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Use of Plant Based Calcium Salt of Fatty Acids in Broiler Diets

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Abstract: This study carried out to evaluate the effect of plant based calcium salt of fatty acids (fat powder) on broiler chicken performance, carcass, organs and some plasma characteristics. A total of 320 one-day old broiler chicks of a commercial breed (Ross 308) from both sex with equal ratio were placed in 16 pens, twenty in each pen. Treatments were included Ca-salt of fatty acids at 0, 2.5, 5 and 7.5%. Each treatment replicated four times. Inclusion of fat powder had no significant effect on feed intake. Feeding different levels of fat powder significantly ($P<0.05$) decreased weight gain in 7-21 and 7-49 day old chicks, and in other ages decreased weight gain numerically. Using of calcium salts of fatty acid significantly ($P<0.05$) increased feed conversion ratio in 7-21 and 7-49 days old broiler chicken. Inclusions of fat powder in diet dose not affect carcass, abdominal fat, liver, pancreas, intestine and heart percentages. No significant differences were observed in plasma triglyceride, cholesterol, HDL and LDL. Our finding showed that using of fat powder could not improve broiler chickens performance.

Key words: Broiler, calcium salt, fatty acids, performance, carcass

Introduction

There have been a notable increase in growth rate and feed efficiency in commercial broiler chickens in last 20 years. Current commercial hybrids with high performance require high energy diets which would enable the maximum exploitation of those genetic potential. Increasing demands for energy in growing chickens can be satisfied by the addition of fat to the feeding mixtures (up to 10%). An increasing supplementation of diets with animal or plant fats or oils for intensive poultry production has been observed (Sadeghi and Tabeidian, 2005; Tabeidian *et al*., 2005). In recent years due to bovine spongiform encephalopathy (BSE) efforts have been made to remove potentially hazardous animal-based raw materials including animal fat from poultry diets and this resulted to replacement of animal fat in broiler chickens diets with vegetable oils. Nitsan *et al*. (1997) showed that addition of 3% soybean oil in the diet improved weight gain than the diet containing 0% soybean oil. Tabeidian *et al*. (2005) in 7-21 d old chicks showed that the feeding a diet with 2.5% soybean oil and a protein level 10% more than NRC recommendation resulted to lowest feed conversion ratio and a lowest abdominal fat was observed in chicks fed with a diet containing 7.5% soybean oil with NRC recommendation protein level.

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. Using from fatty acid calcium salts (fat powder) may be alleviate such a problem. Besides, this form of fat have some other advantages including easier handling, higher stability (particularly of polyunsaturated fatty acids), lower loose of substances and it is a good source of calcium. Mala *et al*. (2004) by replacement of soybean oil with its fatty acid calcium salts showed that the Ca-salts of fatty acids have no negative effect on chicken's health state and the quality of carcass but live weight were lower in chicks that had been fed with Ca-salt of fatty acids and the concluded that the energy value of Ca-salts of fatty acids is lower than that of commonly used fats and oils.

There are a little data in scientific literatures on the use of vegetable oils in the form of Ca-salts of fatty acids and the aim of current study were to evaluate the effect of using Ca-salts of fatty acids in broiler chicken diets.

Materials and Methods

A total of 320 one-day old broiler chicks of a commercial breed (Ross 308) from both sex with equal ratio were placed in 16 pens, twenty in each pen. Feed and water were provided *ad libitum*. The chicks were allocated randomly to 4 experimental diets. The experiment arranged on a completely randomized design (CRD) with for replicate per each treatment. Treatments were included 0, 2.5, 5 and 7.5% Ca-salts of fatty acids. Metabolizable energy of Ca-salts of fatty acid determined by Sibbald (1986) method by using 8 leghorn roosters. Gross energy was determined using an adiabatic bomb calorimeter (Parr Instrument, Moline. Il, USA) using a benzoic acid standard. Metabolizable energy of fat powder was 7000 kcal kg^{-1} that used for diet formulation. The diets (Table 1) were formulated to meet nutrient requirements according to NRC (1994). Diets contain

Table 1: Composition of experimental chicken diets as formulated and as calculated from analyzed composition of the ingredients (g kg^{-1} as fed)

