Iranian Journal of Applied Animal Science

Determination of Apparent and True Digestibility of Poultry by Product Meal in Broiler Chickens

Research Article

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Received on: 21 Oct 2013
Revised on: 26 Nov 2013
Accepted on: 15 Dec 2013
Online Published on: Sep 2014

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ABSTRACT

In order to determination of ileum apparent and true digestibility of two samples of poultry by product meal, an experiment was conducted with a total of 60 day-old broiler chicks, Ross 308 strain. Poultry by-product meal was prepared from two slaughter house in Alborz province. Samples were sent to laboratory for determination of chemical analysis. The birds received commercial broiler starter and grower diets from day l to 30. On day 30, sixty birds of uniform nearly some body weight (38±4 g) were allocated to twelve groups of five birds each and assigned to twelve cages. There were three dietary treatments, two diets containing two samples of poultry by-product meal (PBPM) and a nitrogen-free diet. Apparent digestibility values of the assay diet, using ileal contents, were calculated using chromic oxide as indigestible marker. True digestibility values were calculated using endogenous output determined by feeding a nitrogen-free diet. In day 42, birds were slaughtered by CO_2 and ileum content was collected. Apparent and true digestibility of protein, Ca, P and metabolizable energy were calculated. Result showed there is difference between two samples of PBPM in chemical composition and nutrient digestibility. Apparent metabolizable energy (AME) and apparent metabolizable energy corrected for nitrogen (AME_n) in sample 2 were higher than sample 1 (3665±137.75 *vs.* 3241±2.85 and 3495±134.45 *vs.* 3111±1.50, respectively) however these differences were not significant in some cases.

KEY WORDS poultry by product meal, crude protein, excreta, ileum.

INTRODUCTION

In the nutritional behavior of single stomach animals, the origin of protein is important and its quality varies between different sources and animal origin is better than plant origin (Zarei *et al*. 2006). Animal proteins have more benefits than plant proteins. These benefits are; remaining of Ca and P due to bone in animal proteins, existence of B-complex vitamins especially B_{12} in animal proteins, the lake of anti-nutritional factors in animal proteins such as trypsin inhibitor in soybean meal and toxic pigment gossypol in cottonseed meal and suitable composition and proportion of amino acids in animal proteins than plant proteins. Biological value (BV) is high whenever one protein has all essential amino acids proportionally for animal production. Poultry by-product meal has high BV and is used as a good ingredient in poultry production. Thermal damage maybe happened during preparation of animal proteins such as PBPM. Digestibility of different samples, in the other hand, depends on ingredient composition of them such as: ash, crude fat, crude protein and amino acids content. So digestibility of PBPM is different from one factory to other. The aim of this research is determination of PBPM digestibility from different factories.

MATERIALS AND METHODS

Birds

A total of 100 day-old male broiler chicks (Ross 308 strain) were obtained from local hatchery and raised in battery brooders. The birds received a commercial broiler starter and grower diet from day l to day 30. On day 30, forty birds of uniform body weight (1.11+0.15 kg) were chosen and groups of 5 birds were assigned to each of 12 colony cages. Each treatment was replicated 4 times.

Diets

Poultry by-product meal were prepared from two slaughter house in Alborz province two test diets were formulated to contain two samples of PBPM that each of them as the sole source of dietary protein (Table1).

Table 1 Composition of experimental diets (g/kg air dry basis)

Ingredient	PBPM (1)	PBPM (2)	N free
PBPM	452.3	442.0	-
Corn starch	379.0	399.3	688.5
Corn oil	30.0	20.0	55.0
Sucrose	80.0	80.0	170
Cellulose	20.7	20.7	45.0
Salt	-	-	4.0
DCP	20.0	20.0	20.0
Oyster shell	10.0	10.0	10.0
Vitamin premix	2.5	2.5	2.5
Mineral premix	2.5	2.5	2.5
Chromic oxide	3.0	3.0	3.0

PBPM: poultry by product meal.
DCP: digestible crude protein.

Cellulose (Merck, Darmstadt, Germany) was added as a source of fiber in diets. A protein-free diet was also formulated to allow the determination of endogenous flows of nitrogen. Chromic oxide was included in all diets as an indigestible marker.

