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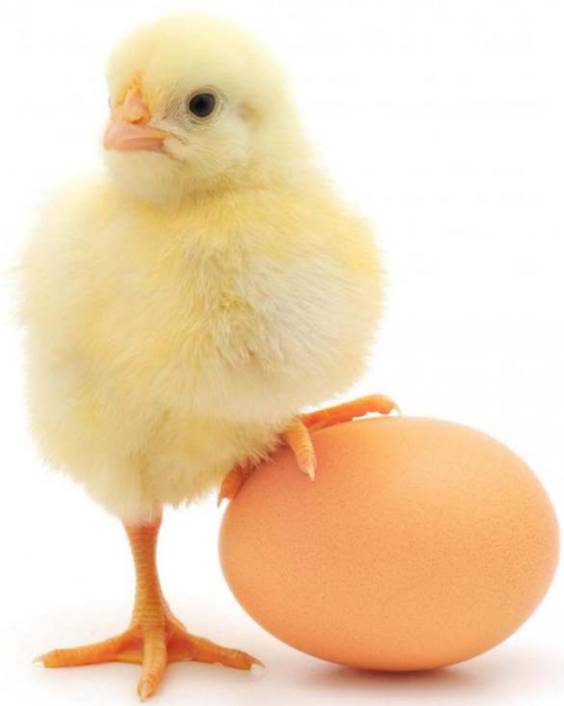

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The Effect of Animal Bone Fat on Body Performance and Carcass Characteristics in Broilers

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Abstract: The objective of this study was to determine the effects of animal bone fat on the body performance, feed efficiency, body composition and blood glucose, lipoproteins and total protein in broilers. In this study, 8-day old Ross PM3 male broiler chicks were randomly distributed into five groups with three replicates of 24 birds each (72 chicks per group) and were fed diets containing 0 (Group A, control), 2% (Group B), 4% (Group C), 6% (Group D) or 8% (Group E) for 6 weeks. Diets contained 23% CP and 3100 kcal of ME were given between day 8 and 21 and then diets containing 21% CP and 3200 kcal of ME were given on the days between 22 and 49. Body performance, feed intake and feed conversion rate were evaluated. The water content, crude protein, fat, ash, and abdominal fat were analyzed. Blood samples (3 per group) were collected on the 14th day of the study for analysis of glucose, lipoproteins and total proteins. Feeding animal bone fat increased body weight gain, feed efficiency, cold carcass weight and abdominal fat weight. As the level of animal bone fat was increased in the diet, relative level of carcass water decreased and carcass fat level increased significantly. Abdominal adipose tissue level (%) was significantly higher in the Group E compared to the other groups. There were no effects of feeding animal fat on the level of blood glucose, but the levels of plasma total protein and total lipoprotein increased significantly. This study indicated that animal bone fat significantly influenced the live weight gain, feed efficiency, cold carcass weight and abdominal fat level. This study also showed that dietary animal fat significantly affected body composition, plasma proteins and lipoproteins, but not the glucose levels.

Key words: Animal bone fat, body performance, feed efficiency, blood glucose and lipoproteins and broilers

Introduction

Meat and bone meal is produced in rendering plants where animal offal and bones are mixed, crushed and cooked and used as feed supplements for animals to cover their requirements for essential amino acids and fatty acids. Fat depots in form of motionless small packs occur in the spaces of the bone marrow (Outram, 2000). The fat extracted after slaughtering by rendering (i.e. the bones are broken up, cooked and the fat is pressed out) is called bone fat. It should be noted that concerns related to the spread of bovine spongiform encephalitis (BSE) have restricted the use of meat and bone meal in ruminant animals. Feeding meat and bone meal to ruminants has been banned within EU since 1994. Bone fat has been added especially to poultry feed as an energy source for the recent years. Meat and bone meal is also good sources of vitamins and minerals, especially for calcium and phosphorus, and is commonly used to supply these nutrients in poultry diets.

