear that there were significant positive interaction (P<0.05) on all the broiler carcass parameters. Study the effect of dietary fat source beef tallow revealed a higher significant effect (P<0.05) among all the carcass parameters compared to the sunflower oil. Dietary fat levels showed a significant progressive (P<0.05) decrease in the broiler carcass parameters including the dressing percentage.

Table 4: Table shows the effect of dietary fat source and level on broiler overall performance (g).

Item	Final Body weight	Total Feed intake	Total Body weight gain	Feed conversion ratio
Interaction effect:				
Beef tallow%				
0	1706.70^{a}	2212.60^{ab}	1657.70^{a}	1.33^{b}
2	1441.30^{b}	2324.50^{a}	1392.30^{ab}	1.71^{ab}
4	1545.30^{ab}	2372.30^{a}	1496.30^{ab}	1.59^{ab}
6	1412.00^{b}	2440.80^{a}	1363.00^{ab}	1.80^{a}
Vegetable oil%				
0	1706.70^{a}	2212.60^{ab}	1657.06^{a}	1.33^{b}
2	1390.70^{b}	2212.30^{ab}	1002.30^{bc}	1.67^{ab}
4	1070.70^{c}	1814.90^{b}	1021.70^{bc}	1.83^{a}
6	762.70^{d}	1270.80^{c}	713.70^{c}	1.85^{a}
SE	122.31	189.59	248.23	0.22
SD	*	*	*	*
Source effect				
Beef tallow	1526.30^{a}	2337.60^{a}	1477.30^{a}	1.67
Vegetable oil	1232.70^{b}	1877.60^{b}	1098.80^{b}	1.61
SE	61.16	94.80	124.12	0.11
SD	*	*	*	NS
Level effect%				
0	1706.70^{a}	2212.60^{a}	1657.70^{a}	1.33^{b}
2	1416.00^{b}	2268.40^{a}	1197.30^{b}	1.69^{a}
4	1308.00^{b}	2093.60^{ab}	1259.00^{b}	1.71^{a}
6	1087.30^{c}	1855.80^{b}	1038.30^{b}	1.83^{a}
SE	8649	134.06	175.53	0.15
SD	*	*	*	*

Values are means of 3 replicates of 10 birds. **SE:** Standard error of means. **SD**: significant difference. **NS:** Not statistically significant.
a, b, c: means in the same column with different superscripts are statistically significant (P< 0.05). * Statistically significant (P< 0.05).

Table 5: Table shows Effect of dietary fat source and level on broiler carcass parameters (g) and dressing percentage.

Item	final body weight	Hot carcass	Cold carcass	neck	Shank	breast	back	drum	thigh	wing	Dressing percentage
Interaction effect:											
Beef tallow%									197.03^{a}	143.87^{a}	72.53^{a}
0	1706.7^{a}	1249.7^{a}	1209.7^{a}	56.1^{a}	75.07^{a}	393.03^{a}	256.2^{a}	161.07^{a}	145.1^{bc}	120.13^{b}	70.14^{abc}
2	1441.3^{b}	1011.3^{b}	920.4^{bc}	47.7^{abc}	74.63^{a}	259.27^{c}	202.83^{b}	122.77^{ab}	160.27^{b}	136.7^{ab}	71.25^{ab}
4	1545.3^{ab}	1101.1^{ab}	1045.1^{b}	50.77^{ab}	70.35^{ab}	317.43^{b}	229.83^{ab}	150.57^{a}	146.13^{bc}	127.73^{ab}	70.52^{abc}
6	1412^{b}	995.4b	971.00^{b}	53.2^{ab}	65.44^{ab}	284.9b^{c}	221.5^{ab}	137.27^{ab}			
Vegetable oil%			^{c}						197.03^{a}	243.87^{a}	72.53^{a}
0	1706.7^{a}	1249.7^{a}		56.1^{a}	75.07^{a}	393.03^{a}	256.2^{a}	161.07^{a}	134.67^{cd}	114.73^{b}	68.6b^{c}
2	1390.7^{b}	954.3^{b}	1209.7^{a}	46.37^{bc}	71.03^{ab}	298.4b^{c}	210.8^{b}	130.13^{ab}	112.53^{d}	91.77^{c}	67.85^{c}
4	1070.7^{c}	727.5^{c}	874.6^{c}	35.53^{bc}	57.92^{b}	189.87^{d}	147.67^{c}	111.27^{b}	74.97^{e}	64.83^{d}	59.96^{d}

