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Effects of Level and Type of Energy on the Plasma Lipid Components in Broiler Chickens

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ABSTRACT: In a completely randomized design, 600 Cobb male broiler chicks were divided into five treatment groups and four replicates involve 30 chicks per each. The effect of level and source of energy on the blood components were measured at the day 28 of age. Chicks were assigned to receive five different types of rations. Dietary treatments were: T1) as control, main energy come from corn and it was according to the standard catalog of Cobb, T2) main energy come from corn and it was 3 percent energy less than the Cobb nutritional requirements, T3) main energy come from corn and it was 6 percent energy lesser than the Cobb nutritional requirements, T4) main energy satisfied according to standard catalogue of Cobb and come from corn and lipid source and T5) main energy come from corn and lipid source and it prepare 3 percent energy more than the Cobb nutrient requirements. There was no significant difference among treatments in very low-density lipoprotein cholesterol (VLDL), while the significant differences were observed in high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), albumin, cholesterol, triglyceride, total antioxidant and total protein content for all treatments ($P<0.05$). The lowest and highest amounts of total antioxidant were found in T1and T4, respectively. Minimum level of LDL was allocated to T1and T4, whereas the maximum belongs to T3. The lowest level of HDL was for T3and the most was for T1. The least amount of cholesterol related to T2, while the greatest amount belongs to T5. It was concluded that energy level and type can be effective on changing blood lipid metabolites such as cholesterol and triglyceride.

Keywords: Blood, Broiler chick, Energy level, Lipid components

INTRODUCTION

The supplementation of lipids from vegetable sources in commercial broiler diets, as an economic means of predicting energy rich formulation, has been necessary to obtain recommended energy concentration and essential fatty acid (Newman *et al.,* 2002). It was shown that, digestion of animals fat, which are rich in saturated fatty acid is difficult in digestion system of poultry in comparison with unsaturated vegetable oils (Dvorin *et al.,* 1998; Zdunczyk *et al.,* 2001). There is needed, a potential possibility of changing the profile of the fatty acids in the feed utilization, carcass quality and meat quality of poultry, by a suitable composition in the diets (Scaife *et al.,* 1994; Dvorin *et al.,* 1998;Viveros *et al.,* 2009). Some of the oil sources are rich in elements such as long chain polyunsaturated fatty acid, which can change the proportion of the lipid constituents of the blood, in human and animals.

Also it is possible to control fatty acid profile in blood and meat of birds, by transferring certain components from the diets (Hollands *et al.,* 1980). There is a large difference between energy levels and the proportion of energy and protein in Iran's broiler farms because of the differences in situations. On the other hand, some of the poultry breeders add fat supplements in their diets and the others only use carbohydrates. Therefore these factors can affect on lipid components in broiler. The level and type of fat in the diet influence the biochemical parameters of blood, which are sensitive indicators of the state of health of animals and reflects the intensity of metabolic processes taking place in their organism (Ross *et al.,* 1978; Krasnodebska-Depta and Koncicki, 2000). Hollands *et al.,* (1980) and Mori et al. (1999) reported that PUFA of dietetic oils decreased the meat and the plasma cholesterol concentrations, but, in contrast Bartov *et al.,* (1971) and Washburn and Nix (1974) did not observed such effect.

In contrast of Saturated fatty acid (SFA) or Carbohydrates, Polyunsaturated fatty acids (PUFA) has shown lower LDL concentration (Krish-Etheton and Yu., 1997). In man, a high consumption of saturated fatty acids causes high serum cholesterol concentrations, which are associated with an increased risk for coronary heart disease (Consensus Conference, 1985 and Grundy *et al.*, 1982). Beynen (1984) calculated that eating poultry meat instead of red meat can lead to a small decrease in serum cholesterol. The advantageous influence of poultry meat is related to its relatively high content of polyunsaturated fatty acids. The intake of polyunsaturated versus saturated fatty acids causes a lowering of serum cholesterol concentrations (Grundy *et al.*, 1982).

There is limited information regarding the effect of level and type of energy on lipid components in broiler chicks. Therefore, the purpose of this study was to examine the effects of levels and source of energy on the blood lipid components such as Triglyceride, Cholesterol, HDL, LDL, VLDL and also albumin and total antioxidant and total proteins content in broiler chicken.

MATERIALS AND METHODS

A total number of 600 one-day-old Cobb broiler chicks were prepared from a commercial hatchery and used in this study for 42 days of feeding trial. The broiler chicks were nearly equal in the live body weight and in a completely randomized design divided into five treatment groups and four replicates of 30 chicks each.

Table 1: Ingredients and calculate nutritional composition of the experimental diets (grower), according to treatments.

