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Effects of Inclusion of Poultry Slaughterhouse by Product Meals in Diet on Performance, Serum Uric Acid and Carcass Traits of Broilers

[1]Mahmood Sahraei, [1]Abazar Ghanbari and [2]Hooshange Lootfollahian

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

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 traits. six composed samples of PBPM produced in Ardabil province were provided during one months sampling period from rendering units of industrial poultry slaughter-houses. 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, 69.63, 16.53, 7.86, 1.3, 0.56, 209 gr/100mg and 4096.6 kcal/kg respectively. In this experiment 120 eleven days old Ross308 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 (11-32d) and finisher (33-46d) period in completely randomized design with 4 treatment 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 46d were similar between diets. While body weight gain in grower phase, feed conversion ratio in grower, finisher phase and overall period(11-46d) of experiment and live weight at 32d were statistically different. Increasing use of poultry by product meal in diets has led to significant increase in percentage of abdominal fat pad and heart relative weight, but there were not seen significant differences in percentage of carcass (oven ready yield), thighs, breast, serum uric acid and liver among diets. 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 · Poultry by product meal · Performance · Uric acid

INTRODUCTION

About 60-70 percent of the expenditures involved in poultry production is feeding costs. Further, a critical cost of appraisal of poultry feed formulae shows protein, especially protein of animal origin, to be the most expensive per unit cost. poultry by-product meal (PBPM) is important feed stuffs 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 [1-3]. 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 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 [4]. The feeding value of this product for poultry was established during early 1950s [3,5]. 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. At present, poultry by-products, like feather meal, poultry offal meal and blood meal are used as commercial poultry feedstuffs in many countries [2]. Recycling of wastes from poultry slaughterhouses is of economical, biological and environmental importance [6]. PBPM has a proper profile of available essential amino acids and is rich in calcium, phosphorus and vitamin B_{12} [7-9]. This by-product is used as a protein source in diets of monogastric animals like pig [10]. Poultry [11,12] and aquatic animals [13] and also extensively used as a ruminally undergradable protei

Corresponding Author: Mahmood Sahraei, Research Center of Agriculture and Natural Resources of Ardabil Province, Iran.

nsource in ruminant diets [1]. The result of Kirkpinar *et al*. [13] showed that crud protein digestibility in diets with 2.5 percent of poultry by product meal increased but dry matter retention, crud 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 [14,5]. But Escalona and Pesti [12] 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 [14-17]. Also the result of study janmahammdi *et al.* [18] in East Azarbayjan of Iran showed that the composition of different sample of poultry by product meal was different from of NRC [8]. Therefore, with the development of poultry industry and high-level productions of PBPM, especially in developing countries, it is likely to be use as a replacement part with other expensive feed ingredients. Therefore, recycling of wastes from poultry slaughterhouses is an economically, biologically and environmentally importance aspect [6,18]. In our country, fish meal is common ingredients as animal by-products in poultry diets. But, fish meal was imported abroad at high amounts, thus it's cost is extremely high. In recent years, there have been attention paid to PBPM supplementation in diets by poultry feed industry. Therefore, the present study was conducted to determine the chemical composition and study the effects of different dietary concentration (0, 30, 60 and 90 g/kg of diets) of PBPM on performance, carcass traits and serum uric acid concentration in broiler chickens.

MATERIALS AND METHODS

The PBPM samples were collected during one month from rendering units of industrial poultry slaughter-house in Ardabil province and six composed samples were prepared so that samples after grinding and mixing the samples were stored at -20°C until further analysis. all composed samples were chemical analysised according to AOAC [19] procedures for determining dry matter (DM), ether extract (EE), crude protein (CP),total volatile nitrogen (TVN),gross energy(GE),calcium and phosphorus were determined [19]. Metabolizeable energy (ME) was estimated using a prediction equation [8]. This research

Table 1: Composition and calculated analysis of the experimental diets

Exp. Diets	Grower(11-32d)				Finisher(33-46d)			
(PBPM* inclusion levels)								
Ingredients(%)	0	3	6	9	0	3	6	9
Ground corn	53.7	57	59.8	62.37	60	61.71	63.6	65.77
Soybean meal	36.99	31.58	26.3	21.1	31.16	26.75	22.29	17.7
PBPM	0	3	6	9	0	3	6	9
Sunflower oil	5.98	5.06	4.32	3.6	5.63	5.15	4.5	3.8
Calcium carbonate	1.1	1.2	1.3	1.38	1.2	1.25	1.21	1.2
Dicalcium phosphate	1	1	1	1.3	1	1	1.3	1.29
Salt	0.2	0.23	0.27	0.26	0.23	0.26	0.26	0.25
L – Lysine	0.26	0.22	0.23	0.24	0.16	0.17	0.17	0.21
DL- Methionine	0.5	0.22	0.22	0.22	0.15	0.16	0.16	0.18
Vit-Min premix**	0.05	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Salinomycin		0.05	0.05	0.05	0	0	0	0
Calculated analysis								
MEn kcal/kg	3150	3150	3150	3150	3200	3200	3200	3200
Cp (%)	21	21	21	21	19	19	19	19
Ca (%)	0.81	0.82	0.86	0.97	0.77	0.87	0.98	1
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	1.23	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