6	762.7^{d}	457.8^{d}	689.8^{d}	31.6^{c}	39.61^{c}	118.8^{e}	89.47^{d}	62.33^{c}	±10.47	±23.47	±1.60
SE	±122.31	±85.98	442.5^{e}	±5.24	±7.68	±26.84	±11.00	±18.29	*	*	*
SD	*	*	±76.03 *	*	*	*	*	*			
Source effect											
Beef tallow	1526.3^{a}	1089.3^{a}	1036.5^{a}	51.94^{a}	71.37^{a}	313.66^{a}	229.84^{a}	142.92^{a}	162.13a	132.11a	71.12^{a}
Vegetable oil	1232.7^{b}	847.3^{b}	804.1^{b}	42.4^{b}	60.91^{b}	250.03^{b}	178.28^{b}	116.2^{b}	129.8b	1038b	67.25^{b}
SE	±61.16	±42.99	±38.00	±2.62	±3.84	±13.42	±11.73	±9.14	±5.5	±5.37	±0.80
SD	*	*	*	*	*	*	*	*	*	*	*
Level effect%											
0	1706.7^{a}	1249.7^{a}	1209.5^{a}	56.1^{a}	75.07^{a}	393.03^{a}	256.2^{a}	161.07^{a}	197.03^{a}	1433.87^{a}	72.53^{a}
2	1416^{b}	982.7^{b}	897.5$_{b}$	47.03^{ab}	72.83^{a}	278.83^{b}	206.82^{b}	126.45^{bc}	139.88^{b}	117.43^{b}	69.39^{b}
4	1308^{b}	914.3^{b}	867.5^{b}	43.15^{b}	64.14^{a}	253.65^{b}	188.75^{bc}	130.92^{b}	136.4^{b}	114.23^{b}	69.55^{b}
6	1087.3^{c}	726.6^{c}	706.8^{c}	42.4^{b}	52.53^{b}	201.85^{c}	155.48^{c}	99.8^{c}	110.55^{c}	96.28^{c}	65.24^{c}
SE	±86.48	±60.79	±53.76	±3.71	±5.43	±18.98	±16.59	±12.93	±7.78	±7.6	±1.13
SD	*	*	*	*	*	*	*	*	*	*	*

Values are means of 3 replicates of 10 birds; **SE**: Standard error of means; **SD**: significant difference; **NS**: Not statistically significant.
a, b, c, d, e, f, g: means in the same column with the different superscripts are statistically significant (P< 0.05); ***** Statistically significant (P< 0.05).

The weights of the broiler internal organs are presented in Table 6. There was a positive significant interaction (P<0.05) between dietary fat sources and levels for liver, heat, and abdominal fat pad weights during revealed no significant interaction effect (P<0.05) for pancreas, spleen, gizzard, and viscera. Bf and SO significantly (P<0.05) affected heart, and abdominal fat pad weights 7.42, 6.18 and 23.24, 10.64 respectively, whilst no significant (P<0.05) effect on liver, pancreas, spleen, viscera, and gizzard weight. The dietary fat levels had significant decreased liver, heart, and abdominal fat pad weight, whereas it had no significant (P<0.05) effect on pancreas, spleen, viscera, and gizzard weights.

Table 6: Table shows effect of dietary fat source and level on broiler internal organs' weight (g).

Item	Liver	Pancreas	Spleen	viscera	Gizzard	Heart	Abdominal fat pad
Interaction effect:							
Beef tallow%							
0	37.80^{a}	2.53	1.83	81.33	33.33	7.70^{a}	22.08^{b}
2	35.27^{a}	2.97	1.83	75.85	31.33	8.33^{a}	19.87^{d}
4	28.37^{c}	3.69	1.80	73.85	35.32	7.10^{a}	21.33^{c}
6	32.67^{a}	3.20	1.33	98.37	38.93	6.54^{a}	29.69^{a}
Vegetable oil%							
0	37.80^{a}	2.53	1.83	81.33	33.33	7.70^{a}	22.08^{b}
2	34.77^{a}	3.60	1.35	96.17	33.93	6.43^{a}	9.78^{e}
4	29.13^{b}	2.67	1.70	89.60	27.65	6.43^{a}	6.87^{f}
6	22.43^{d}	2.60	1.16	79.93	27.65	4.14^{b}	3.84^{g}
SE	2.06	0.63	0.40	13.7	6.79	1.08	0.10
SD	*	NS	NS	NS	NS	*	*
Source effect							
Beef tallow	33.53	3.10	1.64	86.76	34.73	7.42^{a}	23.24^{a}
Vegetable oil	31.01	2.85	1.85	82.35	30.34	6.18^{b}	10.64^{b}
SE	1.46	0.44	o.12	6.88	3.40	0.54	0.05
SD	NS	NS	NS	NS	NS	*	*
Level effect%							
0	37.80^{a}	2.53	1.83	81.33	33.33	7.70^{a}	22.08^{a}
2	35.02^{a}	3.28	1.77	86.01	32.63	7.38^{a}	14.83^{c}
4	28.75^{b}	3.18	1.59	81.27	31.49	6.77^{a}	14.10^{d}
6	27.55^{b}	2.90	1.25	89.15	32.69	5.34^{b}	16.77^{b}
SE	2.06	o.63	0.28	9.74	4.80	0.76	0.07
SD	*	NS	NS	NS	NS	*	*

Values are means of 3 replicates of 10 birds**. SE**: Standard error of means. **SD**: significant difference. **NS**: Not statistically significant. **a,b,c,d,e,f,g:** means in the same column with the different superscripts are statistically significant (P< 0.05). ***** Statistically significant (P< 0.05).