Ingredients (%)	Control	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Corn	69.22	68.8	67.7	65.31	59.31
Soybean meal	18	23.43	26.2	24	28.45
Corn Gluten meal	8.2	3.24	----	4.2	2.9
Soybean Oil	----	----	----	2	5
Dicalcium phosphate	1.9	1.9	1.9	1.9	1.9
Limestone	1.05	1.05	1.05	1.05	1.05
Nacl	0.37	0.37	0.37	0.37	0.37
Dl-Methionine	0.22	0.27	0.30	0.25	0.25
L-Lysine	0.44	0.34	0.28	0.32	0.22
L-Threonine	0.10	0.10	0.12	0.10	0.05
Mineral & Vitamin premix [1]	0.5	0.5	0.5	0.5	0.5
Filler	----	----	1.58	----	----
Total	100	100	100	100	100

Calculated composition

Metabolizable energy (kcal/kg)	3108	3104	2921	3108	3201
CP (%)	19	18.4	17.8	19	19.5
Ca (%)	0.84	0.84	0.84	0.84	0.84
Available P (%)	0.42	0.42	0.42	0.42	0.42
Met TFD (%)	0.53	0.53	0.53	0.53	0.53
Lys TFD (%)	1.05	1.05	1.05	1.05	1.05
M+C TFD (%)	0.89	0.89	0.89	0.89	0.89
Thr TFD (%)	0.78	0.78	0.78	0.78	0.78
Trp TFD (%)	0.21	0.22	0.22	0.22	0.22
Arg TFD (%)	1.25	1.25	1.25	1.25	1.25
Val TFD (%)	0.91	0.91	0.91	0.91	0.91
Na (%)	0.19	0.19	0.19	0.19	0.19
K (%)	0.72	0.81	0.85	0.81	0.86
Cl (%)	0.32	0.33	0.34	0.33	0.34
ME/CP	164	164	164	164	164

[1] Provided the following per kg of diet: Mg, 56 mg; Fe, 20 mg; Cu, 10 mg; Zn, 50 mg; Co, 125 mg; I, 0.8 mg, vitamin A, 10,000 IU; vitamin D3, 2000 IU; vitamin E, 5 IU; vitamin K, 2 mg; riboflavin, 4.20 mg; vitamin B12, 0.01 mg; pantothenic acid, 5 mg; nicotinic acid, 20 mg; folic acid, 0.5 mg; choline, 3 mg.

The first group was served as control and had diets according to Cobb catalog while other four groups were, T2) based on corn which contained 3 percent energy less than the nutritional requirements of broilers, T3) based on corn which consisted 6 percent energy lesser than the nutritional needs of broilers, T4) based on corn, fat and energy according to standard catalogue of Cobb and finally T5) based on corn and fat which contained 3 percent energy more than the nutrient requirements of broilers. The experimental period included three feeding phases (0-10 as starter, 10-28 as grower and 28-40 as finisher) and terminated while birds were 42 days old (Table 1).

Chicks were kept under the same environmental condition, hygienic, management and accessed to feed and water ad libitum. Lighting schedule was 23 hours light and 1 hour dark while the temperature was gradually reduced 3ºC from initially 32ºC each week. Broilers were weighed at the beginning of the experiment, further at weekly intervals until the end of trial period. Feed consumption (FC), feed conversion ratio (FCR), live body weight (LBW), body weight gain (BWG) were recorded during period and all chicks were vaccinated against Newcastle disease, at eight and twenty one days of age with Hitchener B1 and lasota strain vaccine, respectively and Gumboro vaccine against bursal disease at fourteen day of age.

At days 28, 3 ml of blood samples were collected from wing vein of two birds per each replicates in heparinized tubes and centrifuged at 1500 × g for 10 minute. Plasma obtained was stored at -20ºC until analysis. The obtained plasma were used for analysis of triglyceride by using triglyceride colorimetric assay kit of Cayman chemical company based on method of Deska-Pagana *et al.* (2005) and McGowan *et al.* (1983).Total protein based on reaction of copper from copper sulfate solution with protein peptide bonds in alkaline condition and evaluated according to biuret method of Donniger *et al.* (1972). Bovine serum albumin used as standard.

Total antioxidant capacity was measured through: Two mL of peripheral blood were taken. Then the test tubes with blood were placed in a thermostat at the temperature of 37°C and kept for 5 min.

Next, NBT, the final concentration of which ranged to 1×10^{-4} mol, was added to the blood in the test tubes, which were kept for 20 min at the temperature of 37°C.

On completion of incubation, the tubes were centrifuged for 5 min at 2000 rpm to sediment any cells. The supernatant was decanted into fresh test tubes, and the absorbance of NBT was measured in the samples using a spectrophotometer at wave length of 580 nm at 37°C against a blank based on method of Zilinskas *et al.* (2007) and Demehin *et al.* (2001). Albumin was measured by albumin-specific reaction with Bromocresol green, using Abnova kit (catalog NO: KA 1612) based on method of Tietz *et al.* (1990) and Doumas *et al.* (1971). The Shaapiro-Wilk test of normality was used in order to define normal distribution of data. If data was not normal the BOXCOX transformation used to normalize them. Normal data were analyzed by completely randomized design and Duncan multiple range test was used in order to compare the mean of treatment.

