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Effect of tomato (*Solanum lycopersicum* L.) protein on carcass and meat quality of kampong chicken

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ABSTRAK

Penelitian bertujuan untuk mengetahui kualitas karkas dan daging ayam kampung yang mengkonsumsi tepung tomat dalam ransum. Penelitian ini dilakukan menggunakan 200 ekor ayam kampung umur 10 hari. Rancangan yang digunakan dalam penelitian ini adalah rancangan acak lengkap (RAL) yang terdiri dari 5 perlakuan dan 4 ulangan dan tiap perlakuan terdiri dari 10 ekor ayam kampung Perlakuan yang diberikan adalah 0, 3, 6, 9 dan 12% tepung tomat yang disubstitusi pada ransum basal. Ransum basal terdiri dari 42% jagung, dedak halus 9%, tepung ikan 10%, minyak ikan 5%, bungkil kedelai 9% dan ransum komersial 25%. Perlakuan adalah PO = 100% ransum basal (RB) + 0% tepung tomat (TT); P1 = 97% RB+ 3% TT; P2 = 94% RB + 6% TT; P3 = 91% RB + 9 % TT; P4 = 88% RB + 12% TT. Komposisi kimia tepung tomat adalah: 20,73% protein kasar, 1,53 % lemak, 30,94% serat kasar, 0,98% Ca, 1,20% P dan 2.416 kkal/kg *Gross Energy* (GE). Hasil penelitian menunjukkan bahwa pemberian ransum yang mengandung tepung tomat sampai 12% meningkatkan berat potong, karkas, dada, sayap, kaki dan paha, dan menurunkan lemak abdominal dan kolesterol darah, tetapi tidak berpengaruh pada liver, hati dan gizzard. Kandungan air dan protein kasar daging nyata meningkat, lemak daging dan kolesterol daging nyata menurun. Disimpulkan bahwa tepung tomat dapat digunakan dalam pakan ayam kampung sampai 12% karena tidak memberikan pengaruh pada kualitas karkas dan daging ayam kampung.

K*ata Kunci: ayam kampung, kualitas daging, kualitas karkas, protein, tomat*

ABSTRACT

The purpose of this research was to examine the carcass quality and meat quality of native chicken fed dried tomato meal in diet. The study was conducted by using 200 heads of native chickens 10 days. The birds were divided into five experimental diets and each was divided into four replicate groups of ten birds per replicate. The based diet was formulated to contain 42% corn, rice bran 9%, fish meal 10%, fish oil 5%, soybean meal 9% and commercial diets 25%. Tomato meal was included in five experimental diets at levels of 0, 3, 6, 9, 12% to substitute based diets. The treatments were PO = 100% based diet (BD) + 0% tomato meal (TM); P1 = 97% BD+ 3% TM; P2 = 94% BD + 6% TM;P3 = 91% BD + 9% TM; P4 = 88% BD + 12% TM. Chemical composition of tomato meal was: 20.73% crude protein, 1.53% fat, 30.94%crude fiber, 0.98% Ca, 1.20% P and 2,416 kcal/kg of Gross Energy (GE). Results showedthat feeding tomato meal at an inclusion rate of 12% increased slaughter weight, carcass, breast meat, wings, drumstick and thigh, and decreased abdominal fat and blood cholesterol. Moreover, there were no significant difference in giblet (liver, heart and gizzard) between treatments. Meat water and meat crude protein were significantly increased. Meat crude fat and meat cholesterol were significantly decreased. In conclusion, tomato meal can be used as an alternative feedstuff in kampong

chicken diets at inclusion levels up to 12% without negative effects on carcass quality and meat quality.
Keywords :carcass quality, meat quality, kampong chicken, protein, tomato

INTRODUCTION

Kampong chicken have been raised by most of the rural community population of Indonesia and they represent an important source of meat and eggs. Kampong chickens are still not able to provide consumption on a daily basis because of their low production. Kampong chickens contribute a lot to household nutrition and income in rural areas of tropics (Norris *et al*., 2007). However, improving nutrition for increasing egg and meat production in kampong chickens in Indonesia is critical. Productivity of kampong chicken breeds may be doubled with improved diets and management conditions (Chowdhury *et al*., 2006). But the kampong chickens have not attained their full production potencial due to exposure to risks that influence against the survival and productivity under extensive management conditions (Faruque *et al*., 2013). One on the top issues of kampong chickens is a tasty meat flavor. The people are more prefer to consume this type of chickens than that of commercially broiler chickens. Therefore, the demand for kampong chickens is always increasing year to year, while only a small portion of it has been met (Bamualim *et al*., 1994).

