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The effect of energy increasing and protein lowering on performance and some serum biochemical parameters of broiler chickens

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ABSTRACT

This experiment was conducted to determine the effects of increasing energy to protein ratio and partial decreasing of nutrient contents of diet using different levels of fats on broiler chickens performance and serum biochemical parameters. With addition of fats (poultry oil, soybean oil and tallow) in two levels (4 or 8%) to basal diet that was already balanced on NRC (1994) recommendations, seven different non-isocaloric and non-isonitrogenic diets were prepared and given ad libitum between 22 to 49 day of age. The blood samples were collected at 35 and 49 day. The results showed that high fat intake had no significant effect on final body weight and feed conversion ratio. Serum calcium concentration in control group was found to be significantly higher than other groups, whereas serum phosphorus and albumin levels had no significant difference in dietary treatments. Therefore the result of this experiment suggested that energy increasing and protein lowering have no beneficial effects on performance and serum biochemical parameters.

Key words: Broiler chicken, Energy, Protein, calcium, phosphorus, albumin.

INTRODUCTION

Feeding poultry with diets that contain fat can confer several economic advantages by providing increased energy levels and fatty acid composition [1]. There have been a notable increase in growth rate and feed efficiency in commercial broiler chickens in last 20 years [2]. If the poultry is expected to show high performance, their needs of high energy and protein should be provided. Providing their needs of high energy is an obligation to use different fat sources [3]. Fats provide a concentrated source of energy to achieve high energy broiler diets [2]. In developed countries, fat or oils as energy rich feed are available from animal sources such as soybean oil, sunflower oil and maize oil. The main problem for using vegetable oils in poultry diets in developing countries is mixing oils with diet, because there is no or unsuitable facilities

for such a purpose. In other hand, combination of fatty acids with cations in alimentary tract may form cation soaps during the process of digestion [4]. Other important roles of fats in diet are their inhibition from de novo lipogenesis; provide varying quantities of the nutrients such as linoleic acid, vitamins, diet palatability, mechanical and structural roles and low heat increment [5]. Therefore, the specialists endeavor on the basis of these advantages and defects of dietary fat intake, a functional diet to balanced [3]. When the researches related to single or mixed fat on the feeding performance and body fat accumulation of broilers was summarized, the adding fat to diets increased the performance [6]. There are a little data in scientific literature about the effect of different fat sources on calcium, phosphorus and albumin levels in serum. For proper supply of calcium and phosphorus level in diet, we should know the relation between increasing fat level in diets with serum calcium and phosphorus level. Crespo and Garcia [7] stated that, increasing fat levels in diets, decrease retention of calcium and phosphorus in bones, in results decrease body skeletal weight. Biely and March [8] showed that, addition of 12% fat in diets of broiler chicks had no effect on calcium requirement. Smith et al., [9] used four type of fat in broiler diet, but they didn't observe any significant effect between type of fat and serum calcium level. In this study, the relationship between high fat intake with performance value and serum biochemical parameters were determined.

MATERIALS AND METHODS

This study was conducted at Islamic Azad University, Shabestar branch, Shabestar-Iran in summer of 2006. Total of 210 one-day old broiler chicks of the Cobb-500 strain from male sex were randomly assigned in 21 pens. Each bird initially occupied 0.08 m^2 of floor space. The pens were randomized with respect to dietary treatment. Birds were provided with continuous light.