The abdominal fat pad cholesterol and triglyceride were determined and the values are shown in Table 7. The dietary fat sources and levels showed no significant interaction (P<0.05) effect on either abdominal fat pad cholesterol or triglyceride. Similarly, dietary fat sources had no significant impact on abdominal fat pad cholesterol and triglyceride. On the other hand, the sample of abdominal fat pad analyzed showed that cholesterol content was significantly (P<0.05) increased while dietary fat level increments greater than 40% whereas the triglycerides showed no significant differences among the different dietary energy levels. This means that dietary fat level affected significantly only the abdominal fat pad cholesterol rather more than triglycerides. Broiler carcass cholesterol and triglycerides were presented in Table 8. Dietary fat source and levels induced no significant interaction effect on carcass cholesterol while dietary fat source (BF,

SO) were significantly (P<0.05) affected the carcass triglycerides rather than the cholesterol, the dietary fat increment significantly increased the carcass cholesterol (P<0.05) greater than the triglycerides.

Table 7: Table presents the effect of dietary fat source and level on broiler abdominal fat pads' cholesterol and triglycerides.

Item	Cholesterol mg/dl	Triglycerides mg/dl
Interaction effect:		
Beef tallow %		
0	287.33	204.67
2	296.00	203.00
4	305.00	204.00
6	303.00	199.33
Vegetable oil %		
0	287.33	204.67
2	301.67	199.00
4	304.67	201.67
6	307.33	201.00
SE	7.15	3.94
SD	NS	NS
Source effect		
Beef tallow	298.00	202.75
Vegetable oil	300.25	201.58
SE	3.58	1.97
SD	NS	NS
Level effect%		
0	287.33^{b}	204.67
2	298.83^{ab}	201.00
4	305.17^{a}	202.83
6	305.17^{a}	200.17
SE	5.10	2.97
SD	*	NS

Values are means of 3 replicates of 9 birds per treatment; **SE**: Standard error of means; **SD**: significant difference; **NS**: Not statistically significant; **a, b**: means in the same column with different superscripts are statistically significant (P< 0.05); ***** Statistically significant (P< 0.05).

Table 8: Table presents the effect of dietary fat source and level on broiler carcasses' cholesterol and triglycerides:

Item	Cholesterol mg/dl	Triglycerides mg/dl
Interaction effect:		
Beef tallow %		
0	129.33	160.25^{a}
2	130.67	149.98^{c}
4	163.17	152.23^{bc}
6	132.33	157.22^{abc}
Vegetable oil%		
0	129.33	160.25^{a}
2	132.00	161.22^{a}
4	149.11	158.83^{ab}
6	144.83	157.97^{abc}
SE	16.01	3.77
SD	NS	*
Source effect		
Beef tallow	138.87	154.92^{b}
Vegetable oil	138.83	159.57^{a}
SE	5.66	1.33
SD	NS	*
Level effect %		
0	129.33^{b}	160.25
2	131.33^{ab}	155.60
4	156.17^{a}	155.53
6	138.58^{a}	157.59
SE	8.00	1.88
SD	*	NS

Values are means of 3 replicates of 10 birds; **SE**: Standard error of means; **SD**: significant difference; **NS**: Not statistically significant; **a, b**: Means in the same column with different superscripts are statistically significant (P< 0.05); ***** Statistically significant (P< 0.05).

Serum cholesterol and triglycerides content are presented in Table 9. The table showed no significant interaction between dietary fat sources (BF, SO) and levels (2, 4, 6%) on serum cholesterol, and triglycerides. The dietary fat source showed no significant differences (P<0.05) on serum cholesterol and triglycerides, while the dietary fat levels showed progressive increase but not significant (P<0.05) on serum triglycerides content and not significantly increased serum cholesterol content. Effect of dietary fat source and level on abdominal fat pad fatty acids content (percent) was shown in Table (10). There were significant interaction effect (P<0.05) between dietary fat source and levels among all determined fatty acids (palmitic, stearic, linoleic, and olieic acid). The dietary fat sources showed significant effect (P<0.05) overall fatty acids estimated. In addition to that the diets that contained beef tallow had the highest percent of all fatty acids in compare with the diets contained sunflower oil. On the other hand, the ascending arrangement of abdominal fat pad fatty acid percentage for birds fed the diets that contained beef tallow were Linoleic, Stearic, Palmitic, and Oleic acid; 4.40, 5.63, 40.83, and 59.73% respectively, while the birds fed diets contained sunflower oil followed the same manner in lower percentage of fatty acids (Stearic 3.42, Linoleic 3.92, Palmitic 30.74, and Oleic acid 51.37% respectively. Dietary fat level significantly (P<0.05) affected abdominal fat pad fatty acids. It can be seen that fatty acids progressively increased with fat level increase 0, 2, and 4% thus, Palmitic and Oleic acid continually increased with 6% of dietary fat level, whereas Stearic and Linoleic acid decreased with 6% of dietary fat level.

Table 9: Presents the effect of dietary fat source and level on broiler serums' cholesterol and triglycerides.

Item	Cholesterol mg/dl	Triglycerides mg/dl
Interaction effect:		
Beef tallow %		
0	111.67	119.47
2	117.33	124.97
4	119.33	129.80
6	122.33	126.73
Vegetable oil %		
0	111.67	119.47
2	117.67	126.93
4	116.67	130.63
6	123.67	126.93
SE	3.19	2.57
SD	NS	NS
Source effect		
Beef tallow	117.67	125.24
Vegetable oil	117.42	125.99
SE	1.59	1.28
SD	NS	NS
Level effect%		
0	117.67	119.47
2	117.50	125.95
4	118.00	130.22
6	123.00	126.83
SE	2.25	1.82
SD	NS	NS

Values are means of 3 replicates of 10 birds; **SE**: Standard error of means; **SD**: significant difference; **NS**: Not statistically significant; Means in the same column with the same superscripts are not statistically significant (P< 0.05). ***** Statistically significant (P< 0.05).