The nutrional value of tomato can provide the poultry industry as an alternative feedstuff. The tomato seed is rich in protein lysine (approximately 13% more lysine than soya protein) and can supply feed that is deficient in lysine (Latlief and Knorr., 1983). The chemical analysis of tomato meal showed rich in protein (20.73%) and contains high fibre content (30.94%). The high nutrient content of tomato meal makes it a potential feed resource for livestock animals. The crude protein content of tomato meal was higher than the value of crude protein of tomato waste meal. Tomato pomace could be used in broiler chicken diets up to level 20%. Using of dried tomato pomace (only separated tomato seeds) in broiler chicken diets caused an extended shelf life for broiler meats, because of alpha-, beta-, gamma- and delta tocopherols in tomato pomace cause an antioxidant effect (Squires *et al*., 1992).

Tomato pulp is a good source of protein, vitamins and minerals but may be limited in energy due to the high fiber content (Mansori *et al.*,2008) substitution of tomato pulp instead of other dietary ingredients shows comparable performance parameters in laying hen (Jafari *et al.,* 2006). The mentioned study showed that dried tomato pomace including rich food sources, has caused the poultry health and freshness and better feed digestion, as a result, it can increase the absorption of nutrients (Asadollahi *et al*., 2014).

Tomato also contains a variety of phytochemical, including carotenoids and polyphenols (Thompson *et al*., 2000; Campbell *et al*., 2014). Tomatoes and tomato products are the major dietary source of lycopene, folate, vitamin C, vitamin A, phenolics, and flavonoids as potential bioactive compounds (Sahin *et al.*, 2006). Recent studies have suggested a protective role for lycopene, an antioxidant carotenoid, in the prevention of environmental stress and lead to better performance for birds (Donkoh., 1989; Sahin, *et al*., 2008).

The red pigment contained in tomatoes is called lycopene. This compound appears to act as an antioxidant, neutralizing free radicals that can damage cells inthe body (Bhowmik *et al*., 2012). Along with carotenoids, other antioxidant compounds present in tomato, including ascorbic acid, tocopherols and phenols play a determinant role in disease prevention (Karakaya *et al*., 2001). The dried tomato pomace is mainly consisted of tomato`s skin, seed and its hard texture. This by-product, after being dried contains up to 22.1%-22.4% protein, 14.5%-15.7% fat and 20.8%-30.5% fiber. It is a good source of A, B1 and B2 vitamins and also essential (and non-essential) amino acids (Fallahi., 1996).

According to Jouzi *et al*. (2015), dried tomato pulp may be used as ingredient in quails ration up to level of 4-6 % without harming weight gain and feed conversion of birds. Tomato waste has used as feedstuff in broiler diet up to 20% level without harming weight gain and feed conversion of poultry (Lira *et al*., 2010).

When formulating the diets, the main emphasis is placed on the crude protein, because protein is the critical constituent of poultry diets, and together with the other main nutrients such as carbohydrates, fat, water, vitamins, and minerals, is essential for life (Cheeke., 2005). Protein serve vital metabolic roles as blood plasma proteins, enzymes, hormones, and antibodies, each of

which has a specific role in the body (Pond *et al*., 1995). However, protein is also one of the most expensive ingredients in poultry diets. Therefore, nutritionally and economically, proper protein usage is essential in all feeding systems. On the other hand, during broiler diet formulation, choosing ingredients to maximize nutrient availability, rather than simply meeting energy or amino acid levels, is necessary (Ravindran., 2013).

In poultry feed formulation, after the energy -yielding raw materials, protein supplements constitute the biggest component, and attention has been focused on the protein and energy levels of the feed (Skinner *et al*., 1992). Vegetable (plant) and animal products are the two most important protein sources in poultry diets. The usefulness of a protein feedstuff for poultry depends up on its ability to supply a sufficient amount of the essential amino acids that the bird requires, as well as the protein digestibility and the level of toxic substances associated with it (Scanes *et al*., 2004).

