Production and Egg Quality of Quail Layer Given Diets Containing Different Levels of Crab (Portunus pelagicus) by-Product Meal

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ABSTRACT: Crab (*Portunus pelagicus*) by-product is by-product of fishery industry considered to be source of Ca, protein and chitin. The objective of this experiment was to evaluate effect of different levels of crab by-product meal (CPM) in quail feed on egg production and quality. A thousand of two-month-old quail layer (*Coturnix coturnix japonica*) in their first two week laying period were randomly allocated into five dietary treatments in which each treatment consisted of five replicates with 40 birds each. The dietary treatments were P0, P1, P2, P3, and P4 containing 0%, 2%, 4%, 6% and 8% CPM respectively, in combination with rice bran, ground yellow corn, crude palm oil, broiler starter diet, premix, and consentrate. Feed was provided *ad libitum*, mixed with 1:1 water to reduce dustiness and drinking water was always available. Feed consumption and egg production were recorded daily. Observation was done in 30 days period. Three eggs from each replicate were taken at the last day of observation for quality assessment. Feed consumption were 23-26 g/bird/d, and did not affected ($P > 0.05$) by dietary treatments. Inclusion of 6% CPM maintained high (80-87%) egg production with weight of 10.22 – 10.61g/egg . But egg weight and production reduced ($P<0.05$) for the bird given diet containing 8% CPM. The yolk color was not affected but Haugh Unit (HU), increased as the levels of crab by product increases. These results indicate that 6% CPM can be included in quail layer diet without affecting egg weight and production, and improve the egg internal quality.

Keywords: crab by-product, quail, egg production, egg quality

INTRODUCTION

Poultry feed industry in Indonesia is highly dependent upon imported raw materials, as local production is insufficient, seasonally available, and typically located far from feed mills. Consequently around 50-80 percent of raw feed materials are imported, leading to an increase in feed price. Many small poultry farmers ceased their farming activities because of their inability to survive with high feed cost. So, the potency of locally available and cheaper feed materials needs to be explored.

Blue swimming crab (*Portunus pelagicus*) production in Indonesia steadily increases each year and the by-product has not been properly utilized, even some of it pollutes the environment. In West Nusa Tenggara province (NTB) for example, crab production in 2014 was 418.6 tons (BPS, 2015) and the by-product was around 314 tons (+60% x fresh weight). Proximate analyses in our laboratory showed that crab by-product meal (CPM) contained approximately 21% protein, 1.5% fat, 55% ash, and 12.5% fiber. Haryati (2005) reported that this by-product contains significant amount of mineral especially Ca (19.97%) and P (1,81%). Besides, it contains chitin which can reduce cholesterol formation (Warsono dkk, 2004). Chitin in CPM may play important role in reducing cholesterol content of quail egg because cholesterol content of quail egg is higher than those of chicken and duck (Aziz *et al.* 2012). Therefore the objective of this study was to evaluate the effect of different levels of CPM in diets on production and quality of quail eggs.

MATERIALS AND METHODS

Feeding trial was conducted at a quail farm in Kawo village, central Lombok, and the observation of egg quality was done at the Laboratory of Nutrition and Feed Science, the Faculty of Animal Science, University of Mataram.

A thousand of two-months-old quail layer (*Coturnix coturnix japonica*) in their first two week egg production period were randomly allocated into five dietary treatments according to completely randomized design in which each treatment consisted of five replicates with 40 birds each, The composition of control diet (P0) was similar to diet usually formulated by quail farmers in Kawo village. The ingredients used include; rice bran, ground yellow corn, crude palm oil, broiler starter diet, premix, and consentrate (Table 1).

Table 1. Composition of the dietary treatments

Feed materials (% as fed)	P0 (control)	P1	P2	P3	P4
CPM	-	2	4	6	8
Ground yellow corn	21	21	26	26	31
Rice bran	26	26	27	27	26
Broiler starter diet	25	25	20	19	15
Cocentrate	24	22	19	16	16
Crude Palm Oil	3	3	3	2	3
Premix*	1	1	1	1	1
Analyzed chemical composition (%)					
Dry Matter (DM)	90.72	90.90	90.45	91.16	90.01
Ash	13.85	14.34	11.78	13.45	13.92
Organic Matter (OM)	76.87	76.56	78.67	77.71	76.09
Crude Fiber (CF)	11.32	9.75	9.88	10.50	9.66
Crude Protein (CP)	15.20	14.90	14.54	14.20	14.04

**Mineral B12 produced by Eka Farma, per 1 kg contains Ca 48-50%,= 13-15%, Fe + 40.000mg, Mn=27.500mg, Iodium = 500mg, Cu= 2000mg, Zn=25000mg, Vit B12= 4.50mg, Vit D3 =500.00 IU.*

The dietary treatments were formulated using similar feed materials with 2%, 4%, 6% and 8% CPM for P1, P2, P3, and P4 respectively. Feed was provided *ad libitum*, mixed with 1:1 water to reduce dustiness, and drinking water was always available. Feed consumption and egg weight and production were recorded daily for 30 days. Three eggs from each replicate were taken at the last day observation period for external and internal quality assessment. Haugh Unit was determined based on Haugh (1937) formula, and yolk color was measured using standard yolk color fan. The cholesterol content was measured using standard method of AOAC (1980).

Data was analyzed using PROC GLM procedure of Sas (1990) and differences between treatment means were separated using Duncan multiple range test.

