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Effect of Poultry by Product Meal on Performance Parameters, Serum Uric Acid Concentration and Carcass Characteristics

Research Article

M. Sahraei[1*], H. Lootfollahian[2] and A. Ghanbari[1]

[1] Research Center of Agriculture and Natural Resources of Ardabil, Ardabil, Iran
[2] Animal Science Institute of Karaj, Karaj, Iran

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*Correspondence E-mail: m.sahraei2009@gmail.com
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ABSTRACT

This experiment was conducted to determine the chemical composition and gross energy of poultry by product meal (PBPM) and the effects of different levels of inclusion of poultry by product meal on broiler chicken performance, serum uric acid and carcass characteristics. Three samples of PBPM produced in Ardabil province located in northwest of Iran, were provided during one month sampling period from rendering units of industrial poultry slaughter-houses. About 210 U of industrial poultry slaughter-houses are located in Iran. The proximate analysis showed that the average dry matter (DM), crude protein (CP), ether extract (EE), Ash, calcium (Ca), phosphorus (P), total volatile nitrogen (TVN) and gross energy (GE) of the PBPM samples were 92.00%, 69.63%, 16.53%, 7.86%, 1.30%, 0.56%, 209 mg/100g and 4096.6 kcal/kg respectively. In this experiment 120 eleven days old Ross 308 male broiler chicks were used for feed evaluation of poultry by product meal in four levels of 0 (control), 30, 60 and 90 g/kg in whole diet for the periods of grower (11-32 d) and finisher (33-46 d) period in completely randomized design with 4 treatments and 3 replicates. The results showed that feed intake in all stages, body weight gain in finisher phase and overall period, mortality percentage and live weight at 46 d were similar between diets. While body weight gain in grower phase, feed conversion ratio in grower, finisher phase and overall period (11-46 d) of experiment and live weight at 32 d were statistically different (P<0.05). Therefore under the conditions of this study, use of 60 g/kg of poultry by product meal in diet might be more useful and practical in broiler diets.

KEY WORDS broiler, PBPM, performance.

INTRODUCTION

About 60-70 percent of the expenditures involved in poultry production are feeding costs. Further, a critical cost of appraisal of poultry feed formulate shows protein, especially protein of animal origin, to be the most expensive per unit cost. Poultry by-product meal (PBPM) is important feedstuffs in poultry nutrition, due to their high protein content and competitive cost. Poultry by-product meal (PBPM) is one of the by-products resulting from poultry slaughter-houses and produced by processing of the inedible parts of poultry carcasses (Bohnert *et al.* 1999; Senkoylu *et al.* 2005). Property of the raw materials, processing technology (temperature, pressure etc), addition of preservatives, storage time and storage conditions affect its feeding value. Poultry by-product meal, which is produced according to the standard, has good feeding value for poultry and ruminant diets as source of protein and energy (Ozaslan, 2004). It is usually composed of the wastage from poultry meat processing.

While typically higher in protein content and lower in mineral levels, poultry byproduct meal also suffers the

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same variability found in meat and bone meal. This is largely due to the inclusion of other tissues, such as feathers, and differences in rendering procedures (Elkin, 2002).

The feeding value of this product for poultry was established during early 1950 s (Senkoylu *et al*. 2005; Samli *et al*. 2006). Modern methods of poultry processing result in the availability of large quantities of by products like feathers, viscera, heads, feet and blood. These by-products have been successfully converted to digestible meals by steam-pressure cooking. The result of (Kirkpinar *et al*. 2004) showed that crude protein digestibility in diets with 2.5 percent of poultry by product meal increased but dry matter retention, crude fiber digestibility and organic matter retention were not affected.

Some researchers suggested that, PBPM could be included in broiler and layer diets up to 100g/kg level of inclusion in diets (Bhargava and O'Neal, 1975; Samli *et al*. 2006). But Escalona and Pesti (1987) found that chick growth and feed efficiency were significantly depressed when poultry by-product meal was incorporated into the diet at 100 g/kg. The nutritive contents (protein, ash and fat), protein quality and amino acid digestibility of PBPM can vary greatly depending on processing systems, processing temperature and duration, raw material source (Johnson and Parsons, 1997; Shirley and Parsons, 2001).