Table 1: Ingredient and calculated analysis of grower diets

Ingredients	Diets[1]						
	C	C+4%T	C+4%S	C+4%P	C+8%T	C+8%S	C+8%P
Yellow Corn	70.50	67.68	67.68	67.68	64.86	64.86	64.86
Soybean meal (44%)	19.30	18.53	18.53	18.53	17.76	17.76	17.76
Fish meal (66%)	7.50	7.20	7.20	7.20	6.90	6.90	6.90
Fat	-	4.00	4.00	4.00	8.00	8.00	8.00
Oyster shell	1.40	1.34	1.34	1.34	1.29	1.29	1.29
Mono calcium phosphate	0.35	0.34	0.34	0.34	0.32	0.32	0.32
DL-Methionine	0.15	0.14	0.14	0.14	0.14	0.14	0.14
Sodium chloride	0.10	0.10	0.10	0.10	0.09	0.09	0.09
Vitamin Premix[2]	0.25	0.24	0.24	0.24	0.23	0.23	0.23
Mineral Premix[3]	0.25	0.24	0.24	0.24	0.23	0.23	0.23
Coccidiostat	0.10	0.10	0.10	0.10	0.09	0.09	0.09
Vitamin E	0.10	0.10	0.10	0.10	0.09	0.09	0.09
Calculated Composition							
ME (kcal kg^{-1})	3030	3249	3269	3269	3468	3507	3507
Crude protein (%)	19.00	18.24	18.24	18.24	17.48	17.48	17.48
ME:CP ratio	159.00	178.00	179.00	179.00	198.00	200.00	200.00
Calcium (%)	1.12	1.08	1.08	1.08	1.03	1.03	1.03
Av. Phosphorus (%)	0.50	0.48	0.48	0.48	0.46	0.46	0.46
Methionine (%)	0.54	0.52	0.52	0.52	0.50	0.50	0.50
Meth+cyst (%)	0.76	0.73	0.73	0.73	0.70	0.70	0.70
Lysine (%)	1.09	1.05	1.05	1.05	1.00	1.00	1.00

[1]C: Control (basal diet); T: Tallow; S: Soybean oil; P: Poultry oil. [2]Supplemented (For each kg of the diets): Vit. A, 12000 IU; D3, 2000 IU; E, 20 mg; K3, 3 mg; B2, 7 mg; B3, 12 mg; B5, 3 mg; B12, 0.03 mg; Biotin, 0.1 mg; Choline chloride, 300 mg and adequate anti oxidant.
[3]Supplemented (For each kg of the diets): Mn, 130 mg; Fe, 70 mg; Zn, 60 mg; Cu,12 mg; I, 1 mg; Se, 0.2 mg

Table 2: Ingredient and calculated analysis of finisher diets

Ingredients	Diets[1]						
	C	C+4%T	C+4%S	C+4%P	C+8%T	C+8%S	C+8%P
Yellow Corn	73.40	70.46	70.46	70.46	67.53	67.53	67.53
Soybean meal (44%)	20.50	19.68	19.68	19.68	18.86	18.86	18.86
Fish meal (66%)	2.80	2.69	2.69	2.69	2.58	2.58	2.58
Fat	-	4.00	4.00	4.00	8.00	8.00	8.00
Oyster shell	1.60	1.54	1.54	1.54	1.47	1.47	1.47
Mono calcium phosphate	0.70	0.67	0.67	0.67	0.64	0.64	0.64
DL-Methionine	0.10	0.096	0.096	0.096	0.092	0.092	0.092
Sodium chloride	0.10	0.096	0.096	0.096	0.092	0.092	0.092
Vitamin Premix[2]	0.25	0.24	0.24	0.24	0.23	0.23	0.23
Mineral Premix[3]	0.25	0.24	0.24	0.24	0.23	0.23	0.23
Coccidiostat	0.10	0.096	0.096	0.096	0.092	0.092	0.092
Vitamin E	0.10	0.096	0.096	0.096	0.092	0.092	0.092
Calculated Composition							
ME (kcal kg^{-1})	3030	3249	3269	3269	3468	3507	3507
Crude protein (%)	17.00	16.32	16.32	16.32	15.64	15.64	15.64
ME:CP ratio	178.00	199.00	200.00	200.00	221.00	224.00	224.00
Calcium (%)	0.95	0.91	0.91	0.91	0.87	0.87	0.87
Av. Phosphorus (%)	0.42	0.40	0.40	0.40	0.38	0.38	0.38
Methionine (%)	0.42	0.40	0.40	0.40	0.38	0.38	0.38
Meth+cyst (%)	0.64	0.61	0.61	0.61	0.58	0.58	0.58
Lysine (%)	0.87	0.84	0.84	0.84	0.81	0.81	0.81