Table 1: Table shows the effect of dietary fat source and level on broiler abdominal fat pads' fatty acids (percent).

Item	Palmitic acid	Stearic acid	Linoleic acid	Oleic acid
Interaction effect:				
Beef tallow%				
0	40.07^{b}	3.21^{e}	6.52^{a}	50.22^{f}
2	30.57^{c}	5.65^{c}	4.25^{e}	59.62^{d}
4	22.49^{g}	4.12^{d}	4.91^{d}	68.48^{a}
6	29.81^{d}	9.62^{a}	0.00^{f}	60.58^{c}
Vegetable oil%				
0	40.07^{b}	3.21^{e}	6.52^{a}	50.22^{f}
2	28.19^{f}	3.06^{f}	5.64^{b}	63.14^{b}
4	29.25^{e}	7.39^{b}	5.46^{c}	57.90^{e}
6	65.79^{a}	0.00^{g}	0.00^{f}	34.21^{g}
SE	0.05	0.07	0.03	0.03
SD	*	*	*	*
Source effect				
Beef tallow	40.83^{a}	5.63^{a}	4.40^{a}	59.73^{a}
Vegetable oil	30.74^{b}	3.42^{b}	3.92^{b}	51.37^{b}

SE	0.03	0.03	0.01	0.01
SD	*	*	*	*
Level effect%				
0	40.07[b]	3.21[d]	6.52[a]	50.22[c]
2	29.38[c]	4.31[c]	4.95[c]	61.38[b]
4	25.87[d]	5.76[a]	5.19[b]	63.19[a]
6	47.8[a]	4.81[b]	0.00[d]	47.40[d]
SE	0.04	0.05	0.02	0.02
SD	*	*	*	*

Values are means of 3 replicates of 10 birds; **SE**: Standard error of means**; SD:** significant difference; **NS:** Not statistically significant; **a,b,c,d,e,f,g**: means in the same column with the different superscripts are statistically significant (P< 0.05); ***** Statistically significant (P< 0.05).

Table 11 presents the data on carcass fatty acids content (percent). It indicated that dietary fat source and level significantly (P<0.05) interacted among all estimated fatty acids. The same table also revealed that the dietary fat source had significant (P<0.05) effect on fatty acids content of broiler carcass. The sunflower oil had the greatest influence on carcass fatty acids except Oleic acid. Dietary fat levels significantly (P<0.05) affected the carcass fatty acid, Palmitic, and Stearic acids increased gradually from 0 to 4% then decreased at 6%. Oleic acid increased from 0 up to 6% levels, decreased only at 4% level, Whereas Linoeic acid appeared only at 0% fat level and became nil at the rest of fat levels 2, 4, 6%.

Table 11: Table shows the effect of dietary fat source and level on broiler carcasses' fatty acids content (percent).

Item	Palmitic acid	Stearic acid	Linoleic acid	Oleic acid
Interaction effect:				
Beef tallow %				
0	33.82[d]	5.00[e]	8.13[a]	53.03[d]
2	31.57[e]	6.36[d]	0.00[b]	62.07[c]
4	46.19[c]	8.90[b]	0.00[b]	45.00[f]
6	26.87[g]	5.02[e]	0.00[b]	68.08[a]
Vegetable oil%				
0	33.82[d]	5.00[e]	8.13[a]	53.03[d]
2	29.31[f]	7.73[c]	0.00[b]	62.96[b]
4	56.53[a]	34.48[a]	0.00[b]	0.00[g]
6	46.31[b]	4.87[f]	0.00[b]	48.82[e]
SE	0.04	0.02	0.01	0.03
SD	*	*	*	*
Source effect				
Beef tallow	34.61[b]	6.32[b]	2.03	57.05[a]
Vegetable oil	43.74[a]	13.02[a]	3.03	41.20[b]
SE	0.2	0.01	6.68	0.01
SD	*	*	NS	*
Level effect%				
0	33.82[c]	5.00[c]	8.13[a]	53.03[c]
2	30.44[d]	7.05[b]	0.00[b]	62.51[a]
4	55.86[a]	21.69[a]	0.00[b]	22.50[d]
6	36.59[b]	4.95[d]	0.00[b]	58.45[b]
SE	0.03	0.02	9.45	0.02
SD	*	*	*	*

Values are means of 3 replicates of 10 birds; **SE**: Standard error of means; **SD**: significant difference; **NS**: Not statistically significant; **a,b,c,d,e,f,g**: means in the same column with the different superscripts are statistically significant (P< 0.05); ***** Statistically significant (P< 0.05).

Table 12 showed broiler serum content of fatty acids fed diet incorporated with the two sources (BF, and SO) of dietary fat at the four levels (2, 4, 6%). The result showed positive significant interaction (P<0.05) except Linoleic fatty acid which is nil. The dietary fat source significantly altered (P<0.05) broiler serum fatty acids. Beef tallow has significant effect on Palmitic and Oleic fatty acids, thus sunflower oil had significant (P<0.05) increasing on Stearic acid, while there is no effect for both dietary fat sources on Linoeic acid. The same table shows the effect of dietary fat levels regardless of the source on broiler serum fatty acids which revealed that there were a significant (P<0.05) altering effect on fatty acids content while there was no effect on Linoeic acid.