One of the problems associated with use of animal-by products in the poultry feed is their susceptibility of being carriers of pathogenic organisms such as Salmonellae and Escherichia coli to animal and humans. Heat or irradiation treatments have been used to decrease the risk of contamination. Feeding broiler chicks with irradiated meal and bone meal was shown to have no adverse effect on their performance (Al-Masri, 2003). It was also shown that radiation process was effective to decrease the microbial loads with no possible risk of losing nutritive value (Al-Masri and Al-Bachir, 2007). Digestibility of animal fat in monogastric and ruminant animals is approximately 90 and 85%, respectively. When animal fats were added to the diets, the improvements in the carcass quality of broiler chickens were observed (Brake *et al*., 1993). In the earlier studies, it was reported that fat metabolism and deposition in poultry could be affected by different dietary fats (Sanz *et al*., 2000a) and fatty acids (Pesti *et al*., 2002). Digestibility of animal fat increases depending on the age of birds and the highest between day 20 and 43 (Hakansson, 1974). It is also known that saturation degree has an influence on apparent metabolizable energy (Wiseman and Salvador, 1991). A plenty of unsaturated fatty acids leads to an increase in the absorption of saturated fatty acids. It is reported that unsaturated/saturated fatty acids of solid fats such as tallow has to be regulated in a ratio of between 2:1 and 3:1 since meat quality can be affected to a great degree as a result of synergy of saturated and unsaturated fatty acids (Senköylü, 2001). Total body fat depots and abdominal fat amounts are less in chicken broilers fed

Table 1: Composition of starter (day 8-21) or grower (day 22-49) diets

	Composition of Dietary Treatment (g/100g)									
	Starter diets (day 8-21)					Grower diets (day 22-49)				
Feed Ingredients	A	B	C	D	E	A	B	C	D	E
Corn	60.00	53.00	44.00	34.15	16.60	76.00	55.40	52.80	35.70	18.60
Wheat	10.45	12.85	17.45	23.00	38.00	0.00	18.00	15.28	29.36	43.35
Soybean meal	4.69	13.00	20.00	27.00	29.41	2.40	3.80	14.00	17.00	20.20
Fish meal	19.23	14.62	10.60	6.58	4.40	18.46	17.10	11.70	9.50	7.10
Sunflower meal	4.26	2.45	1.28	0.00	0.00	1.90	2.33	0.00	0.00	0.00
Bone fat	0.00	2.00	4.00	6.00	8.00	0.00	2.00	4.00	6.00	8.00
Limestone	0.63	0.61	0.60	0.60	0.63	0.50	0.58	0.53	0.56	0.60
DCP	0.00	0.60	1.10	1.60	1.80	0.00	0.00	0.84	1.06	1.20
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin mixture	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mineral mixture	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Antioxidant	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
L-Lysine	0.03	0.10	0.15	0.20	0.26	0.04	0.09	0.15	0.12	0.25
DL-Methionine	0.01	0.07	0.12	0.17	0.20	0.02	0.03	0.10	0.12	0.15
Total	100	100	100	100	100	100	100	100	100	100
Crude protein, %	23.00	23.00	23.00	23.00	23.00	21.00	21.00	21.00	21.00	21.00
ME. kcal/kg	3100	3100	3100	3100	3100	3200	3200	3200	3200	3200
Crude cellulose, %	2.50	2.50	2.50	2.50	2.50	2.15	2.15	2.15	2.15	2.15
Lysine, %	1.35	1.35	1.35	1.35	1.35	1.25	1.25	1.25	1.25	1.25
Methionine, %	0.58	0.58	0.58	0.58	0.58	0.54	0.54	0.54	0.54	0.54
Calcium, %	1.00	1.00	1.00	1.00	1.00	0.92	0.92	0.92	0.92	0.92
Available P, %	0.55	0.55	0.55	0.55	0.55	0.52	0.52	0.52	0.52	0.52
Crude ash, %	6.77	6.67	6.57	6.46	6.36	6.29	6.11	6.09	5.99	5.80
Crude oil, %	4.65	6.00	7.38	8.76	10.18	4.91	6.34	7.69	9.12	10.53
Sodium, %	0.18	0.17	0.15	0.14	0.13	0.18	0.18	0.15	0.15	0.14

[1]Diets were given *ad libitum* to the animals. Dietary treatments: Group A: Basal diet; Group B: Basal diet plus 2% animal bone fat; Group C: Basal diet plus 4% animal bone fat; Group D: Basal diet plus 6% animal bone fat; Group E: Basal diet plus 8% animal bone fat. ME: Metabolizable energy.

with diets rich of multiple unsaturated fatty acids compared to diets containing saturated fatty acids (Sanz *et al.,* 2000b).