RESULTS AND DISCUSSION

Health condition of all quails was relatively good, although 12 birds (1.2%) were noted dead because they stacked between pens and beaten by rat. Feed consumption, egg production, egg weight and quality are presented in Table 2.

Table 2. Feed consumption, feed conversion, egg weight and quality of laying quail given diet containing different levels of CPM.

Parameters	Levels of CPM						
	Control	2%	4%	6%	8%	SEM	P-value
Feed consumption (g/bird/d)	24.49[a]	25.46[a]	24.71[a]	25.43[a]	23.77[a]	0.632	NS
Hen day egg Production (%)	86.80[a]	85.60[a]	79.80[ab]	80.60[ab]	76.80[b]	0.025	0.0495
Feed conversion ratio (g feed/g egg)	2.65[c]	2.78[bc]	2.95[ab]	3.05[a]	3.04[a]	0.071	0.0021
Egg weight (g/egg)	10.61[a]	10.62[a]	10.41[ab]	10.22[b]	10.17[b]	0.080	0.0013
Egg cholesterol (mg/dL)	50.44[b]	51.31[b]	51.39[b]	49.71[b]	60.84[a]	1.622	0.0005
Haugh unit (HU)	86.20[b]	87.84[b]	89.45[b]	96.09[a]	97.30[a]	1.337	0.0003
Yolk color score	6.67	5.87	6.62	5.74	5.40	0.437	NS

Note: Different superscripts in the same row were significantly different (P<0,05);
SEM = pooled standard error; NS = non significant; CPM = crab by-product meal

Feed Consumption. Inclusion of 2 – 8% CPM in diets of laying quail did not significantly (P>0.05) affect feed consumption. Daily feed consumption of laying quail in this study was 23-26 g/bird/d. Many factors may affect feed consumption (North and Bell, 1992) such as types of feed and quality, production period, body weight of the bird and environmental temperature. Non significant differences observed in this study might be due to similar age and production period of the birds, relatively similar feed composition, and similar environmental temperature. Feed consumption recorded in this study were much higher (15-16 g vs 23-26 g) than those reported by Amo *et al.* (2013). Indonesian feeding standard (SNI) for laying quail recommends the diet to contain 20% protein, while the protein content of dietary treatments were only 14 – 15%. The birds ate more feed to meet their protein requirement to maintain high level of egg production.

Egg Production. The hen house production of laying quail for all treatments were between 72 and 87% and statistical analyzes showed that quail received diet containing 8% CPM produced 14% less egg (P<0.05) than control, but egg production of quail given diets containing 2 %, 4% and 6% were not different (P> 0,05) from control. This indicates that CPM can be incorporated up to 6% in quail layer diet. Lower egg production and higher feed conversion ratio of quail received diet containing 8% CPM might because of too high level of dietary Ca, leading to reduction of digestibility of nutrients and availability of other minerals, especially mineral P (Wilkinson *et al*, 2014).

Egg weight and Quality. Normally, weights of quail eggs are around 8-10 g (Yuwanta, 2010). Egg weight in our study was slightly higher (Table 2). Statistical analyses showed that weight of egg produced by quail received diet containing 8% CPM was significantly lower ($P<0.01$) than control. However, yolk color was in a range of 5.4-6.7 and did not affected ($P>0.05$) by levels of CPM in quail diets.

Haugh Unit (HU) is an indicator of albumen condition which is useful for determining egg quality. The higher height of condensed albumen, the higher the HU values, and the better the quality of the egg (Stadelman dan Cotterill, 1995). The average values of HU for egg produced by quail given diet containing 8%, 6%, 4%, 2% and 0% CMP were 97.3, 96.09, 89.45, 87.84 and 86.20 respectively. These results indicate that the higher the levels of CPM in quail diet the better the internal quality of the egg. According to Nort and Bell (1990) all fresh eggs observed in this study were belong to grade AA (very good quality) with HU values >72.

Egg cholesterol. The concentrations of cholesterol in yolk of quail egg observed in this study were between 49.71 – 60.84 mg/dL. There was no significant difference in level of cholesterol in egg produced by control group and groups given diet with 2%, 4% and 6% CPM. However, level of cholesterol in yolk from quail given diet with 8% CPM was significantly ($P<0.01$) higher than other treatments. This was in contrast to hypothesis that feeding higher level of CPM would result in lower cholesterol. The reason was not clear yet. The concentration of chitin in CPM might not high enough to reduce lipid digestibility. Shahidi *et al.,* (1999) failed to reduce plasma cholesterol concentration after feeding diet containing 2% chitin to rabbit, laying chicken, and broiler. Gallaher *et al.* (2000) showed that feeding dietary fiber such as chitosan to rat increased excretion of bile acid and reduce cholesterol absorption, and at certain level will increase again. Therefore, further study is still needed since results of feeding dietary fiber in order to reduce level of cholesterol in poultry are still inconsistent.

CONCLUSIONS

Feeding laying quail (*Coturnix coturnix japonica*) a diet containing up to 6% crab (*Portunus pelagicus*) by-product meal maintain high (80-87%) egg production with egg weight of 10.2-10.6g, and did not affect yolk color and concentration of egg cholesterol. However, egg weight and production reduced ($P<0.05$) for the bird given diet containing 8% CPM. The results indicate that 6% CPM can be included in laying quail diet.

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