Ingredient	starter				Grower				Finisher			
	0	2.5	5	7.5	0	2.5	5	7.5	0	2.5	5	7.5
Corn	66.14	61.19	57.9	52.56	71.17	67.21	63.3	59.44	74.8	70.5	66.28	62
Soybean	25.8	29.35	29.95	31.9	23.52	23.97	24.5	25	22.02	23.78	25.5	27.3
Fat Powder	0	2.5	5	7.5	0	2.5	5	7.5	0	2.5	5	7.5
Fish meal	5	3.9	4.95	5	2	3	4	5	0	0	0	0
Oyster shell	1.5	1.5	1.45	1.48	1.5	1.5	1.40	1.3	1.4	1.4	1.4	1.4
DCP	0.8	0.8	0.8	0.8	1.06	1.04	1.04	1	1.06	1.06	1.06	1.06
D-L Methionin	-	-	-	-	-	-	-	-	-	-	-	-
Lys- Hcl	-	-	-	-	-	-	-	-	-	-	-	-
Na Cl	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Mineral premix[1]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.25	0.25	0.25	0.25
Vitamin premix[1]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	0.25	0.25	0.25	0.25
Calculated Composition												
ME(MJKg^{-1})	2934	2990	3071	3140	2966	3047	3131	3216	2997	3067	3139	3210
CP	21.1	21.42	22.07	22.56	18.53	19.03	19.57	20.09	16.88	17.27	17.65	18.06
Met	0.39	0.4	0.41	0.41	0.33	0.35	0.36	0.36	0.32	0.31	0.31	0.31
Lys	1.20	1.25	1.30	1.30	1.0	1.0	1.1	1.1	0.85	0.87	0.88	0.9
AP	0.4	0.4	0.4	0.4	0.37	0.38	0.4	0.41	0.31	0.31	0.31	0.31
Ca	0.97	0.97	0.97	0.98	0.87	0.90	0.91	0.92	0.74	0.75	0.74	0.74

[1]Supplemented (mg kg^{-1} of diet): Mn, 1200; Fe, 60; Zn, 120; Cu, 12; I, 1.2; Se, 0.24

[2]Supplemented (mg or IU kg^{-1} of diet): Vit. A, 10800 IU; D_3, 2400 IU; E, 21.6 IU; K_3, 2.4 IU;B_1, 2.16; B_2, 7.9; B_3, 12; B_5, 3.6; B_9, 1.2; B_{12}, 0.015; Biotin, 0.12; choline chloride, 600; and adequate anti oxidant.

the same levels of methionine, lysine, vitamins and minerals. The chickens were weighed at the start of the experiment, and during the experiment, live weight and total feed consumption per pen were recorded and feed conversion ratio was calculated at 21, 42 and 49th days of the experiment. Tow birds (male and female) from each replicate were slaughtered after bleeding at days 49 and carcass, abdominal fat, liver, pancreas, intestine and heart were weighed and presented as a percentage of live weight. Plasma samples were taken from blood samples and analyzed for triglyceride, cholesterol, HDL and LDL.

The results obtained from the experiment were analyzed by an analysis of variance using the general linear model (GLM) procedure of SAS and means were compared by Duncan's Multiple Range Test (SAS Institute, 1995). There was no significant difference between both sexes in organs weights and plasma characteristics, so the data pooled and analyzed together.

Results and Discussion

Feed intake: feeding different levels of fatty acid calcium salts had no significant effect on broiler feed intake in 7-21, 22-42, 42-49 and 7-49 days of age. In all ages, except for 42-49 day old broilers, inclusion of 7.5 percent fatty acid calcium salts increased feed intake numerically (Table 2). There is very few data on fatty acid calcium salt effects on feed intake in broiler chicken. Our previous work (Sadeghi and Tabeidian, 2005) showed that in 7-56 day old chicks feeding a diet containing NRC protein level, adding 5 and 7.5 percent tallow significantly increased feed intake. Higher feed intake in fat powder supplemented diet may be a result of better palatability of diet.

Weight gain: Effects of fat powder supplementation on weight gain are shown in Table 3. Feeding different levels of fatty acid calcium salts significantly ($P<0.05$) decreased weight gain in 7-21 and 7-49 day old chicks, and in other ages decreased weight gain numerically. These results are in agreement with Mala *et al.* (2004) findings for male broiler chicks who showed that live weight in male chicks that fed with calcium salts of fatty acids in a plant based diet were significantly lower, but they observed no significant difference in female broiler chicks. Lower weight gain in groups that fed with fat powder could be attributed to poor quality of this product or its lower digestibility because of its incomplete hydrolysis in gastro-intestinal tract of broiler chickens. So, its energy utilization will be lower than those we have determined by Sibbald method in adult roosters.

