THE EFFECT OF CALCIUM AND PHOSPHORUS DIETARY LEVEL ON EGG PRODUCTION OF THE BANTUL LOCAL DUCK

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ABSTRAK

Penelitian ini dilakukan untuk mengetahui pengaruh beberapa level kalsium dan fosfor pakan terhadap performa produksi itik Bantul. Sebanyak 270 itik betina umur 26 minggu digunakan dalam penelitian ini menggunakan rancangan pola faktorial 3x3, yaitu 3 level Ca: 3,75, 3,25 dan 2,75% dengan 3 level P: 0,45, 0,35, dan 0,25%. Masing-masing perlakuan menggunakan 3 replikasi kandang, setiap kandang berisi 10 ekor itik. Penelitian dilaksanakan selama 12 minggu produksi. Data yang dicatat meliputi: (a) konsumsi pakan (g/ekor/hari), (b) produksi telur (% HDA), dan (c) konversi pakan. Semua data yang diperoleh selama penelitian dianalisis menggunakan analisis ragam pola faktorial dengan program komputer SPSS. Semua variabel yang diteliti menunjukkan hasil yang tidak berbeda nyata secara. Peningkatan level Ca pakan menunjukkan tren peningkatan produksi telur. Rerata konsumsi pakan bervariasi 151-159 g/ekor/hari; produksi telur 75-84%, dan konversi pakan 184-212 g/butir.

Kata kunci: level kalsium dan fosfor, itik lokal, produksi telur

ABSTRACT

This study was conducted to determine the effect of various calcium and phosphorus levels on the production performance of Bantul Duck. A total of 270 female ducks, 26 weeks age, were used in the study with a 3x3 factorial treatment, which is a combination of three levels of Ca: 3.75; 3.25 and 2.75% and three levels of P: 0.45, 0.35 and 0.25%. Each treatment occupied three replication cages, each of which consisted of 10 ducks. The experiment was conducted for 12 weeks.. Data recorded were: (a) feed intake (g/duck/day), (b) egg production (% HDA), and (c) feed conversion. All quantitative data obtained during the study were analyzed by analysis of variance (ANOVA) using SPSS computer program. The results of the variables recorded did not show significantly difference. Increasing Ca level on feed showed an increasing trend of egg production. The average feed consumption ranged at 151-159 g/duck/day; egg production was 75-84%, and the feed conversion was 184-212 g/egg.

Keywords: calcium and phosphorus levels, local duck, egg production

INTRODUCTION

In Indonesia there are several kinds of local duck, one of them is Bantul duck in Bantul, Yogyakarta Province. Bantul duck is known for its high egg production and many of them are developed as layer duck by the farmer. These ducks use scavenging system on paddy field after harvest and along the river. The herdsman bring the duck from one place to another, where there are sufficient feeds, such as spilled rice, small snail, worm, little fish, etc. In line with the growing needs of eggs, and the limited grazing area, breeding ducks have been much evolved into intensive systems. In intensive rearing system, all nutrients should be obtained from food because ducks do not have a chance to get from nature.

One important nutrient for eggs production after protein and energy is mineral. Mineral plays a very important role in poultry layer production because 97% of the egg shell consists of minerals component. The large type of mineral is calcium,

whose compounds as calcite $CaC0_3$, about 95% of the total weight of eggshell (Nys and Gautron, 2007). The presence of Ca is known to have close links with the mineral phosphorus. Thus, the discussion of Ca is always associated with the phosphorus in formula Ca: P ratios (Lukic *et al.*, 2009).

There was a general trend that metabolizable calcium decreased with the increases in calcium levels in the diet. Chen and Sen (1989) reported that diet containing calcium levels of 2, 3 and 4% for Tsaiya duck, resulted in metabolizable calcium 62.84, 57.06, and 45.63%, respectively. Levels of Ca, vitamin D and P must be adequate and Ca dietary inclusion rates in particular should be increased to an appropriate levels in layer-diet before sexual maturity (about 14 weeks of age). Most dietary interventions are ineffective if hens are already in lay, since effects will only be on non-structural woven medullary bone (Fleming, 2008). For brown laying hens of 47 weeks of age, the feed intake of 115 g per hen per day with a dietary Ca content of 3.5% is sufficient to complete 0.27% Available Phosphorus (AP) in wheat-based diet and 0.30% AP in maize-based diet without added phytase (Skřivan, 2010).

