

The relationship between blood lipid profile and performance of broilers fed two types of finisher diets

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Abstract

A study was conducted to evaluate the effect of two types of finisher diets differed in metabolizable energy (ME) level, but formulated to be iso-nitrogenous, on certain blood lipid profile and some productive traits of broiler chickens from 3 to 7 wks of age. The relationship, as correlation coefficients, among these traits were studied. Birds fed high (ME) diet showed heavier body weight (BW), better feed conversion ratio (FCR), higher dressing and fat pad percentages with more observed fat depots. Serum biochemical parameters for the birds of the two dietary treatments showed that birds fed high (ME) diet, 3200 Kcal / Kg, had higher values of total triglyceride (TG), total cholesterol (TC), and high density lipoprotein – cholesterol (HDL-C) than their counterparts fed lower (ME) diet, 3070 Kcal / Kg. However low density lipoprotein – cholesterol (LDL-C) and very low density lipoprotein – cholesterol (VLDL-C) values were relatively similar in the two treatment groups. Regarding the relationship analysis among some productive traits, a significant ($P \leq 0.05$) positive correlation coefficient was found between (BW) and fat pad percentage at 49-days of age for both groups. Moderate relationship values were found between (BW) and (TG). On the other hand, fat pad percentage and (TG) correlation values were 0.721 and 0.297 for the high (ME) and the low (ME) dietary treatments, respectively. (VLDL-C) value was shown to be so consistent in both groups of birds with a significant ($P \leq 0.05$) positive correlation with (TG).

Keywords: Broilers; Performance; Lipid profile; Diet.
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(TC) (TG) (HDL-C) / (VLDL-C) - (LDL-C) -

$$\frac{(VLDL-C) \cdot (TG)}{(TG)} - \frac{(TG)}{(TG)}$$

Introduction

Blood lipid profile has an important role in the performance and carcass quality of broilers. Due to the intense selection programs toward increasing body weight of broiler chickens, an excess of fatness in current modern stock is observed, this is becoming of substantial concern to poultry producers and consumers, as well. By the consumers, the acceptance of too oily carcass is no longer attractive. For producers, excess fat in the abdominal cavity and under the skin is feed costing formula. In this matter, it has been reported that abdominal fat percent was doubled up compared with the past broiler stocks, at 49 days of age (1). Reported by (2) that 4 fold energy is required to deposit a unit weight of body fat in comparison with an equal weight of muscles. This means a significant increase in the cost of carcass protein production is an inevitable phenomenon. Physiological studies have been adapted to correlate some of the blood parameters with the degree of fatness in broiler chickens. In this regard, (3,4) indicated that plasma very low density lipoprotein (VLDL) was a useful parameter to infer the degree of fatness in chickens. (3,4) also stated that decreasing plasma (VLDL) level, by any mean, causes decreasing abdominal fat in broiler chickens. Similar suggestion was reported by (5) in two strains of chickens. On the other hand, inclusion of fat or oil in broiler diet has been practiced in order to enhance dietary energy level and to achieve more weight gain. However, this was found to be on the expense of obtaining leaner carcasses, as stated by (6). The relationship between abdominal fat and body fat, carcass fat and fat depots were found to be, 0.69, 0.56, and 0.81, respectively (7).

The present study was carried out to assess the relationship between serum lipid profile and some performance traits and carcass quality of broilers fed two different finishing rations in respect with their metabolizable energy levels.

Materials and methods

A study was performed at AL- Rashidia poultry experimental station, Mosul province, Iraq, in march 2002. A total of 400 one day old Fawbro broiler chicks were raised from 1 day to 3 wks of age in a 4x6 m. room, which was supplied with two gas hoovers and proper number of feeders and waterers. A starter corn – soy broiler diet was given *adlibitum*. All birds were vaccinated against

Newcastle and Gumboro diseases as recommended by commercial breeding manuals.