In general, vegetable (plant) protein sources are nutritional balanced and poor in certain essential amino acids and this decreases their biological value as they may not furnish the required limiting amino acids needed by birds for egg and meat production (Akhter *et al*., 2008). Formulation of poultry diets greatly depends on plant protein that can supply the necessary amino acids that are not available in adequate quantities in the cereals (Atteh., 2000). Plant protein is relatively cheaper and readily available than the animal protein source.

The Objectives of this study were to evaluate effect protein of tomato on carcass and meat quality of kampong chickens.

MATERIALS AND METHODS

Preparation of Tomato Meal

The tomatoes were washed, cutted, and sun-dried to constant weight for 3-5 days. Part of tomato then was ground to fine powder using mortar and pestle. After that, mixed with other ingredients to compound the feed.

Birds, Feeding and Management

Two hundred of kampong chickens (10 days of age) were used for the study and maintained for 105 days. The birds were divided into five experimental diets and each was divided into four replicate groups of ten birds per replicate using completely randomized design. The control diet (based diet) was formulated to contain 42% corn, rice bran 9%, fish meal 10%, fish oil 5%, soybean meal 9% and commercial diets 25%. Tomato meal was included in four experimental diets at levels of 3, 6, 9 and 12% to substitute based diet. The treatments were: RO = 100% based diet (BD) + 0% Tomato meal (TM); R1 = 97% BD+ 3 % TM; R2 = 94% BD + 6% TM, R3 = 91% BD + 9% TM, R4 = 88% BD + 12% TM. Chemical composition of tomato meal was: 20.73% crude protein, 1.53 % fat, 30.94 % crude fiber, 0.98% Ca, 1.20% P and 2,416 Kcal/Kg of Gross Energy (GE), and chemical composition of the diets are presented in Table 1.

At termination of the experiment, twenty chickens representing weight average of the group were taken carcass characteristics, and chemical composition of breast and thigh muscles were determined.

Chemical Analysis

Proximate analysis of diet and meat of kampong chickens was determined by the methods of AOAC (1996). Crude protein was determined by multiplying crude nitrogen by 6.25. Cholesterol was determined by Libermann and Burchad Method (Kenny, 1952)

Statistical Analysis

Data were analyzed by one-way analysis of variance. Probability values <0.05 were taken to indicate statistical significance. The treatments means were compared using Duncan's Multiple Range Test (Steel and Torrie, 1980). The IBM SPSS Statistics 22 software was used for the statistical processing of data.

RESULTS AND DISCUSSION

The effects of dietary dried tomato meal on the carcass quality and meat quality of kampong chicken are presented Table 2 and Table 3. Results showed that feeding tomato meal at an inclusion rate of 12% increased slaughter weight, carcass, breast meat, wings, drumstick and thigh, and decreased abdominal fat and blood cholesterol. Moreover, there were no significant difference in giblet (liver, heart and gizzard) between treatments. Meat water and meat crude protein were significantly increased, however, meat crude fat and meat cholesterol were significantly decreased (Table 3).

Leke *et al*. (2015) in previous study reported

Table 1. Composition of Experimental of the Diets

Nutrient Composition	Diets (% of TM)				
	0*	3**	6**	9**	12**
Base Diet	100	98	96	94	92
TM	0	2	4	6	8
Crude protein (%)	15.71	18.87	18.64	19.09	19.77
Fat (%)	4.36	2.97	2.59	2.97	3.29
Crude Fiber (%)	3.56	4.16	4.45	5.58	6.26
Ca (%)	0.80	0.80	0.81	0.82	0.82
P(%)	0.86	0.87	0.88	0.85	0.90
GE (Kcal/kg)	3057	3037	3018	2999	2980

TM = Tomato meal
* Laboratory of Science and Technology of Feed, Bogor Agricultural University (2017)
**Laboratory of Nutritional Biochemistry and Fodder, Gadjah Mada University (2017)