Feed conversion ratio: Using of calcium salts of fatty acid significantly ($P<0.05$) increased feed conversion ratio in 7-21 and 7-49 days old broiler chicken. Also, the feed conversions ratios were higher numerically in 22-42 and 42-49 days old chicks (Table 4). These findings are well coincidence with higher feed intake and lower weight gain in chicks that fed with calcium salts of fatty acid.

Carcass and organs weight: Effects of different levels of fatty acid calcium salt on carcass and organs weight in 49 days old broiler chicks as a percentage of carcass weight are shown in Table 5. Using fat powder dose no

Table 2: Effects of different levels of fatty acid calcium salt on feed intake

fatty acid calcium salt	Feed Intake (g)			
	7-21	22-42	42-49	7-49
0	769	2158	952	3880
2.5	777	2115	838	3775
5	770	2090	871	3731
7.5	790	2354	889	4033

Table 3: Effects of different levels of fatty acid calcium salt on weight gain

fatty acid calcium salt	Weight Gain (g)			
	7-21	22-42	42-49	7-49
0	419.9^{a}	1018.1	391.7	1829.7^{a}
2.5	417.2^{ab}	1007.8	405.3	1830.3^{a}
5	392.1^{bc}	1040.2	376.1	1808.4^{a}
7.5	389.1^{c}	1006.2	297.6	1692.9^{b}

Table 4: Effects of different levels of fatty acid calcium salt on feed conversion ratio

Fatty acid calcium salt	Feed Conversion Ratio (g/g)			
	7-21	22-42	42-49	7-49
0	1.83^{b}	2.12	2.3	2.15^{b}
2.5	1.86^{b}	2.10	1.93	2.06^{b}
5	1.96^{ab}	2.01	2.05	2.06^{b}
7.5	2.03^{a}	2.34	2.65	2.4^{a}

Table 5: Effects of different levels of fatty acid calcium salt on carcass and organs weight in 49 days old broiler chicks (As percentage of carcass weight)

	Fatty acid calcium salt			
Carcass	0	2.5	5	7.5
Abdominal	75.6	76.1	76.1	75.1
Fat	1.67	2.00	1.70	1.16
Liver	3.00	3.01	3.08	2.41
Pancreas	0.36	0.34	0.29	0.26
Intestine	7.73	7.28	6.92	8.00
Heart	0.80	0.66	0.63	0.58

Table 6: Effects of different levels of fatty acid calcium salt on plasma triglyceride, cholesterol, HDL and LDL in 49 days old broiler chicks (mg/dl).

	Fatty acid calcium salt			
	0	2.5	5	7.5
Triglyceride	129	136	97	106
Cholesterol	118	118	114	132
HDL	90.0	88.5	96.8	100.2
LDL	7.75	9.75	8.25	15.25

significantly affect carcass, abdominal fat, liver, pancreas, intestine and heart percentages. Although chickens differed in the mean weight gain, the differences in the yield of carcass and the yield of individual body parts were not statistically significant. It can be concluded from the results that all part of chicken's body decreased evenly with decreasing weight gain in chickens that fed with fat powder. These findings are in agreement with Mala et al (2004) who showed no significant differences in the weight of abdominal fat, yield of carcass and the yield of individual parts of carcass.

Plasma parameters: No significant differences were observed in plasma triglyceride, cholesterol, high density lipoprotein (HDL) and low density lipoproteins (LDL) in chicks that fed with different levels of calcium salt of fatty acid (Table 6). However, all plasma parameters were higher numerically in chicks that fed with 7.5 percent fat powder. Our finding is in agreement with Mala *et al.* (2004) who showed no significant differences in these parameters in plasma.

Conclusion: It could be concluded that feeding of calcium salt of fatty acids to broilers has no beneficial effects on performance and increase feed conversion ratio. Although feeding 2.5 percent of fat powder resulted to more similar performance to control diet, but it could not be recommend, because of its higher cost.

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