[1]C: Control (basal diet); T: Tallow; S: Soybean oil; P: Poultry oil. [2]Supplemented (For each kg of the diets): Vit. A, 12000 IU; D3, 2000 IU; E, 20 mg; K3, 3 mg; B2, 7 mg; B3, 12 mg; B5, 3 mg; B12, 0.03 mg; Biotin, 0.1 mg; Choline chloride, 300 mg and adequate anti oxidant.
[3]Supplemented (For each kg of the diets): Mn, 130 mg; Fe, 70 mg; Zn, 60 mg; Cu,12 mg; I, 1 mg; Se, 0.2 mg

This experimental design was completely Randomized design, with seven combinations treatment and three replicates. With addition of three types of fats including poultry oil, soybean oil and tallow in two levels (4 or 8%) to basal diet that was already balanced on National Research Council [10] recommendations. Seven different non-isocaloric and non-isonitrogenic diets were prepared (12 or 24% increasing of energy to protein ratio in 4 or 8% of additional fat level, respectively) and given *ad libitum* at 22 to 49 day old (grower and finisher periods). Total birds were fed a resembling starter diet at 1 to 21 days old. Ingredient percentage and calculated analysis of grower and finisher diets are provided in Table 1 and 2. At 35 and 49 day of age in fasting state, bloods samples were randomly collected from wing vein of one bird per pen and rapidly were centrifuged at 5000 rpm during 5 min and then sera by using commercial kits (Pars Azmun) in auto analyzer (ALCYON 300) were analyzed.

Statistical analysis

Data were analyzed by the ANOVA option of the GLM of SAS/STAT software [11] as a completely randomized design of dietary treatment. The treatment comparison test by Duncan test method and was statistically analyzed by the same software [12].

RESULTS AND DISCUSSION

The effect of different types and levels of dietary fats that were added to control diet on performance values are presented in Table 3. There were no significant differences in performance value in chicks fed with different experimental diets but numerically due to increasing of diet palatability in broilers that fed with additional fat were better than broilers of control group. There was numerically, higher feed intake and final body weight and better feed conversation ratio in broilers that fed with 8% additional tallow fat. Tabiedian and Sadeghi [4] were showed that adding of 5 and 7.5% tallow significantly ($p<0.05$) increasing feed intake due to better palatability of fat supplemented diet.

Table3: Means comparisons of dietary treatments effect on performance values at 49 day of age

Dietary treatments[1]	Total feed intake (g/bird)	Final body weight (g)	Feed conversion ratio
C(NRC)	4210	1900	2.22
C+4%T	4210	1920	2.19
C+4%S	4220	2000	2.24
C+4%P	4460	2000	2.23
C+8%T	4670	2170	2.15
C+8%S	4410	2040	2.16
C+8%P	4230	1910	2.24

[1]C: Control (basal diet); T: Tallow; S: Soybean oil; P: Poultry oil

The calcium, phosphorus and albumin content of blood of experimental broiler are presented in Table 4. Serum calcium concentration in control group was found to be significantly higher than other groups. The results demonstrated that diets supplemented with oils could be decrease the serum level of calcium. Calcium is necessary for maintenance of bone integrity, however, decreased retention of calcium in chicks have been reported with increasing dietary fat content [13]. Other researchers [8] indicated that dietary fat levels as high as 12% did not increase calcium requirement while still others [14] indicated that supplemental fat type had no effect on bone calcification.