Birds body weight at one day old and at the end of the 3rd wk of age were recorded. Weekly feed consumption was measured, in order to determine the over all daily growth rate and feed intake during the 7wks of trail period. At the end of 3rd wk of age, two dietary treatments with 6 replications (of 6 males and 6 females per rep.) per treatment were initiated. The two dietary treatments differed in their metabolizable energy (ME) levels as shown in table 1.

Table 1. Ingredient of selected starter and finisher diets.

Ingredient	Starter, 1-21d. %	Finisher, 22-49 d.	
		High ME, %	Low ME, %
Yellow corn	33	51	48.8
Wheat	30	20	22
Soy bean meal, 44%	33	22	24
Ground limestone	1.3	1.5	1.5
Dicalcium phosphate	1.2	1.3	1.25
Choline chloride	0.05	0	0
Vegetable oil	1	3.75	2
DL- methionine	0.1	0.1	0.1
Salt	0.25	0.25	0.25
Vit- min premix	0.1	0.1	0.1
Estimated Analysis:			
Crude protein, %	22	18.8	19
ME, kcal / kg	2950	3200	3070
C:P ratio	134	170.2	161.5

Care was taken to choose only those birds which fall within the mean \pm 0.5 standard deviation, within each sex. This was done for sake of minimizing the experimental error. Feed and water were provided *adlibitum* till the end of the experiment. Performance data included feed consumption, growth rate and feed conversion ratio (g/b/d) were determined each week throughout the experimental period. At day 49, four birds from each replication (2 males and 2 females) were picked up and manually cut for bleeding, scalded, picked of feathers and eviscerated. Carcass fat pad, and giblets weight were determined, fat pad collection including all abdominal as well as fat from around the proventriculus and gizzard. For lipid profile analysis, blood samples secured from slaughtered birds and were allowed to clot and centrifuged for 20 min at 1500

rpm, to secure the sera which were used for the determination of total cholesterol (TC), total triglyceride (TG), high density lipoprotein – cholesterol (HDL-C), low density lipoprotein – cholesterol (LDL-C). Very low density lipoprotein – cholesterol (VLDL-C) values were estimated by the formula:

$$\text{VLDL-C} = \text{Total triglycerides divided by 5. as stated by (8).}$$

All analyses were determined by employing commercially available kits (Randox, UK). Statistical analysis for computing the means of performance traits and the correlation coefficients among some of those traits and lipid profile values were calculated according to (9) using statistical package SPSS.

Results

Table 2 shows the effect of ME levels of finisher diets on performance traits. live body weight of birds fed high ME finisher diet excelled their counterpart who fed low ME diet by 69.11 gm. (2.60%) at 7-weeks of age. These differences were found to be significant ($P \leq 0.05$). Daily feed intake (DFI), daily growth rate (DGR), and feed conversion ratio (FCR) were found to be significantly differ

($P \leq 0.05$) in favor of birds raised on the high ME finisher diet at 6 and 7wks of age and for the entire period (0-7wks). The differences were 3.63, 1.42 g/b/d and 0.12 for the above mentioned traits, respectively. Values for measures of dressing and fat pad percentage were significantly ($P \leq 0.05$) higher for birds fed with high ME diet and the differences were 1.89% and 0.29% respectively. However, giblets data showed similar values in the two treatment groups.

In regard of blood analysis, some sera biochemical parameters for the two dietary treatments are shown in table 3. Statistical analysis on sera TG, TC and HDL-C levels revealed the presence of significantly ($P \leq 0.05$) higher values for birds fed with high ME diet than those fed with lower ME diet. However, LDL-C and VLDL-C values were relatively similar in the two experimental treatment groups. This finding was so consistent with the results reported by (10 and 11). Regarding the relationship analysis among some performance traits, herein this study, a significant positive correlation was found between body weight and percent of fat pad at 49-days of age, in both types of diets table 4. As with body weight and TG, moderate correlation values were detected (0.570 and 0.393) for the two groups of birds, respectively.