Procedure

On day 30, the birds were given their respective diets ad libitum for 4 days and then were fasted for 24 h. The birds were then allowed to consume the respective diets for one hour period (Kadim and Moughan, 1997). Following, excreta were collected for 13 h on a tray placed under each cages, transferred to a plastic container and frozen (-20 ˚C). The birds were offered the same diet ad libitum for a further 2 days. Then, the birds were again fasted for 24 h. The birds were then allowed to consume their diet for one hour. Four hours after the start of the meal (Kadim and Moughan, 1997) birds were killed by CO_2. After killing the birds, the body cavity were opened, the ileum removed and digesta collected from ileum. Ileal digesta of birds within a cage were pooled to provide adequate material for chemical analysis. The digesta were frozen immediately after collection at -20 ˚C. The excreta and digesta samples were subsequently freeze dried, finely ground and stored at -20 ˚C for chemical analysis.

Chemical analysis

Dry matter (DM), crude protein (CP) (N×6.25) and ether extracts (EE) content were determined according to AOAC (1990) procedure and Cr_2O_3, Ca and P determination were done using atomic absorption spectrophotometry (1979). Energy content was determined by oxygen bomb calorimeter (IKA-C5000).

Data analysis

Apparent and true digestibility was calculated using the following equations (Kadim *et al*. 2002).

Apparent nutrient digestibility (AND)= (nutrient concentration in diet nutrient output (in ileum or excreta)) / nutrient concentration in diet.
True nutrient digestibility= (AND+endogenous nutrient output) / nutrient concentration in diet.

The paired t-test was used to compare ileal digestibility of two sample values. The SPSS version 19 program was used for statistical analysis.

RESULTS AND DISCUSSION

The crude protein and amino acid content of PBPMs is presented in Table 2.

Table 2 Chemical composition of PBPM samples (g/kg DM basis)

	Sample1	Sample 2
Dry matter	928.4	885.6
Crude protein	403.7	575.0
Ether extract	22.0	27.0
Crude Ash	231.5	76.0
Calcium	10.2	14.9
Phosphorus	12.1	12.9
Sodium	2.7	3.8
Methionine	6.7	9.5
Cysteine	6.6	9.4
Lysine	20.9	29.7
Threonine	14.6	20.8
Tryptophan	2.5	3.5
Arginine	26.5	37.8
Isoleucine	14.5	20.7
Leucine	26.8	38.2
Valine	19.3	27.5
Histidine	7.2	10.3
Phenylalanine	15.4	21.9
Glycine	41.5	59.1
Serine	18.2	26.0

PBPM: poultry by product meal.

The apparent metabolizable energy (AME) and apparent metabolizable energy corrected for nitrogen (AME_n) are shown in Table 3. Apparent and true digestibility of dry matter (DM), crude protein (CP) energy, Ca and P of two samples of PBPM are shown in Table 4.

Results were showed there is some difference between samples in chemical composition. Dry matter, CP and essential amino acids, Ca, P and ether extract in sample 2 were higher than sample 1. Ash content was vice versa (Table 1).

Table 3 Compare mean of AME and AME_n in two sample of PBPM

PBPM	kcal/kg	
	AME	AME_n
Sample 1	3241±2.85	3111±1.50
Sample 2	3665±137.75	3495±134.45
P-value	0.20	0.21

PBPM: poultry by product meal.
AME: apparent metabolizable energy and AME_n: apparent metabolizable energy corrected for nitrogen.

Table 4 Apparent and true digestibility (coefficients) of PBPM by ileum sampling

PBPM	Apparent digestibility				
	DM	CP	Energy	Ca	P
Sample 1	89±0.4	34±1.14	65±0.06	37±8.67	38±6.58
Sample 2	91±0.03	58±1.14	77±2.91	29±8.24	47±2.41
P-value	0.20	0.05	0.16	0.75	0.51
PBPM	True digestibility				
	DM	CP	Energy	Ca	P
Sample 1	95±1.11	40±0.95	75±1.08	69±1.51	66±9.73
Sample 2	96±0.56	65±3.44	86±3.91	46±6.36	64±0.48
P-value	0.65	0.05	0.17	0.13	0.86

PBPM: poultry by product meal.
DM: dry matter and CP: crude protein.