Table 12: Table shows the effect of dietary fat source and level on broiler serumś fatty acids (percent).

Item	Palmitic acid	Stearic acid	Linoleic acid	Oleic acid
Interaction effect:				
Beef tallow%				
0	34.89[a]	12.29[c]	0.00	52.81[f]
2	22.78[g]	6.35[g]	0.00	70.87[a]
4	34.07[b]	13.87[b]	0.00	52.05[g]
6	29.97[d]	9.71[f]	0.00	60.32[c]
Vegetable oil%				
0	34.89[a]	12.29[c]	0.00	52.81[f]
2	25.78[f]	10.33[e]	0.00	63.90[b]
4	27.30[e]	16.11[a]	0.00	56.59[e]
6	30.87[c]	10.72[d]	0.00	58.42[d]
SE	0.10	0.05	0.00	0.04
SD	*	*		*
Source effect				
Beef tallow	30.43[a]	10.56[b]	0.00	59.01[a]
Vegetable oil	29.71[b]	12.36[a]	0.00	57.93[b]
SE	0.05	0.02	0.00	0.02
SD	*	*		*
Level effect%				
0	43.89[a]	12.29[b]	0.00	52.82[d]
2	24.28[d]	8.34[d]	0.00	67.39[a]
4	30.69[b]	14.99[a]	0.00	54.32[c]
6	30.42[c]	10.22[c]	0.00	59.37[b]
SE	0.07	0.03	0.00	0.03
SD	*	*		*

Values are means of 3 replicates of 10 birds; **SE**: Standard error of means; **SD**: significant difference; **NS:** Not statistically significant; **a,b,c,d,e,f,g**: means in the same column with the different superscripts are statistically significant (P< 0.05); ***** Statistically significant (P< 0.05).

4. DISCUSSION:

In the present study dietary fat source and levels showed a significant interaction effect on overall broiler performance parameters. Beef tallow showed higher values in expense of sunflower oil inclusion levels. The study result was in agreement with Azman (2005) who noted that daily weight gain and daily feed intake was significantly higher in the beef tallow group, compared to the other groups [1]; and Brue and Latshaw (1985) reported that inclusion level of Sunflower Seed (SFS) reduced the average daily gain, and feed per gain. However, Beef tallow revealed higher significant influence on final body weight, feed intake, and body weight gain, and high but not significant on feed conversion ratio compare to sunflower oil inclusion diets [13]. The present result was agree with many authors Hauge, 2007; Nitsan et al, 1997; and Azman, 2005 who stated that improvement of performance with inclusion of animal fat (beef tallow) in compare to vegetable oil inclusions [14,15-1]. The present finding were disagreement with Wongsuthavas (2007), Purushothaman (2000), and Seerly et al 1978) who stated that replacing of dietary saturated fatty acid (BT) by polyunsaturated fatty acid (VO) was neither significant nor systematic in all broiler performance parameters [16,17,18]. The inconsistency can be elevated when we know that inclusion of both SFA and UFA in broiler diets from 2% up to 4% had the positive effect in all performance parameters. The dietary fat increment induced negative and significant influence on all broiler performance parameters measured. The present result was in agreement with El Yamany et al (2008) stated that birds showed little differences in performance with different levels of UFA inducted. Pinchasov and nir (1992) reported that energy increment decreased feed intake, but not negatively affect daily gain, resulting in improvement in feed efficiency [19]. The reduction in broiler performance associated with increment of dietary fat source mainly due to the negative effect of unsaturated fat on feed intake which reflected sequence on feed conversion ratio, body weight gain and final body weight. In table (8) all carcass parameters studied showed a significant interaction effect. Beef tallow prospectively showed higher significant effect all over carcass parameters illustrated here including the dressing percentage. Dietary fat increment induce positive effect with (2, 4%) inclusion of both sources whereas, 6% induce contrary effect with different sources. Beef tallow positively increase whilst sunflower diminishingly affect all carcass parameters. Generally carcass parameters diminished with increase inclusion of sunflower oil. The results presented here was in agree with Aldaraji et al (2011) and Witt et al. (2009) who were stated that animal fat diets surpasses other treatment groups with relation to all carcass parameters involved in the experiments [20,21]. The present result is in disagreement with Mohammed and Horniakova (2012) and Guerreiro Neto et al (2011) whom were concluded that the use of soybean oil, poultry fat and their blend in the diet does not influence the performance, carcass traits [22,23]. This result mainly due to the low feed intake associated with vegetable oil groups which affecting final body weight sequentially other carcass parameters, and partially due to the nutritional inhibition factor accompanied with vegetable oils (unsaturated fatty acid utilization disability inspite of high digestibility and metabolizable energy it contents). The inclusion of tallow and sunflower oil with