Especially for ducks, Scott and Dean (1991) in their book, Nutrition and Management of Ducks, did not discuss much mineral for layer duck. The study was more about the meat of the duck. There are several examples of mineral requirement for ducks, which are Pekin breeder 2.85% Ca and 0.35% P (available); Khaki Chambell 3.5% Ca and 0.42% P, as well as for the Wild Duck 3.5% Ca and 0.4% P. The requirement set by the NRC (1994) for the Pekin duck breeder is Ca 2.75% and P 0.35%. Chen *et al.* (1980) cited Scott and Dean (1991), who conducted research on Tsaisya laying ducks, obtained that on 2.75% Ca, P level for maximum eggshell strength was 0.46% and for maximum egg production and feed conversion was 0.56%. In the further study the requirement Ca for Tsaisya was 3.0% and Khaki Cambell was 3.25%. Meanwhile, the SNI (2006) mineral requirements for laying ducks were 3.0 - 4.0% Ca and 0.6 - 1.0% for total phosphorus with a minimum of 0.35% available phosphorus.

The standard mineral requirement for duck is very importan for production and reproduction, However, up to now there is no clear standard mineral requirements for the local ducks in Indonesia, including Bantul duck. The standard used by farmers for laying ducks generally still follows the mineral requirement for chicken, or refers to overseas standard. Obviously, the standard is not appropriate for the Indonesian local ducks because of the different nature, characteristics, and climate where they grow ducks. Therefore, the study was conducted to determine the effect of the Ca and P on egg production of Bantul duck.

MATERIALS AND METHODS

Materials

The main material of this study was 270 Bantul ducks and feed treatment consisting of soybean meal, corn, rice bran, fish meal, limestone, dicalcium phosphate, and vitamin-mineral premix (Table 1).

Methods

The experiment was conducted by using a completely randomized factorial design, 3x3, which was 3 Ca levels: 2.75, 3.25 and 3.75% and P 3 levels: 0.25; 0.35 and 0.45%; thus, there were 9 treatments (Table 2). Feed prepared in iso protein and calories, with 17.2% CP and 2850 kcal ME / kg (Table 1). Each treatment used three replication cages, of which each (1 x 3 m^2) consisted of 10 ducks. Feed and water were given *ad libitum*. The experiment was conducted for 12 weeks.

Data collected for 12 weeks were: (a) eggs production (%), (b) the average of feed intake (g/duck/day), and (c) average feed conversion by comparing the amount of feed weight to egg weight.

Data Analysis

The experiment was conducted by using a 3×3 factorial design. The main effects were concentration of calcium (Ca), concentration of phosphorus (P) in the diets and the interaction among these two factors (Ca × P). The data were analyzed by the analysis of variance (ANOVA) using the SPSS software. All the differences were considered non-significant at 5%.

RESULTS AND DISCUSSION

The data for egg performance, feed intake (FI) and feed conversion ratio (FCR) are presented in Table 3. In the present study, all data were not statistically significant between treatments.

Table 1. Ingredients and Calculated Nutrient Composition of Experimental Diets

Ingredients	Treatments*								
	A	B	C	D	E	F	G	H	I
Corn	62.27	62.27	62.27	62.27	62.27	62.27	62.27	62.27	62.27
Soybean Meal	18.79	18.79	18.79	18.79	18.79	18.79	18.79	18.79	18.79
Rice Polishing	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57
Fish Meal	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73	2.73
MBM	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83
Crude Palm Oil	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
L-Lysine HCl	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
DL-Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Kalmiral (Mineral mix)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Kalvimix (Vitamin mix)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Salt	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Limestone	7.83	8.16	8.50	6.51	6.85	7.18	5.20	5.51	5.87
DCP	1.12	0.56	0.01	1.12	0.56	0.01	1.12	0.56	0.01
Filler	0.13	0.35	0.56	1.44	1.66	1.88	2.76	3.00	3.20
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Nutrient									
CP (%)	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2
ME (kcal/kg)	2850	2850	2850	2850	2850	2850	2850	2850	2850
Ca (%)	3.75	3.75	3.75	3.25	3.25	3.25	2.75	2.75	2.75
P Avialable (%)	0.45	0.35	0.25	0.45	0.35	0.25	0.45	0.35	0.25
Fiber (%)	2.48	2.48	2.48	2.48	2.48	2.48	2.48	2.48	2.48
Fat (%)	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Linoleic Acid (%)	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Lysine (%)	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Methionine (%)	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Methionine+Cystine (%)	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Tryptophan (%)	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Arginine (%)	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Isoleucine (%)	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Valine (%)	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Ca:P Ratio	8.3	10.7	15	7.2	9.3	13	6	7.9	11

*: A (Ca 3.75%, P0.45%); B (Ca 3,25%, P 0.45%); C (Ca 2.75%, P0,45%); D (Ca2.75%, P0.35%); E (Ca 3.25%, P 0.35%); F (Ca 2.75%, P.0.35%); G (Ca 3.75%, P0.25%); H (Ca 3.25%, P 0.25%) and I (Ca 2.75%, P 0.25%).