Also the result of a study in East Azarbayjan province of Iran showed that the composition of different sample of poultry by product meal was different from of NRC (1994). Ozaslan (2004) reported that poultry by-product meal, which is produced according to the standard with a certain hygiene level, contributes to economy and environment by utilization of slaughterhouse offal, prevention of environmental pollution and also cost reduction in feed formulation for the compound feed industry. When poultry by product meals was used in different levels (0, 2.5, 5.0 and 7.5%) in laying hens, the result showed that level of 7.5% has the best color of yolk (Hosseinzadeh *et al*. 2010). Therefore, with the development of poultry industry and high-level productions of PBPM, especially in developing countries, it is likely to be used as a replacement with other expensive feed ingredients.

Therefore, recycling of wastes from poultry slaughterhouses is an economically, biologically and environmentally important aspect (Cai *et al*. 1994; Steffens, 1994). In Iran, fish meal is common ingredients as animal by-products in poultry diets. But, fish meal is imported with a high cost. Therefore attention has been attracted toward PBPM supplementation in diets by poultry feed industry. The present study was conducted to determine the chemical composition and also to study the effects of different dietary concentration of PBPM on performance parameters, carcass characteristics and serum uric acid concentration in broiler chickens.

MATERIALS AND METHODS

The PBPM samples were collected during one month, four times per month from rendering units of industrial poultry slaughter-house in Ardabil province and 3 samples were prepared and after grinding and mixing were stored at -20 ^{0}C until further analysis. The raw material source of all the PBPM samples included heads, feet, viscera, spent liver and gizzard, feather, blood and birds found dead on arrival at the processing plants were chemically analyzed according to AOAC (1992) procedures for determining dry matter (DM), ether extract (EE), crude protein (CP), total volatile nitrogen (TVN), gross energy (GE), calcium (Ca) and phosphorus (P) were determined (AOAC, 1992).For feed evaluation 120 Ross-308 male broiler chickens in were used in this experiment. Before experiment, the chicks were fed a commercial starter diet (based on as management guide) from day-old to 10 days of age. Four different treatments were formed in the study. The broiler chicks with similar body weight (170±5 g) were kept in their pens. First treatment was a control with no PBPM. The other treatments were 3.0, 6.0 and 9.0% PBM supplementation, respectively. Experimental diets from 11 to 46 days of age were formulated as isonitrogenous and isocaloric (Table 1) (NRC, 1994). Experimental diets were given to broiler chickens *ad libitum* in mash form. Broiler chickens were assigned randomly to four treatment groups (per treatment/3 pens). One hundred and twenty broilers were housed on litter-floor. Broilers were weighed individually at 11, 32 and 46 d of age. Broilers were benefited from day light (average 23 hours/day) and water was continuously available. For each pen, feed consumption ratio (FCR), weight gain and feed intake were measured weekly. In the end of the experiment (46 d of age), final body weight were measured in all treatments. Four birds of each pen (12 birds/treatment), approximate to the average BW of that treatment, were selected for slaughter. Carcasses were eviscerated and weighed. Relative weight of carcass, thighs, breast, abdominal fat pad and liver were measured in all treatments. In the final day of this experiment one bird of each pen (3 birds/treatment) were selected for bleeding the vein wing, then the serum uric acid content was determined based on enzymatic method (Liddle *et al*. 1959).

Statistical analysis

The data were analyzed in a completely randomized design using GLM procedure of SAS (1999). Comparison of means were conducted by Duncan's multiple range test.

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RESULTS AND DISCUSSION

The average of chemical composition of the PBPM samples are shown in Table 2, and the effects of supplementation PBPM to broiler diets on various live performance parameters are depicted in Table 3.

The average DM, EE, CP, Ash, Ca, P and TVN were 92.00%, 16.53%, 69.63%, 7.53%, 1.30%, 0.56% and 209 mg/100 gr, respectively. The average GE was 4096.6 kcal/kg.