This study was carried out to investigate the effects of animal bone fat, an alternative to vegetable oils by economical reasons in poultry nutrition, on the body performance, carcass characteristics, body composition and blood parameters in broiler chickens.

Materials and Methods

Animals and Diets: In this study, 8-day old Ross PM3 hybrid male broiler chicks were randomly distributed into five groups with three replicates of 24 birds each (72 chicks per group) and were fed diets supplemented with 0 (Group A, control), 2% (Group B), 4% (Group C), 6% (Group D) or 8% bone fat (Group E) for 6 weeks. Bone fat source was obtained from Gündüz Gida San. Tic. A.S. (Ankara, Turkey). All diets were isocaloric and isonitrogenous and the animals were illuminated for 24 hours. Diets contained 23% crude protein and 3100 kcal of metabolizable energy were given from the 8 and 21th days and then diets containing 21% crude protein and 3200 kcal of metabolizable energy were given on the days between 22 and 49 (Table 1).

The crude materials (such as crude protein, crude fat, crude fibre, crude ash and water) in the animal feed were analyzed according to the method described (Lloyd *et al.*, 1978). Some values of crude feed substances were taken from Anonymous (1984). Live weight and feed consumption were measured weekly. Water and feed were given *ad libitum* throughout the experimental study. The feeding was ended two hours before slaughtering. Eight chickens from each group, which were nearest to the average live weight, were selected for carcass analysis. Blood glucose level was determined according to the “ortho-toluidin analysis” method (Michod and Frei, 1963). The analysis of total plasma lipoprotein was determined with the aid of “Kunkel’s phenolic reaction” (Lecoq, 1972). Serum total protein was determined according to “Biüret reaction” method (Gornall *et al.*, 1949). Carcass was divided into two equal parts and then minced, and crude protein (N x 6.25), crude fat, ash and water content were analyzed according to Weende analysis method (Lloyd *et al.*, 1978). All data were interpreted variant analytically with “Statistical Analysis System” (SAS). The mean values were compared with “Duncan test” (SAS, 1992).

Results and Discussion

The differences in live weight gain, feed efficiency and feed consumption were statistically significant among the groups (Table 2). Broilers fed diets supplemented with 4% or higher levels of animal bone fat had greater body weight gain than the others. And also chickens fed

Table 2: The effects of diets[1] supplemented with different levels of animal bone fat

	Dietary Treatments				
	Group A	Group B	Group C	Group D	Group E
Live weight gain (g)	2066±29^{c}	2263±59^{b}	2375±71^{ab}	2393±63^{ab}	2465±57^{a}
Feed intake (g)	4537±51^{b}	4606±48^{b}	4645±88^{b}	4686±57^{ab}	4864±62^{a}
FCR	2.19±0.01^{a}	2.04±0.04^{b}	1.96±0.03^{b}	1.96±0.03^{b}	1.98±0.05^{b}
Cold carcass weight (g)	1633±46^{c}	1783±12^{b}	1893±23^{ab}	1853±30^{b}	1977±63^{a}
Carcass yield (%)	73±0.00^{b}	75±0.01^{a}	75±0.01^{a}	74±0.00^{ab}	75±0.01^{a}

[1]Diets were given *ad libitum* to the animals. Dietary treatments: Group A: Basal diet; Group B: Basal diet plus 2% animal bone fat; Group C: Basal diet plus 4% animal bone fat; Group D: Basal diet plus 6% animal bone fat; Group E: Basal diet plus 8% animal bone fat. [2]Eviscerated carcass= carcass without head, neck, and feet. [a, b]Means within a row lacking a common superscript differ (P<0.05)

Table 3: The effects of feeding different levels of animal bone fat on the body composition in broiler chickens