Table 2. Carcass and Meat Quality of Kampong Chickens

Variable	0% TM	3% TM	6% TM	9% TM	12% TM	*P Value*
Slaughter Weight (g)	1230 ±15.72^{a}	1241 ±23.37^{a}	1339 ±17.51^{b}	1330±20.13^{b}	1471 ±22.75^{c}	.000
Carcass (%)	71.2 ± 0.13^{a}	72.1 ± 0.43^{b}	74.2 ± 0.53^{c}	74.5 ± 0.43^{d}	74.7 ± 0.16^{d}	.000
Breast Meat (%)	28.59± 0.31^{a}	29.49 ± 0.07^{a}	32.11± 1.82^{b}	33.88± 0.66^{c}	34.58± 0.29^{c}	.000
Wings (%)	12.15± 0.45^{a}	12.49± 0.46^{a}	13.27± 0.54^{b}	13.36± 0.38^{b}	14.22± 0.13^{c}	.000
Drumstick +Thigh (%)	31.63± 0.21^{a}	32.08± 0.01^{b}	32.92± 0.11^{c}	35.41± 0.47^{d}	35.45± 0.41^{d}	.000
Abdominal Fat (%)	1.88± 0.11$^{\mathbf{b}}$	1.44± 0.29$^{\mathbf{b}}$	1.32± 0.17$^{\mathbf{a}}$	1.39± 0.32$^{\mathbf{a}}$	1.25± 0.17$^{\mathbf{a}}$	.000
Abdominal Fat (g)	20.78± 0.69^{c}	19.52± 0.46^{b}	19.12± 1.08^{ab}	18.44± 0.74^{a}	18.26± 1.51^{a}	.000
Blood Cholest. (mg/dl)	136.62± 0.30^{d}	133.64± 0.31$^{\mathbf{c}}$	122.42± 1.32^{a}	123.90± 0.57^{b}	122.22± 1.33^{a}	.000
Liver (%)	2.80± 0.14	2.74 ± 0.19	2.42± 0.14	2.50± 0.14	2.38± 0.14	.000
Heart (%)	0.63± 0.10	0.68± 0.10	0.64± 0.03	0.62± 0.06	0.60± 0.02	.528
Gizzard (%)	3.09± 0.17	3.14± 0.10	2.91± 0.08	3.11± 0.34	2.80± 0.20	.062

TM = tomato meal

that the whole egg nutrients have similar quality to based diet when chicken fed tomato diet up to 8%, so that could have beneficial nutritional impact for laying hens. Leke *et al*. (2016) reported effect of dried tomato in diet up to 8% without negative effects on performance and egg quality. These suggest that the use of tomato meal in laying hen diets might have positive effects on whole egg quality.

Yitbarek (2013) showed that carcass yield values were higher for a group fed on 5% dried tomato pomace compared with other treatment

Table 3. Water, Crude Protein, Crude Fat and Cholesterol of Meat of Kampong Chickens

Variable	0% TM	3% TM	6% TM	9% TM	12% TM	*p Value*
Water (%)	72.58±0.55^{a}	73.26±0.56^{bc}	72.78±0.44^{ab}	73.50 ± 0.47^{c}	74.72±0.16^{d}	.000
Crude Protein (%)	20.56±0.42^{a}	22.08±1.30^{b}	22.34±0.82^{bc}	23.26 ± 0.42^{cd}	23.60±0.29^{d}	.000
Crude Fat (%)	2.64±0.20^{d}	2.28±0.08^{c}	2.15±0.05^{bc}	2.07 ±0.06^{ab}	1.96±0.13^{a}	.000
Meat Cholesterol (mg/100 g)	24.47±0.58^{d}	23.18±0.79^{c}	21.62 ±0.29^{b}	20.74 ±0.11^{a}	20.26±0.23^{a}	.000

TM = tomato meal

groups. But statistically there were no significant difference between the groups. Moreover, the obtained result was not similar to that reported by King and Zeidler (2004) who showed that dried tomato pomace up to 15% in diet does not affect carcass traits of broiler chicks. Sayed and Abdel-azeem (2009) reported that dried tomato pomace can be utilized efficiently and safely in the diets of rabbits up to level of 20% without any adverse effect on the performance and carcass traits. Significantly similar carcass yield and dressing percentage was observed at 20 % of dried tomato pomace inclusion on grower chicks (Yitbarek., 2013). Our results indicated that alterations in feed intake and weight gain in some phases promoted by inclusion of tomato meal. Chemical composition of tomato meal were : 16.73 % crude protein, 1.53% fat, 30.94% crude fiber, 0.98% Ca, 1.20% P and 2,416 Kcal/kg GE (Leke *et al*., 2016)

Squires *et al.* (1992) reported that tomato pomace could be used in broiler chicken diets up to level of 20%. That using of dried tomato pomace (only separated tomato seeds) in broiler chicken diets were caused an extended shelf life for broiler meats, because of alpha-, beta-, gamma- and delta tocopherols in tomato pomace cause an antioxidant effect.