different levels (0, 2, 4, 6%) provoke no significant interaction effect on pancreas, spleen, viscera, and gizzard but significantly affect liver, heart, and abdominal fat pad weights. Similar result was found by Vila` and Esteve-Garcia (1996) who found that sunflower acid oil produced less abdominal fat deposition in broilers than tallow acid oil at different levels of fat inclusion [24], and Pan et al. (1979) who observed that replacing soybean oil with tallow increased the amount of abdominal fat in chickens [25], Shimomura et al (1990) have reported less body fat accumulation in animals fed safflower oil than in those fed beef tallow [26]. Crespo and Esteve-Garcia (2001) reported that abdominal fat increased with level of fat inclusion only in birds fed tallow or olive oil [27]. The result in the present study was in contrast with that found by Sadighi and Tabdian (2005) who stated that the inclusion of different level of tallow had no significant effect on carcass, abdominal fat and liver weight [28]. Selvaraj and Purushothaman (2004) who stated that abdominal fat was increased in birds fed 20% SFS [29]. El Yamany et al (2008) using different levels and sources of oil reported that no significant effect was recorded on both edible giblets (gizzard, liver and heart) and offal (blood, feather, legs, head and viscera) percentage [6]; Monfaredi (2011) who stated that no significant effect on carcass parameters liver, and heart weight inclusion beef tallow and soybean oil in broiler chicks diet with different level (2, 4%) [9]. Dietary fat source only had significant effect on heart and abdominal fat pad. This result is agree with Zakaria (2013) who stated significant effect of fat source on heart and abdominal fat [30]. Sanz et al. (1999) who found less abdominal fat in broilers fed sunflower oil than in those fed tallow or lard [31]. Omenka and Anyasor (2010) who stated that no significant difference in the mean weight of birds' organs (head, gizzard, heart, lung, small intestine, large intestine, upper limbs) examined [32]; and the result agree in part with Aydin (2007) who found that there was no difference in the proportions of abdominal fat (%) of the chickens among the groups, and the respective relative organ weights did not differ significantly between the respective dietary treatments [33]. That mean inclusion fat and oil in broiler diets induced positive effect at level of 2, 4% regarding the source it seemed that beef tallow had a higher effect in those levels. But high level 6% of energy source only sound with beef tallow that related to inhibition action for lipogenesis when vegetable oil (unsaturated fatty acids) inclusion in contrarily to the hypothesis that said oils produced more energy than fat (saturated fatty acids) so the addition energy should deposit in avian body as fat. Also the reduction of fat deposit in broiler carcass can be due to preferentially oxidation, and lower gain of PUFA versus SFA which proposed to lower abdominal fat deposition in broiler chicken. In general many authors revealed visual contradictory results when oil or fat induced in broiler diets we can elevated this when say that in low levels (2, 4%) of inclusion both source of energy (fat, oil) increases broiler performance, carcass characteristics, carcass parameters, internal organs weight, fat deposition. but when reach 6% vegetable oil negatively affect broiler performance and all carcass parameters measured. This reduction associated with total fat reduction may be due to changes in rate of lipid oxidation or lipogenesis. Generally, body fat accumulation may be considered the net result of the balance among dietary absorbed fat, endogenous fat synthesis (lipogenesis) and fat catabolism via β-oxidation (lipolysis). These results indicate that chickens that consumed the highly polyunsaturated diets deposited less fat due to a lower gain of polyunsaturated fatty acids. Dietary fat increment induced only significant effect on liver, heart, and abdominal fat pad. The result in the present study was agreed in part with Fouladi et al (2008) who showed that canola levels (4, and 2%) significantly increased carcass weight, breast, thigh, liver, spleen (level 4% canola oil has a higher effects). Also increased gizzard, and heart but not significant, and significantly decrease fat deposition [34]. It significantly reduced both abdominal fat pad and heart weight only with sunflower oil (unsaturated fat) whereas significantly increased abdominal fat pad and not systemically heart weight when beef tallow (saturated fat) used. It may be due to disability or inhibition effect of unsaturated fat for lipogenesis. The research in the thesis includes the observation of broiler abdominal fat pad and its content of cholesterol and triglycerides. The determined results revealed no significant interaction between the source and level of the dietary fat. It has been reported that the fat source had impact on the abdominal fat cholesterol and triglycerides content. However, the present study indicated that there was an increase in abdominal fat pad cholesterol content associated with dietary fat increase even though it was insignificant [3-35-37,38]. The systematic triglycerides value on the other hand diminished insignificantly with the dietary fat increment. Thus, there was a negative relationship between abdominal fat pad cholesterol and triglycerides. This result is in contrast with that of Elmansy (2006) who reported that the higher level of dietary fat induced a higher level of triglyceride and cholesterol [36]. This finding is in line with that of Newman et al (2002) who stated that sunflower oil is rich in unsaturated fatty acids, which have been reported to reduce the fat and cholesterol content in broiler birds [37]. Regardless of the source fat increment induced a significant effect on cholesterol content of the abdominal fat pad, while diminishing and has no significant effect on triglycerides content. Negative relationship between cholesterol and triglycerides were also observed. Broiler carcass muscles content of cholesterol showed no significant interaction between the two sources of dietary fat in the different levels, while triglycerides showed significant diminishing but not regular interaction between fat sources and increasing levels. The same result was reported by Malakian (2010) who stated that full fat sunflower seeds (SFS) had no effect on broiler performance, and the cholesterol content not significantly affected by different SFS levels inclusion, muscle (meat) total cholesterol was 96-107%, and Fan et al. (1995) who found that serum cholesterol concentration of chicks was not affected by different fat sources; and karamouz et al (2009) working in liver chemical analyses, showed that canola oil in level 4 and 2% decrease the cholesterol and triglycerides contents numerically [8- 39-10]. These results were in contrast with many authors who stated significant effects on the cholesterol and triglycerides among the different levels and source of fat; Maraschiello et al (1998) and Crespo and Esteve-Garci, (2001) who stated that abdominal fat pad and cholesterol content of the thigh muscles were significantly reduced in animals fed sunflower and linseed oils, than in those fed tallow or olive oil ($P < 0.001$) [40-27]. Also Elyamany et al