	Group A	Group B	Group C	Group D	Group E
Fat (%)	11.00±0.38^{b}	11.07±0.42^{b}	12.25±0.5^{ab}	12.62±0.6^{ab}	13.54±0.64^{a}
Protein (%)	20.29±0.35^{b}	21.27±0.53^{b}	21.85±0.1^{ab}	21.39±0.4^{ab}	22.53±0.37^{a}
Water (%)	63.82±0.44^{a}	63.67±0.59^{a}	63.44±0.63^{a}	59.36±0.75^{b}	58.61±1.18^{b}
Ash (%)	3.00±0.06^{ab}	2.98±0.17^{ab}	3.12±0.20^{a}	2.52±0.18^{b}	2.62±0.17^{ab}
Abdominal fat (%)	1.43±0.08^{b}	1.43±0.05^{b}	1.60±0.13^{ab}	1.73±0.14^{ab}	1.84±0.13^{a}

[1]Diets were given *ad libitum* to the animals. Dietary treatments: Group A: Basal diet; Group B: Basal diet plus 2% animal bone fat; Group C: Basal diet plus 4% animal bone fat; Group D: Basal diet plus 6% animal bone fat; Group E: Basal diet plus 8% animal bone fat.
[a, b]Means within a row lacking a common superscript differ (P<0.05)

Table 4: The effect of different levels of animal bone fat on blood glucose, protein and lipoproteins in broiler chickens

	Dietary Treatments				
	Group A	Group B	Group C	Group D	Group E
Glucose	2.93±0.17	3.03±0.19	3.04±0.09	3.07±0.13	3.29±0.12
Protein	4.86±0.19^{b}	5.52±0.19^{a}	5.82±0.21^{a}	5.91±0.16^{a}	5.97±0.20^{a}
Lipoprotein	0.25±0.02^{c}	0.29±0.02^{bc}	0.31±0.03^{ab}	0.36±0.01^{ab}	0.39±0.03^{a}

[a,b,c]Means within a row lacking a common superscript differ (P < 0.05)

diets containing animal bone fat had a better feed conversion rate compared to the control. Carcass weights of the chickens in the Group D and E were significantly greater than those from the Group A and B. The carcass yield, carcass water, carcass crude protein, carcass crude fat, cold carcass weight, carcass crude ash and carcass abdominal fat among the groups were found statistically significant (Table 2 and 3).

Although all diets were isoenergetic, broilers fed diets containing animal bone fat at the different levels had a better body performance than the others. Moreover, there were significant effects of fat addition on feed consumption, body weight gain, feed conversion and carcass values. This is probably energy from bone fat was used more efficiently than the energy coming from the source of carbohydrates. Another possibility may be due better taste of animal bone fat in the diet, leading to a better carcass value. The findings related to the body weight gain are congruent to studies in which diets containing pig fat given to broiler chickens (Peebles *et al*., 1997a; Rutkowski *et al*., 1998), tallow fat from cattle to broiler chickens (Manilla *et al*., 1999), and pig fat to breeding broiler chickens (Peebles *et al.,* 2000). The results about feed consumption in this study were similar to results of a study in which tallow fat increased feed consumption of broilers significantly (Bartov, 1987), while lard caused a decrease in feed consumption in another study (Rutkowski *et al.,* 1998). Feed conversion improved significantly with increase in bone fat. This result is parallel to studies in which lard improved feed conversion in broilers (Peebles *et al*., 1997b). The results of this study are similar to results of studies in which effects of diets containing lard were significant on carcass percentage and carcass yield (Peebles *et al.,* 1997a), lard compared to coconut oil and glucose addition increased carcass fat significantly (Takahashi *et al*., 1986), and animal fat caused more carcass fat depots in broilers than plant oil (Sanz *et al*., 2000a). The effect of adding bone fat on accumulation of carcass protein was significant. While this result is agree with the study in which lard addition to diets increased carcass protein (Latour *et al*., 1994; Peebles *et al*., 1997b). However, it was in disagreement with the study showed a decrease in the accumulation of carcass protein when animal fat was given (Sanz *et al*., 2000b).

In the present study, addition of bone fat had proportional effect on accumulation of abdominal fat. This result is parallel to studies, in which increase of fat percentage in the diet caused an increase in accumulation of abdominal fat (Deaton *et al*., 1981), and the profile of diet fatty acids affected accumulation of abdominal fat (Sanz *et al*., 2000c).

In conclusion, this study indicated that animal bone fat significantly influenced the live weight gain, feed efficiency, cold carcass weight and abdominal fat level. This study also showed that dietary animal fat significantly affected body composition, plasma proteins and lipoproteins, but not the glucose levels.

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