* Poultry by Product Meal

** Supplied per kilogram of diet: vitamin A, 10000 IU; vitamin D3,9790 IU; vitamin E, 121 IU; B, 20 ìg; riboflavin, 4.4 mg; calcium pantothenate, 40 mg; niacin, 22 mg; choline,.840 mg; biotin, 30 ìg; thiamin, 4 mg; zinc sulfate, 60 mg; manganese oxide, 60 mg projects was conducted from 2 February2010 to 8 July2010 in animal science department of agriculture and natural resource research station in Ardabil province, located in the north west of Iran. For feed evaluation 120 Ross308 male broiler chickens were used in this experiment. Before experiment, the chicks fed a commercial starter diet (based on management guide) from day-old to 10 days of age. Four different treatments were formed in the study. First treatment was control with no PBPM. The other treatments were 30, 60 and 90 of age were formulated as isonitrogenous and isocaloric (based on Ross308 management guide) (Table1),

Experimental diets were given to broiler chickens *ad libitum* in mash form. The experiment lasted for 5 weeks. Broiler chickens were assigned randomly to four treatment groups (per treatment/3 pens). One hundred and twenty male broilers were housed on litter-floor. Broilers were weighted individually at the 11, 32 and 46d of age. For each pen, feed conservation ratio (FCR), weight gain and feed intake were measured weekly. Mortality was monitored throughout in the study and the weights of dead birds were included in weight gains when feed to gain ratios were calculated .In the end of experiment (46 d of age) and final body weight were measured in all treatments. In the end of experiment (46d of age), four birds for 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, liver and heart were measured in all treatments. The serum uric acid content was determined based on enzymatic method of Liddle *et al.* [20] in the final day of this experiment. The data were analyzed in a completely randomized design using GLM procedure of SAS [21]. Comparison of means was conducted by Duncan's multiple range test [22].

RESULTS AND DISCUSSION

The chemical composition and Gross Energy contents of the poultry by product meal(PBPM) samples are shown in Table 2.

The average DM,EE,CP,Ash,Ca,P and TVN were 92, 16.53, 69.63,7.86,1.3,0.56 percent and 209 mg/100gr, respectively. The average GE was 4096.6 kcal/kg. The average DM of the PBPM samples 92 percent was lower than that reported by NRC [8]. Pesti *et al*. [23] 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 [8]. 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.* [24] also reported an average of 32.2 percent for EE in twenty two PBPM samples which is significantly higher than that reported by NRC [8] or that obtained in the present study. The average CP of the PBPM samples (69.63%) was higher than NRC [8]. The average GE value of the PBPM samples was 4096.6 kcal/ kg. Johnson and Parsons[17] also reported a value of 5652 kcal/kg GE for one low ash PBPM sample. Pesti *et al.* [23] reported a value of 4842 kcal kg^{-1} for the average GE of eight PBPM samples and this value is significantly higher than that obtained in the our study. The lower GE values for the PBPM samples reported in present study due to higher ash contents of samples analyzed. The average ash content of the poultry by product meal(PBPM) samples was 7.86 percent. Bhargava and O'Neil [14] also reported a value of 9.15 percent for the average ash content of poultry by-product and hydrolyzed feather meal samples. The high coefficient of variation for ash, calcium and phosphorus content as compared with that of other chemical composition indicating 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 are summerized in Table 3. Feed intake in different period, mass gain in finisher and total experiment, body mass in 46d 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 32d and production index ($P<0.05$). The data obtained from this experiment are inaccord with findings of Klantar and Fahimi [25] and Escalona and Pesti [12]. These investigators were included different levels of poultry by product meal in broiler chicken diets and found that level up to 60 and 100g/kg of poultry by product meal in diets had significantly decrease on live performance. But the result of present study against with finding of others [17, 25]. Observed dissimilarity between result of our experiment with study of other research might be due to poorer quality of poultry by product meal used in the present study or difference in processing conditions. McNaughton *et al*. [26], using a chick growth assay, showed that increased pressure from 15 to 45 psi (103 to 310 kPa) during processing of poultry by-product

Table 2: Composition of PBPM[1] Selected (%)

Composition	Concentration	SD	CV	NRC(1994)
DM	92	0.757	0.82	93
CP	69.63	1.67	2.39	60*
EE	16.53	1.4	8.46	13*
Ash	7.86	0.503	6.39	-
Ca	1.3	0.2	15.3	3*
P	0.56	0.057	10.17	1.7*
TVN mg/100g	209	9.83	4.7	-
GE kcal/kg	4096.6	78.9	1.92	-

1- Poultry by Product Meal

*Indicating a highly significant difference ($P<0.05$) between the average value in our PBPM samples and that reported by NRC (1994)