Table 4: Means comparison of dietary treatments effect on Calcium, Phosphorus and Albumin at 49 day of age

Dietary treatments[1]	Calcium	Phosphorus	Albumin
C(NRC)	12.61^{a}	39.44	1.77
C+4%T	11.80^{ab}	39.12	1.78
C+4%S	11.70^{b}	39.99	1.80
C+4%P	11.52^{b}	39.89	1.71
C+8%T	11.73^{ab}	39.92	1.76
C+8%S	12.20^{ab}	39.44	1.73
C+8%P	11.85^{ab}	39.60	1.80

$^{a, b, c}$: Means within diets for each performance values with no common superscript differ significantly ($p<0.05$). [1]C: Control (basal diet); T: Tallow; S: Soybean oil; P: Poultry oil

Table 5: Means comparison of dietary treatments effect on Calcium, Phosphorus and Albumin at 39 and 49 day of age

	Calcium		Phosphorus		Albumin	
Dietary treatments[1]	35 day	49 day	35 day	49 day	35 day	49 day
C(NRC)	13.58±1.65	11.63±0.91	39.50±2.92	39.38±2.59	1.75±0.15	1.80±0.09
C+4%T	12.43±1.75	11.17±0.44	39.38±0.97	38.87±1.25	1.77±0.10	1.80±0.09
C+4%S	12.53±1.51	10.87±0.38	38.87±1.97	41.12±1.09	1.77±0.12	1.83±0.10
C+4%P	12.10±1.12	10.95±0.55	37.65±1.01	40.13±1.36	1.63±0.08	1.78±0.15
C+8%T	12.75±2.57	10.72±0.28	38.25±1.44	41.58±1.78	1.70±0.13	1.83±0.10
C+8%S	13.42±3.06	10.98±1.02	38.43±1.92	40.45±1.55	1.68±0.08	1.78±0.08
C+8%P	12.57±1.06	11.13±0.50	37.70±1.73	41.50±2.13	1.72±0.08	1.88±0.10

[1]C: Control (basal diet); T: Tallow; S: Soybean oil; P: Poultry oil

The decrease in calcium level may be due to combination of fatty acid with cations and form of insoluble soaps. Singh and panda [15] stated that the fatty acid arising from digestion of dietary fats from insoluble calcium soaps which are assimilated with difficulty. Calverley and Kennedy [16] found that fats increased fecal calcium excretion in rats by the formation of indigestible calcium soaps, and that long-chain saturated fatty acids were more reactive than other fatty acids. The retention of magnesium and calcium were shown to be reduced by fatty acid supplementation [17].

Rezq et al. [18] were reported that addition of palm oil, olive oil, sunflower oil, butter, animal fat and margarine significantly decreased serum level of calcium in mice but Usayran et al. [19] showed that fat supplementation had no effect on serum calcium.

Addition of oils had no significant effect on serum phosphorus and albumin level. The results are in agreement with result of Salari et al. [20] that added sunflower oil in diets and found no relation between fat level and phosphorus concentration. Rezq et al., [18] showed that adding soybean oil to mice diet decrease phosphorus level. Several treatments-related differences between treatments groups regarding blood traits included in this study may be explained by the physiological changes in metabolism in chicks due to fatty acids found in different oils supplemented to the diet of these birds. Dilworth et al. [21] estimated the bioavailability of calcium from different calcium and phosphorus sources for the chick and concluded that there were significant differences in the calcium availability of feed grade phosphates to the chicks and suggested a positive correlation between the availability of calcium and phosphorus in feed grade supplements.

The serum chemistry values closely reflected the differences in productive and reproductive performance of birds [22]. Al-Daraji et al. [23] found that different oil sources supplemented to the diet of laying quail had varying effects on productive and reproductive performance of these birds. This is reflected by the fatty acid composition of these oils added to the diet. Pérez-Granados et al. [24] concluded that calcium and phosphorus utilization may depend not only on the type of fat consumed but also on changes produced in the fat during the frying process, as has been recently described in the case of magnesium.

CONCLUSION

It could be concluded that energy increasing and protein lowering have no beneficial effects on performance and serum biochemical parameters.

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