(2008) reported changes in blood plasma cholesterol and triglycerides in different level of unsaturation [6]. Fat source induces only significant effect on carcass meat triglycerides whilst no effect on carcass meat cholesterol content; it also induced a negative correlation between cholesterol and triglycerides. This result agrees partially with Crespo and Esteve-Garcia (2001) who reported that in both thigh and breast muscles, tallow and olive oil diets caused higher values (significantly ($P < 0.001$)) of cholesterol than sunflower and linseed oil diets [27]. Villaverde et al; (2006) reported that total body fat and body energy were lower in the animals fed on high PUFA compared to the animals on the saturated-rich ones [3]; and Makala (2007) stated that fish oil lowers cholesterol level [41]. Dietary fat increment, regardless of the source, significantly, but not systematically affected the cholesterol content of carcass meat, thus not significantly and dissimilarly decreased triglycerides content [41]. Similar results were found by Malakian (2010) who stated that muscle cholesterol content was not significantly affected by different SFS levels inclusion (96-107%) [8]. The result in the present study was partially in line with that of Elmansy (2006) who reported that the higher level of dietary fat (3200 Kcal ME/kg diet) induced a higher level of triglycerides and cholesterol [36]. Cholesterol and triglycerides content of broiler serum revealed no significant interaction between dietary fat sources and levels. Similar finding were stated by Malakian (2010) who reported that the cholesterol content was not significantly affected by different sunflower seeds levels inclusion. Whereas, triglycerides decreased in expend of cholesterol (negative relation) [8]. Dietary fat source induce no significant effect on both broiler serum cholesterol and triglycerides. This result was similarly found by many authors who stated that broiler serum parameters (cholesterol, triglycerides) were not affected by dietary treatment, and contrarily with Monfaredi., (2011), Blanch et al (1995), Verma et al. (1995) and Asti et al. (1989) who reported high significant effects of dietary source on plasma cholesterol and triglycerides [9-42,43,44]. Dietary fat levels manifested no significant effect among all levels of broiler serum cholesterol and triglycerides. This result was not in line with that of Qureshi (2004) who observed that high dietary fat induced significantly higher ($P<0.05$) effect in chicks fed on animal fat as compared to those fed on vegetable oils, and with that of Asti et al. (1989) who stated that animal fat gave the highest concentration of serum cholesterol and triglycerides at different level of linseed oil, sunflower oil, and olive oil in broiler diets; this does not agree with Elyamany et al (2008) who observed changes in plasma cholesterol [7,6-44]. The result in the present study agree with Malakian (2010) who reported that full-fat sunflower seeds induced no significant effect on the plasma cholesterol content at different sunflower seed levels inclusion [8]. And partially agree with Neudonerffer and Lea (1968) and Peebles et al (1997) who reported no significant dietary effects on cholesterol, and significantly lower triglycerides, whereas, triglycerides diminishingly decreased but not in one rhythm [45,46], cholesterol increased (negative correlation), which not agreed with the result found by Navidshad (2010) who observed that Triglycerides and cholesterol were positively correlated with each other [11]. The inclusion of sunflower oil would be expected to increase digestion and absorption and the biosynthesis of triglycerides in the liver because of its unsaturated fatty acid content, thereby increasing the free fatty acid content in the blood serum, but in the result presented here induction no effect may be due to inhibition factor that associated with unsaturated fatty acid. The abdominal fat pad showed higher content of cholesterol and triglyceride studied here about two fold than carcass meat and broiler serum content (regardless of the dietary fat source or level). The result showed significant interaction between fat source and different levels in fatty acid content of abdominal fat pad (palmitic, stearic, linoleic, and oleic acid). Only palmitic contrary which appear higher significant effect on bird fed sunflower oil with level elevation. This result was in line with Azman (2005) who stated that beef tallow caused increase accumulation of saturated fatty acid in the abdominal fat pad predominantly palmitic and stearic, Newman et al (2002) who reported that sunflower diets had a significantly a higher proportion of linoleic compared to beef tallow diet [1-37]. The result was in contrast with Newman et al (2002) who reported that feeding sunflower oil diets significantly reduced the proportion of palmitic (16:00) and oleic in fat pad compared to beef tallow diets [37]. This result was partially in line with Maraschiello et al (1998) who found birds fed tallow presented higher value palmitic and stearic acid in abdominal fat pad than those fed sunflower oil [40]. These results because of dietary fatty acids are reflected in fatty acid accumulation in birds that state the fact that the dietary acid profile can alter the fatty acid accumulation in broiler abdominal fat. Dietary fat sources significantly affect abdominal fatty acid profile, tallow was higher significant in palmitic and stearic whilst sunflower oil diet was higher in linoleic and oleic acid. The present finding was in agreement with Hrdinka et al (1996) who stated the different dietary treatments caused significant changes in the fatty acid patterns for all analyzed tissues, Hargis and Van Elswyka (1993) who stated that omega-3 fatty acid content of both poultry meat and can be readily increased by the inclusion of marine oils/meals in the diet, and Crespo and Esteve-Garcia (2001) who reported polyunsaturated fatty acids were higher in muscle fat [47, 48-27]. Regarding dietary fat source, fat increment in the present study results showed significant but not regular increase in fatty acid content. Partially agreed with Gallardo (2012) who stated increase in oleic acid ($P<0.01$) was detected, as well as a decrease in linoleic acid ($P<0.01$), together with a slight increase in α-linolenic acid when canola oil used in different inclusion level [49]. These results proved the fact that said dietary fatty acid alter the fatty acid content of broiler carcass. Significant interaction between dietary fat source and levels in fatty acid profile of a broiler carcass meat higher effect of 6 and 4% of sunflower oil respectively, whereas 4% sunflower significantly affect stearic acid. The result showed that sunflower had higher significant effect on carcass meat palmitic, stearic, high but not significant on linoleic acid. Beef tallow induced high and significant effect on carcass oleic acid. The result agrees with Maraschiello et al (1998) who stated that birds fed sunflower oil showed higher values of linoleic acid than those fed beef tallow, Crespo and E. Esteve-Garcia (2001) who stated that linoleic acid had higher concentration in thigh muscle but not significant, and Crespo and E. Esteve-Garcia (2002) who reported that higher values of fatty acids from endogenous synthesis were found in broilers