Table 1 Composition and analysis results of the experimental diets

Exp: Diets (PBPM* inclusion levels) ingredients (%)	Grower (11-32 d)				Finisher (33-46 d)			
	0	3	6	9	0	3	6	9
Ground corn	53.70	57.00	59.80	62.37	60.00	61.71	63.60	65.77
Soybean meal (44% CP)	36.99	31.58	26.30	21.10	31.16	26.75	22.29	17.70
PBPM (69.63% CP)	0.00	3.00	6.00	9.00	0.00	3.00	6.00	9.00
Sunflower oil	5.98	5.06	4.32	3.60	5.63	5.15	4.50	3.80
Calcium carbonate	1.1	1.2	1.3	1.38	1.2	1.25	1.21	1.2
Dicalcium phosphate	1.0	1.0	1.0	1.3	1.0	1.0	1.3	1.29
Salt	0.2	0.23	0.27	0.26	0.23	0.26	0.26	0.25
L-Lysine	0.29	0.22	0.23	0.24	0.16	0.17	0.17	0.21
DL-Methionine	0.26	0.22	0.22	0.22	0.15	0.16	0.16	0.18
Vit-Min premix**	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Salinomycin	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total	100	100	100	100	100	100	100	100
Calculated analysis								
MEn kcal/kg	3150	3150	3150	3150	3200	3200	3200	3200
CP (%)	21	21	21	21	19	19	19	19
Ca (%)	0.79	0.81	0.87	0.99	0.77	0.87	0.99	1.07
P.available (%)	0.36	0.37	0.39	0.42	0.34	0.37	0.47	0.51
Lysine (%)	1.25	1.26	1.24	1.2	1.1	1.09	1.07	1.07
Methionine (%)	0.57	0.56	0.56	0.56	0.46	0.48	0.48	0.51
Met + Cys (%)	0.9	1.02	0.88	0.88	0.76	0.77	0.78	0.81

* Poultry by Product Meal.

** Supplied per kilogram of diet: vitamin A, 10000 IU; vitamin D3,9790 IU; vitamin E, 121 IU; B , 20 µg; riboflavin, 4.4 mg; calcium pantothenate, 40 mg; niacin, 22 mg; choline, 840 mg; biotin, 30 µg; thiamin, 4 mg; zinc sulfate, 60 mg; manganese oxide, 60 mg.

Table 2 Composition of PBPM selected

Composition	DM (%)	ASH (%)	CF (%)	CP (%)	EE (%)	TVN (mg/100 g)	Ca (%)	P (%)	GE (kcal/100 g)
Average	92.00	7.53	1.83	69.63	16.53	209	1.30	0.56	409

Table 3 The effects of PBPM supplementation to broiler diets at different levels on performance parameters

Exp: Diet PBPM* inclusion levels (%) traits	0	3	6	9	SEM**
Feed intake (11-32 d) (g)	1601.3	1631.0	1661.0	1612.6	17.68
Body weight gain (11-32 d) (g)	948.3[ab]	978.6[b]	965.6[ab]	901.0[a]	12.04
Feed conversion ratio (11-32 d)	1.68[a]	1.66[a]	1.72[a]	1.79b	0.0159
Mortality (11-32 d) (%)	0.33	0.66	0.66	1.00	0.188
Body weight (32 d) (g)	1120[ab]	1150[b]	1134[ab]	1071[a]	12.18
Feed intake (33-46 d) (g)	2060.0	1929.3	2047.0	2051.0	31.24
Weight gain (33-46 d) (g)	972.6	906.0	966.0	903.6	19.09
Feed conversion ratio (33-46 d)	2.118[a]	2.129[a]	2.119[a]	2.269[b]	0.0246
Mortality (33-46 d) (%)	0.66	0.66	1.33	1.00	0.259
Feed intake (11-46 d) (g)	3661.3	3560.3	3708	3664.3	32.75
Weight gain (11-46 d) (g)	1920.9	1884.6	1931.6	1804.6	23.18
Feed conversion ratio (11-46 d)	1.906[a]	1.889[a]	1.919[a]	2.030[b]	0.0186
Mortality (11-46 d) (%)	0.66	0.66	1.33	1.00	0.2599
Body weight (46 d) (g)	2092.6	2056.0	2100.0	1974.6	22.90

* Poultry by product meal.

a, b, The means in the same row that have at least one common letter, do not have significant difference (P>0.05).

** Standard error mean.

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The average DM of the PBPM samples 92.00 percent was lower than that reported by NRC (1994). Najafabadi *et al*. (2007) found that to be 94.8% (DM). Pesti *et al.* (1986) reported a value of 94.6 percent for the average DM of eight PBPM samples.

Also the average EE of the PBPM samples (16.53%) was higher (P<0.01) than that reported by NRC (1994). That's why, fat is not removed from final product in rendering units producing PBPM in Iran. Although the presence of high fat content can be beneficial in providing energy for animal, however it may facilitate the oxidation of product and reduce its nutritional value for poultry. Dale *et al.* (1993) also reported an average of 32.2 percent for EE in twenty two PBPM samples which is significantly higher than that reported by NRC (1994) or that obtained in the present study.