Feed Consumption

The average of feed consumption for the nine treatments ranged from 150.7 to 158.6 g/duck/day (Table 3). Feed intake of the study was smaller than the one managed by the farmers in general, which is about 160 to 200 g/duck/day (Sasongko, 2010). Chen and Shen (1987) who conducted research on Tsaiya, Taiwan local ducks,

Table 2. Factorial Experiment Design

	Ca-3.75[1]	Ca-3.25[2]	Ca-2.75[3]
P-0.45[4]	A	B	C
P-0.35[5]	D	E	F
P-0.25[6]	G	H	I

A-I : Feed treatments, [1]Ca = 3.75%, [2]Ca = 3.25%, [3]Ca = 2.75%, [4]P = 0.45%, [5]P = 0.35%, [6]P = 0.25%,

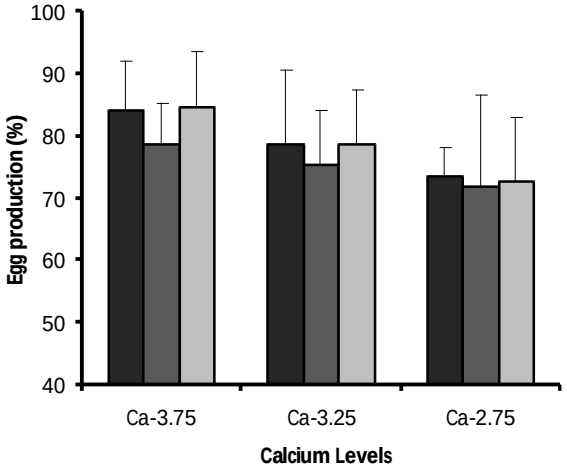

Figure 1. Eggs production of 3 phosphorus levels: 0.45% (■); 0.35% (▩), and 0.25% (□) within 3 calcium levels (3.75; 3.25, and 2.75%)

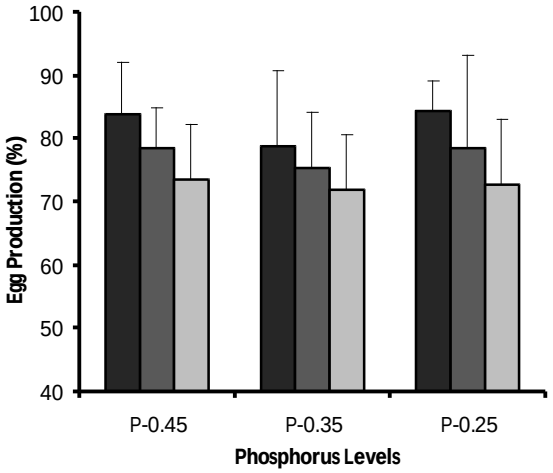

Figure 1. Eggs production of 3 calcium levels: 3.75% (■); 3.25% (▩), and 2.75% (□) within 3 phosporus levels (0.45; 0.35, and 0.25%)

with the body size was almost the similar to the Bantul duck, showed the results of feed intake ranged from 205 to 225 g/duck /day with feed on mash form. Feed used in this study was generally pellet, while farmers usually give mash.

Egg Production

The level of Ca and P treatments showed no different on egg production. The average of egg production for 12 weeks (3 months), ranged from 71.8 to 84.4% (Table 3.). Egg production for this study was relatively higher than the production from the farmers, which was about 65% (Sasongko, 2010).