In the present study, a positive effect of dried tomato meal on cholesterol concentration in the blood of kampong chicken was observed. The obtained results were similar to that reported by Rahmatnejad *et al*. (2009) who showed that feeding dried tomato pomace at an inclusion rate of 16% and 24% to broiler chicks increased the mean values of HDL-cholesterol and decrease in serum cholesterol and LDL-cholesterol, as compared to other dietary treatments. Moundras *et al*. (1997) said that the serum cholesterol decreasing effect of crude fiber could be due to its ability to enchange faecal excretion of cholesterol and bile acids. Burr *et al*. (1985) suggested that there is a negative correlation between dietary fiber content and serum cholesterol level. It is possible that for a significant reduction of serum cholesterol, a higher inclusion level of dried tomato pomace in laying hen diets is required. Mahata *et al*. (2016) reported that the total cholesterol, LDL-cholesteroland HDL-cholesterol of laying-hen's blood serum and fat content of egg yolk was not affected by different levels of boiled tomato waste powder up to 12% in diets. Even though there were no difference among treatments statistically but numerically it appeared that increasing in the level of boiled tomato waste powder in the diet lowered the total cholesterol and LDL tremendously and increased the HDL.

In contrast, Frederiksen *et al*. (2007) showed that dietary supplementation with an extract of lycopene rich tomatoes had no effect on cholesterol and triglycerol levels measured in rabbit's plasma. Feeding dried tomato pomace to laying hens had no effect on plasma cholesterol and low-density lipoproteins (Nobakht and Safamehr, 2007).

Results of abdominal fat and giblet in this experiment are not in agreement with those reported of Lira *et al*. (2010), in which there was no difference between regime with different levels of tomato waste for absolute weight of heart, liver and gizzard neither for yield of gizzard, with means of 13.35 g; 41.83 g, 34.87 g and 1.94%, respectively. However, for yield of heart and liver, there was linear effect, because for each 1% of tomato waste inclusion, there was an increase of 0.0036 and 0.0133%, respectively. Effect of

dietary supplemental plant extracts on different organ weights was reported by Akbarian *et al*. (2013). Relative spleen, pancreas, gizzard, liver, proventriculus, thigh, breast, heart and visceral fat weight were not influenced by the use of plant extract.

The statistics analysis results of moisture, protein, fat, and cholesterol of meat in this research in different levels of dried tomato pomace significantly different and using 12% of dried tomato pomace showed the best result. Asadollahi *et al*. (2014) reported that results of protein, fat, moisture and ash of meat in different levels of dried tomato pomace up to 10% were significantly increased (Asadollahi *et al*., 2014). Comparing the studied parameters showed that increasing the amount of used dried tomato meal up to 12% leads to increase both water and protein content, but reduces the fat and meat cholesterol content of the kampong chicken texture which consequently increased overall consumer acceptability. In general, according to the obtained results of each of the five parameters, the treatment which contained 12% dried tomato meal was determined as the best one and was recommended to be added to the diet of chickens.

Proteins and lipids of muscle tissue are important meat quality parameters. Normally thigh meat fat content in broiler is 90.44 g/kg to 107.55 g/kg in female and 76.95 g/kg to 96.83 g/kg in male. They contribute substantially to the nutritional characteristics of meat. Mahata *et al*. (2014) reported the inclusion of dragon fruit peel in broiler diet up to 15% lowering fat and cholesterol content in thigh meat. The level of dragon fruit peel 10 and 15% in diet were as same as effect in lowering fat content, while the highest lowering cholesterol in thigh meat occured when the dragon fruit peel was included reach 15 % in diet. It be predicted, lowering fat and cholesterol in thigh meat due to anthocyanin, lycopen, and β-carotene from dragon fruit peel inhibited cell cholesterol synthesis by inhibiting HMG-CoA reductase work to synthesize mevalonate as intermediate reaction in cholesterol synthesize in cell.

CONCLUSION

Based on the present data, it can be concluded that tomato meal can be used as an alternative feedstuff in kampong chicken 105 days of age diets at inclusion levels up to 12 % without negative effects on carcass quality and meat quality.

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