Table 2. Means of some productive traits of broiler duo to finisher diets differed in metabolizable energy levels *.

Type of diet	Trait	Age, wk				
		4	5	6	7	0-7
High ME	BW (gm.)	1161.18 ^a	1645.65 ^a	2144.61 ^a	2652.00 ^a	
	DFI (gm.)	101.00 ^a	132.88 ^a	151.83 ^a	163.11 ^a	100.28 ^a
	DGR (gm.)	59.41 ^a	69.21 ^a	71.28 ^a	72.49 ^a	53.31 ^a
	FCR	1.70 ^a	1.92 ^a	2.13 ^a	2.25 ^a	1.88 ^a
	Dressing, %				69.32 ^a	
	Fat pad, %				3.40 ^a	
	Giblets, %				5.93 ^a	
Low ME	BW (gm.)	1146.49 ^a	1611.57 ^a	2085.61 ^b	2582.89 ^b	
	DFI (gm.)	105.04 ^a	136.88 ^a	159.42 ^b	172.89 ^b	103.91 ^b
	DGR (gm.)	57.22 ^a	66.44 ^a	67.72 ^b	71.04 ^a	51.89 ^b
	FCR	1.84 ^b	2.06 ^a	2.35 ^b	2.40 ^b	2.00 ^b
	Dressing, %				67.63 ^b	
	Fat pad, %				3.11 ^b	
	Giblets, %				6.01 ^a	

*Means with different letters of the same trait, vertically, are significantly different ($P \leq 0.05$).

On the other hand, correlation coefficient values between fat pad percentage and TG were found to be significant ($P \leq 0.05$) with the high ME diet group (0.721) and not significant with low ME diet group (0.297). Correlation coefficients of total cholesterol with each of the body weight, fat pad, and TG were moderately positive in

both treatments. HDL-C correlation coefficients with each of body weight, fat pad and TG were relatively similar in the two treatments. Correlation coefficients of LDL-C with body weight and fat pad were significantly positive only in group of birds fed low ME diet. However these values were either low or negative in group of birds fed high ME diet.

On other hand, VLDL-C as a single value was shown to be so consistent in both groups of birds, with a significant positive correlation with TG. When data of VLDL-C and LDL-C were combined, their correlation with body weight and fat pad were significantly positive in birds fed with low ME diet but not for birds of high ME diet.

Table 3. Serum lipid profile values (means ± se) for broilers fed with finisher diet differed in metabolizable energy levels*

physiological traits mg/100ml ¹	Type of finisher diet	
	High energy	Low energy
Total triglyceride TG	52.83± 2.44 a	50.17 ± 1.40 b
Total cholesterol TC	139.69± 5.82 a	131.83± 4.13 b
HDL-C	57.50 ± 4.39 a	53.33 ± 1.71 b
LDL-C	75.50 ± 3.71 a	73.50 ± 1.52 a
VLDL-C ²	10.57 ± 0.46 a	10.03 ± 0.29 a

*Means with different letters of the same trait are significantly different (P<0.05). ¹Values are means of both sexes combined, ²Calculated according to the equation: VLDL-C = Total triglycerides divided by 5, as stated by (8).

Discussion

The dominance, in performance traits, for birds fed with high ME level of finisher diet over those fed with lower ME finisher diet is due to better metabolic rate as a result of higher ME diet, particularly at the finishing stage of broiler production. This stage is considered a stage of muscle accumulation and gaining weight at fast rates of growth. However, this betterness of feed utilization has caused, on other hand, more fat deposition, due to the fact that the

surplus of energy could be stored as triglyceride in adipose tissue of fat depots as stated by (7). It is evident that varied results of lipid profile and correlation values in the two dietary treatments are attributed to the differences in ME levels of the two types of diets. Discussing the issue of different correlation values between TG and fat pad percent in the two groups of birds may be due to difference in plasma circulating lipid concentration as stated by (10). On the other hand, the varied correlation values between VLDL-C and each of body weight and fat pad percent could be related to the reduction in fat deposition in birds fed with low ME diet. This result is in good agreement with the finding of (12). However, HDL-C similarity of correlation values with the body weight, fat pad, and TG indicating that this blood parameter is acting similarly in birds fed different ME diets, at the range of the ones selected in this experiment.