fed diets rich in polyunsaturated fatty acids (PUFA) [40-27-35]. In contrast to the present findings Gallardo (2012) stated an increase in oleic acid (P<0.01) was detected, as well as a decrease in linoleic acid (P<0.01) with a higher percentage of canola oil, and Smith et al (2003) who found that the fatty acid pattern of the fat from various sources were similar to that seen in the diet. While dietary fat increment 4 and 6% induced higher significant effect on palmitic and stearic respectively, 2 and 6% had sequence and higher significant effect on oleic acid. The present study result is similar to that obtain by Salamatdoustnobar et al (2010) who showed that canola oil could affected MUFA and PUFA content in breast meat [50], and Valavan et al (unpublished) stated that the total unsaturated fatty acids concentration in breast and thigh meat of broilers showed an increase in all the treated groups. The result in the present study showed that significant interaction effect among all fatty acid observed in the blood serum samples studied here, only linoleic is seem to be a trace (nil) in all fat source and levels inclusion presented here. Beef tallow was significantly higher in palmitic and oleic acid in compare to sunflower oil which significantly higher in stearic acid. Dietary fat increment induced significant effect on palmitic, stearic, and oleic acid in absence of linoleic acid. The result was in agreement with Safamehr et al (2012) who reported that Fish Oil elevated the blood levels of palmitic acid (C16:0) and n-3 PUFAs, and caused a decline in the level of arachidonic acid (AA, C20:4n-6; P < 0.05), and linoleic acid (C18:2n-6); and an increase in the level of AA [51]. The present result was contrary with many authors (Burlikowska et al, 2010; Ayerza, 2007) who reported increased the unsaturated fatty acids in plasma contents when use oils compared to animal fat diets interactions (source and levels) and all level of inclusion [52,53]. The result was partially in contrast with many authors (mentioned elsewhere) whom stated that fatty acid deposition was a reflection to dietary fatty acids source the high content of palmitic, stearic, and oleic associated with inclusion of unsaturated fat (sunflower oil) may be due to the endogenous fatty acid synthesis particularly, when we follow up the effect of inclusion percent of unsaturated fat (2, 4%) which induced positive effect on broiler fat deposition and performance, and negative effect when reach 6%. In addition sunflower oil which rich in linoleic acid a precursor of fatty acid synthesis. Overall fatty acid results observed that abdominal fat pad had higher fatty acid content followed by carcass meat and less fatty acid content was observed in broiler serum that agreed with Yua et al (1991) who concluded that abdominal fat is a good indicator of chicken body fat [54]. That was due to high sensitivity of abdominal fat to the changes in the dietary fatty acid composition followed by meat which include additional store (intramuscular fat), and then broiler serum.

5. CONCLUSION

Beef tallow (saturated fats) is the best energy source for broiler diets, while unsaturated fats (vegetable oils) have a high energy value and their merits can be observed when used in correct amounts (2, 4%). Broiler fat deposition, cholesterol and triglycerides are genetic dependent factors, but the only precaution is made here to the edible fat (amount of fat that consume), which affect to some extend the broiler fat deposition. According to the results of the present study, adding animal fat as additional energy source is preferable but for human health it is advisable to use vegetable oils even though, it is adversely affected broiler performance. Currently, we should readdress our knowledge to have an equation that ameliorates merits of both animal fats and vegetable oils (mixture). We can conclude that lean broiler meat can be achieved through genetics, and or nutritional practices where special consideration should be given to the amount of energy intake, and the dietary energy protein ratio.

6. REFERENCES

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