Performance of Japanese Quails Fed Different Protein Levels and Supplemented with Betaine

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ABSTRACT: The objective of the experiment was to investigate the performance of Japanese quails *(Coturnix coturnix japonica)* fed different levels of protein and supplemented with betaine. The experiment used 300 quails with an average initial body weight of 43.21±2.68 g. The design used was completely randomized design of factorial 2 × 2. The first factor was the 2 levels of crude protein (18.0 and 19.5%) and the second factor was the supplementation of betaine (0 and 0.12% betaine). Each treatment used 5 replications containing 15 quails each. During adaptation, quails were fed a grower diet until the age of 41 days and then replaced with a layer diet containing 18% protein. The treatments were given when egg production has reached 50%. The data were analyzed using analysis of variance followed by Duncan's test. Feeding 19.5% increased feed intake ($P<0.5$). However, dietary protein did not affect egg production, egg weight, feed conversion and protein efficiency ratio. Feeding 19.5% protein improved eggshell weight but resulted in a lower yolk index compared with 18% protein ($P<0.05$). Supplementation of 0.12% betaine increased feed intake, egg production, egg weight and protein efficiency ratio and decreased feed conversion ($P<0.05$). Supplementation of 0.12% betaine did not affect albumen index and eggshell weight. Moreover betaine increased yolk weight but decreased yolk index ($P<0.05$). It can be concluded that increasing dietary protein levels from 18.0 to 19.5% had minor impacts on quails' performance and egg quality. Supplementation of betaine improved the performance of quails but showed inconsistent effects on egg quailty.

Keywords: Quails, Performance, Egg Quality, Protein, Betaine

INTRODUCTION

According to NRC (1994) protein requirement for laying quail at moderate temperature (21ºC) is approximately 20%. However, this requirement may be not appropriate to be applied in Indonesia which has a tropical climate with high ambient temperatures. The high protein content in quail diet may cause heat stress as a result of metabolic processes (Li *et al.,* 2011). The high protein content in the diet can also increase undigested nutrients, thereby leading to inefficiency because many nutrients are excreted from the body and decrease the performance of poultry (Faria-Filho *et al.,* 2007).

Betaine (trimethyl glycine) is a methyl group donor and is involved in protein and energy metabolisms (Metzler-Zebeli *et al.,* 2009; Ratriyanto *et al.,* 2014). Supplementation of betaine may be an alternative to obtain optimal protein content as betaine improves the availability of methionine for protein synthesis (Ratriyanto *et al.,* 2009). In addition, betaine has an osmotic function for both epithelial cells and the microflora of the digestive tract thereby potentially increasing the digestibility of nutrients and animal performance (Metzler-Zebeli *et al.*, 2009).

Previous studies showed an increased egg production and feed efficiency in laying hens

due to betaine supplementation (Zou and Lu, 2002; Ezzat *et al.,* 2011). Betaine supplementation is expected to increase protein synthesis and improve performance of quail. Therefore, the objective of this study was to determine the effect of protein levels and betaine supplementation on performance of laying quail (*Coturnix coturnix japonica*).

MATERIALS AND METHODS

The study used 300 quails aged 21 days with an average initial body weight of 43.21 ± 2.68 g. The experiment was designed to as completely randomized design of factorial 2 × 2. The first factor was the 2 levels of crude protein (18.0 and 19.5%) and the second factor was the supplementation of betaine (0 and 0.12% betaine). Each treatment used 5 replications containing 15 quails each.

The basal diet was formulated to meet the nutrient requierement of laying quail according to the recommendation of the Indonesian National Standard (2006). The nutrient composition of the basal diet can be seen in Table 1.

Table 1. Nutrient composition of experimental diets

Nutrient	Protein Levels	
	18.0%	19.5%
Metabolizable energy (KCal/kg)	2800.00	2800.00
Crude protein (%)	18.01	19.51
Calcium (%)	3.41	3.40
Available phosphorus (%)	0.63	0.62
Lysine (%)	1.14	1.14
Methionine (%)	0.41	0.41

This experiment used 20 units of colony cages with the size 75 × 50 × 35 cm (p × l × t). During the experiment, diet and water were provided ad libitum. The quails were fed twice a day, at 07:00 and 13:30. During the growing phase, the quails were fed a commercial grower diet. From the age of 42 days until the egg production reached 50% quails were fed a basal diet containing 18% protein. The experimental diets were fed after egg production reached 50%.

The observed data included the feed consumption, egg production, egg weight, feed conversion (FCR) and protein efficiency ratio (PER), albumen and yolk index, and yolk and and eggshell weight. The PER value is the ratio between the egg mass and protein consumption (Suprijatna *et al.,* 2009).

The data obtained in this study were analyzed using analysis of variance (ANOVA) to determine the effect of treatment and followed with Duncan's test for signifincant effect (Steel and Torrie, 1991). Significance level was set at $\alpha = 0.05$.