In conclusion, it would be so feasible to assume that the rate of fat accumulation might be influenced by the concentration of available plasma triglyceride which in turn so much affected by dietary ME level. Despite the fact that the high energy diet caused better performance for some economic traits such as BW and FCR, however, low energy diet in this trial produced better quality broiler chicken as far as carcass fat content is concerned. Thus, many measurements could be adapted, such as feed restriction, modifying lighting regime and lessen ME level, or at discretion of the broiler producer, to minimize carcass fat contents and secure better economy in whole process of production.

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Table 4. Phenotypic correlation coefficients among some serum physiological parameters and some productive traits of broilers.

Serum physiological parameters and body weight and fat pad %	Type of finisher diet					
	High ME			Low ME		
	Body weight	Fat pad %	TG	Body weight	Fat pad %	TG
Body weight	-----	0.928 *	0.570	-----	0.870 *	0.390
Fat pad %		-----	0.721*		-----	0.297
Total cholesterol	0.506	0.123	0.508	0.460	0.589	0.293
HDL-C	0.122	0.273	0.156	0.291	0.231	0.078
LDL-C	0.230	- 0.188	0.465	0.704*	0.700 *	0.192
VLDL-C	0.531	0.587	0.940 *	0.393	0.297	0.999 *
(VLDL + LDL)	- 0.043	- 0.108	0.540	0.777*	0.745 *	0.412

*Significant values (P≤0.05).

References

1. Chamber JR, Govara JS, Fortin A. Changes in meat – type chickens in the last twenty years. *Can J Anim Sci.* 1981;61:555-563.
2. Pym R A E, Solvyns AJ. Selection for food conversion in broiler: body composition of birds selected for increased body weight gain, food consumption and food conversion ratio. *Br Poult Sci.* 1979; 20:87-97.
3. Whithead CC, Griffin HD. Development of divergent lines of lean and fat broilers using plasma low density lipoprotein concentration as a selection criterion: the first three generations. *Br Poult Sci.*1984; 25:573-582.
4. Whithead CC, Saunderson CL, Griffin HD. Improved productive efficiency in genetically leaner broilers. *Br Poult Sci.* 1986;27:162(abstr.)
5. Grunder AA, Chamber J R, Fortin A. Plasma very low density lipoproteins, abdominal fat, and fatness during rearing in two strains of broiler chickens. *poult Sci.* 1987;66: 471-479.
6. Nitsan Z, Dvorin A, Zoret Z, Mokady S. Effect of added soybean oil and dietary energy on metabolizable and net energy of broiler diets. *Br Poult Sci.* 1997;38:101-106.
7. Crespo N, Gracia EE. Dietary poly unsaturated fatty acids decrease fat deposition in separable fat depots but not in the remainder carcass. *poult Sci.* 2002;81:512-518.
8. Tietz N W. *Fundamentals of clinical chemistry.* WB saunders Company.1976;Washington D.C.
9. SPSS. Program files, General Social survey. 2007; vol.16: Microsoft inc.USA.
10. Whithead CC, Griffin HD. Plasma lipoprotein concentration as an indicator of fatness in broilers ; effect of age and diet. *Br.Poult Sci.*1982;23:299-305.
11. Celebi S, Utlue N. Influence of animal and vegetable oil in layer diets on performance and serum lipid profile. *Int J poult Sci.* 2006;5:370-373.
12. Crespo N, Gracia EE. Polyunsaturated fatty acids reduce insulin and very low density lipoprotein levels in broiler chickens. *Poult Sci.* 2003;82;1134-1139.