RESULTS AND DISCUSION

The data in Tables 2 and 3 illustrates the effect of energy level and source in different diets on total antioxidant, albumin, VLDL, LDL, HDL, cholesterol, triglyceride and total Protein levels at the age of 28 days in male broilers, respectively. There were significant differences among treatments for total antioxidant while the highest level belongs to those that were fed by diets based on corn, fat and energy according to standard catalog of Cobb and the lowest level stands for control diets. As it can be seen there was a considerable diversity in Albumin content while the maximum level stands for the treatment that contained corn, fat and energy according to standard catalogue of Cobb and the minimum level belongs to those that were fed by diets based on corn which consisted 3 percent energy less than the nutritional requirements of broilers. An increase in plasma albumin in diets containing higher energy may be related to the increase in liver capacity for producing protein and albumin. There was a report (Boostani *et al.,* 2010) that showed plasma true protein and albumin levels were not significantly affected by energy restriction which is in contrast to our finding.

Table 2: The effect of energy level and source on plasma biochemical components at day 28 of age.

Treatments	Total antioxidant µg/ml	Total protein mg/dl	Albumin mg/dl
T1	$37.40^{C}\pm1.387$	$3.57^{b}\pm0.209$	$1.81^{bc}\pm0.536$
T2	$48.10^{b}\pm1.699$	$3.51^{b}\pm0.071$	$1.66^{c}\pm0.091$
T3	$53.70^{ab}\pm2.151$	$4.18^{a}\pm0.120$	$1.95^{ab}\pm0.080$
T4	$59.35^{a}\pm3.551$	$4.40^{a}\pm0.110$	$2.15^{a}\pm0.097$
T5	$47.00^{b}\pm1.477$	$4.27^{a}\pm0.813$	$1.88^{bc}\pm0.054$

$^{a-d}$within columns ,values with different superscripts differ significantly ($p < 0.05$)

In contrast there were no noticeable differences among treatments for VLDL level but significance can be seen in LDL while the greatest level were on diets contain corn which consisted 6 percent energy less than broilers needs and lowest level allocated to control and diets based on corn and 3 percent energy less than their needs. The circumstances in HDL were meaningful while the highest level can be observed in control diet and the lowest level were on diets based on corn which contained 6 percent energy less than the nutritional requirements of broilers. it is evident that Cholesterol also has significant differences between treatments whereas the highest-level belongs to the ration with diets based corn and fat which contained 3 percent energy more than the nutritional requirements of broilers and the lowest-level stands for diets based on corn which included 3 percent energy less than their nutritional requirements. The highest amount of triglyceride content belongs to chicks were fed by diets based on corn which contained 6 percent energy less than the nutritional requirements of broilers and diets based on corn and fat which consisted 3 percent energy than the nutrient requirements of birds while lowest stands for control and 3 percent energy less than that ration. Energy restriction and type caused a rise in plasma triglyceride level of broiler chicks. Generally, triglyceride is affected by two factors: diet and hormones. More feed intake causes less lipolysis which leads to decrease of blood triglyceride, therefore feed restriction can increase blood triglyceride. Also, the stress caused by limitation in feed access can lead to increase in corticosterone hormone secretion. Corticosterone increases lipolysis in tissues therefore triglyceride level raises in blood (Kubikova *et al.*, 2001). In a study (Onbasilar *et al.*, 2009) reported that energy restriction in broilers increases triglyceride level at day 42 of age. However another study (Cornejo *et al.*, 2007) found no significant difference in plasma triglyceride level among energy restricted groups and the control group at day 28 in broilers. Similar results were found in a study (Tumova *et al.*, 2002). It seems that these contradictive results are because of the effect of other factors in the experiments.

In comparison with other blood plasma except VLDL it was clear that there were a significant level in total protein content among treatments while highest belongs to diets based on corn and fat contained 3 percent energy more, and diets basted on corn and fat and energy according to standard catalogue of Cobb, and diets based on corn which contained 6 percent energy less than nutritional needs however lowest stands for control and diets based on corn which contained 3 percent energy less than the nutritional requirements of broilers.

Table 3: The effect of energy level and source on plasma lipid components at day 28 of age.

Treatment	VLDL mg/dl	LDL mgr/dl	HDL mg/dl	Cholesterol mg/dl	Triglyceride mg/dl
T1	10.21±0.130	43.70^{c}±2.322	52.10^{a}±1.962	156.20^{bc}±5.508	76.33^{b}±4.120
T2	9.72±0.153	48.50^{c}±1.815	46.30^{bc}±1.83	131.60^{c}±13.910	80.32^{b}±5.278
T3	9.59±0.313	61.27^{a}±2.546	40.70^{d}±1.710	173.17^{b}±14.777	94.32^{a}±3.230
T4	10.07±0.421	57.37^{ab}±1.249	42.20^{cd}±1.62	194.00^{ab}±14.388	85.40^{ab}±2.661
T5	10.55±0.331	51.50^{bc}±3.720	48.80^{ab}±1.39	22010^{a}±14.368	93.22^{a}±3.787

$^{a-d}$within columns ,values with different superscripts differ significantly ($p < 0.05$)

The results of this study showed that energy level and type can be effective on changing blood lipid metabolites such as cholesterol and triglyceride.

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