RESULTS AND DISCUSSION

There was no interaction between protein and supplementation of betaine on performance and egg quality of the quails. Feeding 19.5% protein resulted higher feed intake (Table 2) and eggshell weight (Table 3) than feeding 18.0% protein ($P<0.05$). In accordance with this result, feeding 18% protein increased feed intake compared with 16% protein (Garcia *et al.*, 2005),

altough feeding 17.75 vs 19.95% protein (Li *et al.*, 2011) and feeding 18 vs 20% protein (Garcia *et al.*, 2005) did not affect feed intake of the quails (*Coturnix coturnix japonica*). Meanwhile, Garcia *et al.* (2005) showed that feeding 18 and 20% protein did not affect egg production, egg eight and feed conversion of the quails. Garcia *et al.* (2005) also showed that feeding 18 vs 20% protein resulted similar responses on egg quality of Japanese quails. This result indicated that feeding 18% protein was adequate for laying quails in the tropics. Optimal protein requirement for quail is greatly influenced by the type of quail (Ri *et al.,* 2005) and environmental conditions (Garcia *et al.,* 2005). Compared to carbohydrates and fats, proteins produce more heat, therefore, the low protein diet is expected to minimize heat production, especially in tropical climates (Furlan *et al.,* 2004).

Table 2. The effect of protein levels and betaine supplementation on performance of Japanese quails

Treatments	Feed Intake (g/day)	Production (%)	Egg Weight (g)	Feed Conversion	PER
Interaction effect between protein and betaine					
18.0 Control	18.80	61.54	8.34	3.68	1.52
18.0 Betaine	19.72	70.39	8.72	3.24	1.72
19.5 Control	18.75	63.44	8.40	3.56	1.46
19.5 Betaine	20.51	72.75	8.65	3.25	1.58
Significance	NS	NS	NS	NS	NS
Main effect of protein					
18.0	19.26b	65.97	8.53	3.46	1.62
19.5	19.63a	68.10	8.53	3.41	1.52
Significance	<0.05	NS	NS	NS	NS
Main effect of betaine					
Control	18.78[b]	62.49[b]	8.37[b]	3.62[a]	1.49[b]
Betaine	20.11[a]	71.57[a]	8.69[a]	3.25[b]	1.65[a]
Significance	<0.01	<0.01	<0.01	<0.01	<0.01

PER: protein efficiency ratio, NS: not significant.
[a,b] Means within a treatment and column with different superscripts differ significantly (P<0.05).

Supplementation of betaine improved (P<0.01) performance of the quails (Table 2) and yolk weight but decreased yolk index (Table 3). However, albumen index and eggshell weight were not affected by betaine supplementation (Table 3). Supplementation of betaine increased feed intake by 7.1% (P<0.01), which was in accordance with the increase in egg production, egg weight, protein efficiency ratio and the decrease in feed conversion. This suggests that supplementation of betaine contribute to increased protein synthesis and manifested by increased performance of the quails. Betaine donates its labile methyl groups in the process transmetilation and plays an important role in the metabolism of proteins (Ratriyanto *et al.,* 2009). Haryadi *et al.* (2015) observed that supplementation of betaine into a low protein diet (16.5% protein) increased feed intake and egg production but did not affect egg weight of quails. Previous studies showed that supplementation of 0.1% betaine in the diet enhanced production performance of laying hens (Ezzat *et al.,* 2011). The same result was reported by Zou and Lu (2002), in which betaine increased egg production in laying hens by 8.7%. In accordance with this result, Park *et al.* (2006) showed that supplementation of betaine increased egg weight in laying hens.

Table 3. The effect of protein levels and betaine supplementation on egg quality of Japanese quails

Treatments	Albumen Index (%)	Yolk Index (%)	Yolk Weight (g)	Eggshell Weight (g)
Interaction effect between protein and betaine				
18.0 Control	11.59	48.97	2.43	0.81
18.0 Betaine	11.62	44.68	3.01	0.85
19.5 Control	10.27	47.22	2.49	0.87
19.5 Betaine	11.27	46.01	2.74	0.90
Significance	NS	NS	NS	NS
Main effect of protein				
18.0	11.60	46.82	2.72	0.83[b]
19.5	10.95	46.62	2.62	0.89[a]
Significance	NS	NS	NS	<0.01
Main effect of betaine				
Control	11.12	48.10[a]	2.46[b]	0.84
Betaine	11.44	45.34[b]	2.88[a]	0.87
Significance	NS	<0.01	<0.01	NS

NS: not significant.
[a,b] Means within a treatment and column with different superscripts differ significantly (P<0.05).

Betaine supplementation increased protein efficiency ratio by 10.7% and decreased feed conversion by 10.2% compared with control (P<0.01), which was caused by the increase in egg production and egg weight. Protein efficiency ratio describes the egg mass produced for each unit of protein intake. Thus, protein efficiency ratio is influenced by productivity of the animals (Suprijatna *et al.,* 2009; Ratriyanto *et al.,* 2012). In support with this results, supplementation of betaine into a low protein diet increased protein efficiency ratio and decreased feed conversion of quails (Haryadi *et al.,* 2015). Ezzat *et al.* (2011) observed that supplementation of 0.1% betaine in the diet decreased feed conversion of laying hens by 6%.

CONCLUSIONS

Increasing dietary protein levels from 18.0 to 19.5% had minor impacts on quails' performance and egg quality. Supplementation of betaine improved the performance of quails indicating contribution of betaine in protein metabolism. However, betaine showed inconsistent effects on egg quailty.

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