SD: Standard Division CV = Coefficient of Variation

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

	Exp.Diet PBPM** inclusion levels)(g/kg DM)				
Traits	0	30	60	90	SEM**
Feed Intake(11-32d)(g)	1601.3	1631	1661	1612.6	17.68
Mass Gain(11-32d) (g)	948.3^{ab}	978.6^{b}	965.6^{ab}	901^{a}	12.04
Feed Conversion Ratio (11-32d)	1.68^{a}	1.66^{a}	1.72^{a}	1.79^{b}	0.0159
Mortality(11-32d) (%)	0.33	0.66	0.66	1	0.188
Body mass 32d(g)	1120^{ab}	1150^{b}	1134^{ab}	1071^{a}	12.18
Feed Intake(33-46d)(g)	2060	1929.3	2047	2051	31.24
Mass Gain(33-46d) (g)	972.6	906	966	903.6	19.09
Feed Conversion Ratio (33-46d)	2.118^{a}	2.129^{a}	2.119^{a}	2.269^{b}	0.0246
Mortality(33-46d) (%)	0.66	0.66	1.33	1	0.259
Feed Intake(11-46d)(g)	3661.3	3560.3	3708	3664.3	32.75
Mass Gain(11-46d) (g)	1920.9	1884.6	1931.6	1804.6	23.18
Feed Conversion Ratio (11-46d)	1.906^{a}	1.889^{a}	1.919^{a}	2.030^{b}	0.0186
Mortality(11-46d) (%)	0.66	0.66	1.33	1	0.2599
Body mass 46d(g)	2092.6	2056	2100	1974.6	22.90

* Poultry by Product Meal

a,b: In the same row differently superscripted are significantly ($P<0.05$) different.

** Standard Error Mean

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

	Exp.Diet(PBPM** inclusion levels)(g/kg DM)				
Traits	0	30	60	90	SEM
Carcass (oven ready yield) (%)*	68.13	69.35	68.69	69.73	0.4156
Thighs(%)*	18.23	18.27	18.27	18.23	0.228
Breast(%)*	20.36	20.25	19.92	20.47	0.202
Abdominal fat pad(%)*	2.03^{a}	1.79^{a}	2.57^{b}	2.68^{b}	0.108
Liver(%)*	2.24	2.01	2.05	2.38	0.070
serum uric acid (mg/dl)	2.63	2.7	2.96	3.16	0.3124

* Relative to live body mass

**Poultry by Product Meal

a,b: In the same row differently superscripted are significantly ($P<0.05$) different

meal (including feathers) for 15 min decreased bioavailable lysine concentrations from 3.77 to 1.52%, respectively. Further decreases in bioavailable lysine were observed when processing time was increased to30 min. Two of the primary factors believed to affect AA digestibility of animal meals are ash concentration and processing temperature. In addition, Batterhama *et al*. [27] found that lysine availability in meat bone meal for chicks decreased from 85 to35% when the processing temperature increased from125 to 150°C. heat processing of protein sources may change L amino acid to D amino acids which may decrease its digestibility and amino acid availability [28].

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. 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 finding of Pesti [29] 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 90g/kg ofpoultryby product meal inclusion in diets, led to poorer feed efficiency [29,11]. 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 agreement with the previous findings [11,29] however abdominal fat pad percentage and some organs such as heart 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). This affect on abdominal fat pad percentage might be due to probable amino acids imbalances in diets containing high levels of poultry by product meal. Wessels [30] investigated the protein quality of poultry offal meal used in chick rations with or without amino acid supplementation. He observed an improvement in the nitrogen of chickens when methionine and lysine were added to the experimental diet containing South African poultry offal meal. Thus, methionine and lysine were reported to be the first and second limiting amino acids in this protein source. Also Jackson *et al.* [31] reported that amino acids imbalances increases deamination of amino acid to make up fats. Probably poultry by-product meal is involved in increased metabolic load, it may relate to the specific dynamic action associated with deamination of excess nitrogen-yielding components (the increased metabolic activity of digestion, absorption and excretion of protein that cannot be used). In this situation, the field problem may relate to poor quality poultry by-product in the ration. Some nutrients, such as poultry by-product meal or poultry fat that may impose an additional burden on metabolism [32]. Also the result of present study showed that serum uric acid concentration was not difference among experimental diets (p>0.05). but viewpoint of numerically lowest amount (2.63 mg/dl) of uric acid in control diet (without poultry by product meal) and highest amount (3.16 mg/dl) of this were observed in 90 g/kg inclusion level of poultry by product meal in diets. Uric acid is the end product of nitrogen metabolism in poultry and as influenced under the quality and quantity of protein sources using in bird diets. This criteria could be used for evaluation of poultry feed protein quality [33, 34].

CONCLUSIONS

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) value. Also the present study showed that the use of poultry by product meal up to 60 g/kg in diets no adverse effects on various live performance in grower and finisher phase, carcass traits, serum uric acid concentration and relative weight of some organs. In general, the chemical composition, mineral content and protein quality of PBPM may vary greatly and needs to be evaluated continuously.

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