Dry matter: dry matter in sample 1 is higher than sample 2 (92.84% *vs*. 88.56%). Result from sample 1 is near the values reported from Robbins and Firman (2006), however values from samples 1 and 2 are lesser than results from Samli *et al*. (2006), Hosseinzadeh *et al*. (2010), Senkoylu *et al*. (2005) and Najafabadi *et al*. (2007) (95.5, 95.5, 95.5 and 94.8 respectively). This difference seems due to method of production such as; temperature, duration of processing and amount of basic different raw materials. Raw materials of PBPM are different in slaughterhouses due to method of slaughter, because some stages of process are not automatic and doing by hand.

Protein and amino acids: sample 1 has more protein and amino acids from sample 2. Protein content of samples2 is nearly same amount reported from Dozier *et al*. (2003) (58.3%). Both of samples are less than values reported by NRC (1994), Dozier and Dale (2005), Najafabadi *et al*. (2007), Senkoylu *et al*. (2005), Samli *et al*. (2006), Robbins and Firman (2006) (70, 60, 60, 61, 63, 63 and 64 percent respectively). This difference is due to present of feather, leg, nail, beak and variation of this material in samples. As explained before PBPM are different in slaughterhouses due to method of slaughter, because some stages of process are not automatically and doing by hand and in this situation percent of ingredients is differ.

Fat: ether extract from sample 2 is more than sample 1 (27% *vs*. 22%). These two samples have more ether extract from those reported from Dozier and Dale (2005), Senkoylu *et al*. (2005) and Samli *et al*. (2006) (13.5, 11.8 and 11.8% respectively). High crude fat content in our samples is due to absent of fat refinery system in most Iranian slaughterhouses and produced PBPM has more fat content.

Crude energy: crude energy like fat content is high in sample 2 *vs*. sample 1 (5718 kcal/kg *vs*. 5001 kcal/kg). Crude energy of sample 2 is more than values reported by Najafabadi *et al*. (2007), Robbins and Firman (2006) and Jafari *et al*. (2011) (5646, 4624 and 5619 kcal/kg respectively). High content of crude energy in this sample is due to high content of fat in it.

Crude ash: ash content of PBPM in sample 1 is higher than sample 2 (%23.5 *vs*. %7.6). In Iran, some slaughter houses or processing plants removed legs from carcasses and packaged them for soup usage. So the ash content is different from one slaughter house to another. This difference is reported by some researchers from other countries; Najafabadi *et al*. (2007), Senkoylu *et al*. (2005), Dozier and Dale (2005), Robbins and Firman (2006), (9.3, 20.7, 14.49 and 18.34 percent respectively).

Ca, P and Na: sample 2 has more Ca, P and Na in comparison sample 1. The main reason of this variation was mentioned in crude ash section.

Metabolizable energy: metabolizable energy (ME) and ME_n in sample 2 are greater than sample 1.In both samples metabolizable energy corrected for nitrogen (ME_n) is more than ME. This is obviously due to correction nitrogen. Apparent *vs*. true digestibility: values from true digestibility are higher than those from apparent digestibility in both samples (Table 4). However there is not any significant difference between two samples from standpoint of apparent or true digestibility, except protein digestibility. Sample that has more ash content have fewer digestibility. Our finding is like Kadim *et al*. (2002). Time of ileum sampling after feeding is important. This probability was mentioned by Zarei *et al*. (2006). Heat damage is another reason for low protein digestibility (McNaughton *et al*. 1977). As a result; amino acid imbalance, low quality of sample, lake of palatability, high fat content are main factors that effect on digestibility of PBPM (Parsons *et al*. 1997).

Metabolizable energy: apparent metabolizable energy (AME) and apparent metabolizable energy corrected for nitrogen (AME_n) in sample 2 were higher than sample 1.However this difference was not significant (Table 3). Sample 2 had more ether extract and less ash content. Pesti *et al*. (1986) showed there was high positive correlation between AMEn and gross energy of sample.

CONCLUSION

Results of present study showed that there is no significant

difference between samples gathered from different slaughter houses stand point of chemical composition and digestibility. Anyway we need determine chemical composition and digestibility of each sample before use.

ACKNOWLEDGEMENT

We offer our thanks to chairman, vice president and personals of Karaj Islamic Azad University, Iranian Animal Science Research Institute that had brought these research possibilities.

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