The average CP of the PBPM samples (69.63%) was higher than NRC (1994). The average GE value of the PBPM samples was 4096.6 kcal/kg. Johnson and Parsons (1997) also reported a value of 5652 kcal/kg GE for one low ash PBPM sample. The average gross energy (GE) value for the PBPM samples was 5645 kcal/kg (Najafabari *et al*. 2007). Pesti *et al*. (1986) reported a value of 4842 kcal/kg for the average GE of eight PBPM samples and this value is significantly higher than that obtained in the present study. The lower GE values for the PBPM samples reported in the present study due to higher ash contents of samples analyzed.

The average ash content of the poultry by product meal (PBPM) samples was 7.53%. Bhargava and O'Neal (1975) also reported a value of 9.15 percent for the average ash content of poultry by-product and hydrolyzed feather meal samples.

The average ash value for the PBPM samples was 9.3% (Najafabadi *et al*. 2007). The high coefficient of variation for ash, calcium and phosphorus content as compared with that of other chemical composition indicated the use of different proportions of skeletal tissues in the PBPM samples examined in the present study. The effects of supplementation PBPM in broiler diets on various live performance parameters are summarized in Table 3.

Feed intake in different period, mass gain in finisher and total experiment, body mass in 46 d and mortality in whole experiment were not significantly influenced by the experimental diets (P>0.05). Supplementation PBPM upper 60 g/kg to broiler diets had adverse effect on various live performance such as mass gain(11-32d), feed conversion ratio in different period of this study, body mass in 32 d and production index (P<0.05). The data obtained from this experiment are in accordance with the findings of Klantar and Fahimi (2004). These investigators included different levels of poultry by product meal in broiler chicken diets and found that level up to 60 and 100 g/kg of poultry by product meal in diets had significantly decreased live performance. Observed dissimilarity between the result of our experiment with other study might be due to poorer quality of poultry by product meal used in the present study or difference in processing conditions. As shown in table 3, feed conversion ratio increased as the level of poultry by product meal in the experimental diets increased. The broiler chickens fed 90 g/kg of poultry by product meal in diets showed bad feed conversion ratio than other diets (11-46 d).

This may be related to imbalances of essential amino acid, poorer quality and lower palatability of poultry by product meal when used in high level diet. This effect of poultry by product meal on feed conversion ratio is similar with the finding of who reported that 5% poultry by product meal level in broiler diets has no harmful effect on feed conversion ratio and other researchers that reported 90 g/kg of poultry by product meal inclusion in diets, led to poorer feed efficiency (Klantar and Fahimi, 2004). Relative weight of carcass, thighs, breast, liver to live body weight and serum uric acid of the chicks were not different (P>0.05) among the experimental diets (Table 4). This data was in agreement with the findings of Klantar and Fahimi (2004). However, abdominal fat pad percentage and some organs relative weight to live body weight of the chicks in 46 day were increased as the level of poultry by product meal was increased in experimental diet (Table 4). The affect on abdominal fat pad percentage might be due to probable amino acids imbalances in diets containing high levels of poultry by product meal.

Table 4 Effect of different levels of PBPM on broiler chickens carcass traits, liver and serum uric acid

Exp: Diet PBPM** inclusion levels (%) traits	0	3	6	9	SEM
Final body weight (46 d) (g)	2092.6	2056.0	2100.0	1974.6	22.90
Carcass (oven ready yield) (%)*	68.13	69.35	68.69	69.73	0.4156
Thighs (%)*	18.23	18.27	18.27	18.23	0.2280
Breast (%)*	20.36	20.25	19.92	20.47	0.2020
Abdominal fat pad (%)*	2.03[a]	1.79[a]	2.57[b]	2.68[b]	0.1080
Liver (%)*	2.24	2.01	2.05	2.38	0.0700
Serum uric acid (mg/dL)	2.63	2.70	2.96	3.16	0.3124

* Relative to live body mass.

** Poultry by product meal.

a, b, The means in the same row that have at least one common letter, do not have significant difference (P>0.05).

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CONCLUSION

In summary, the results showed that CP, EE, Ca and P contents of studied poultry by product meal samples were different and the DM content was similar to NRC (1994) values. Also, the present study showed that the use of poultry by product meal up to 60 g/kg in diets had no adverse effects on various live performance in grower and finisher phase, carcass characteristics, serum uric acid concentration and relative weight of some organs.

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