As shown in Figure 1, the average of egg production indicated an increasing trend with increasing Ca content in the feed. Similar to Figure 2, at all levels of P, egg production showed an increasing trend of increasing Ca. In all treatment groups, P levels from 0.25 to 0.45 % levels showed a consistent picture of the same production of Ca. These results were in accordance with the findings of many researchers. Ducks dietary at 3.75% Ca showed the highest values of egg production during the whole experimental periods compared to 3,25 and 2,75% Ca (Figure 2). Chen and Shen (1989), showed that feed with Ca 1 to 5% with the same level of P 0.4% in Tsaiya ducks, showed decreased egg production by Ca 2% level, while the Ca between 3 to 5% levels did not show significant difference in egg production. Kesavarz (1990) using 2 and 3.5% Ca levels for the laying hens producing significantly different egg production, which were 76.2 and 79.2% respectively. Roland *et al.* (1996) reported that increasing dietary Ca level linearly increased egg production. Chamber *et al*. (1996) reported that increased Ca on feed increased egg production.The other research, Solarte-Narvaez *et al*. (2006), stated Ca on white laying hens with 2.6, 3.0 and 3.4% levels, resulting in egg production respectively 77.6, 81, and 83.1% . A similar study conducted by Sultana *et al.* (2007) stated that the quail given Ca 3% produced higher egg than 2.75 and 2.5%.. Also Navaez-Solarte *et al.* (2008) reported that increasing dietary Ca had a quadratic effect on egg production and egg mass. As dietary Ca level increased from 2.6 to 3.8%, egg production also increased from 77.6 to 83.1%, resulting in a 5.6% increase. However, further increase of dietary Ca from 3.4 to 4.2%, had no improvement of egg production.

Table 3. Feed Intake, Egg Production and Feed Conversion during 12 Weeks Experiment.

Parameters	Treatments								
	A	B	C	D	E	F	G	H	I
Feed Intake (g/duck/day)	152.8	151.7	155.2	154.1	150.7	158.6	151.9	151.6	154.3
Egg Production (%)	83.9	78.5	73.3	78.7	75.4	76.6	84.4	78.6	72.6
Feed Conversion (g feed/g egg)	2.7	3.1	3.1	2.9	3.0	3.1	3.1	3.4	3.2
Feed Conversion (g feed/egg)	182.8	199.4	207.0	193.9	201.5	219.0	184.7	203.3	214.1

Treatments explanation are similar to Table 1.

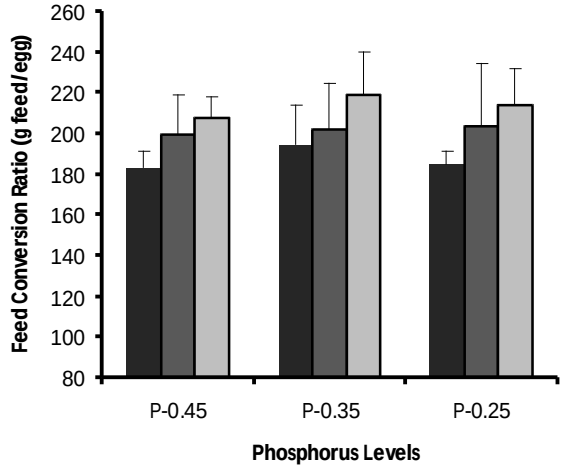

Figure 3. Feed Conversion Ratio (g/ g egg) of 3 calcium levels: 3.75% (■); 3,25% (■), and 2.75% (□) within 3 phosporus levels (0.45; 0.35, and 0.25%)

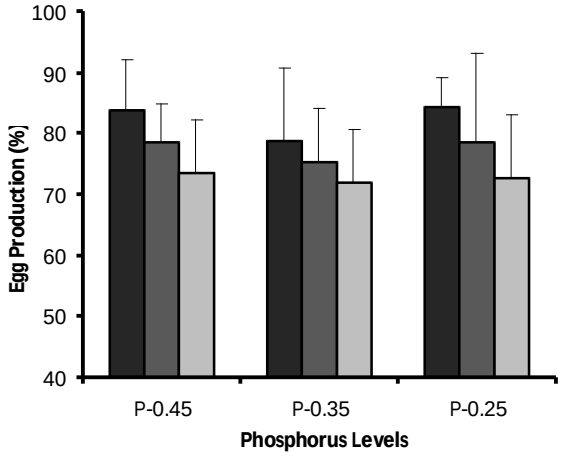

Figure 4. Fed Conversion Ratio (g/egg) of 3 calcium levels: 3.75% (■); 3.25% (■), and 2.75% (□) within 3 phosporus levels (0.45; 0.35, and 0.25%)

Feed Conversion Ratio

The results of the calculation of feed conversion ratio (FCR) (g feed / g egg) are shown in Table 3. Based on the statistical analysis, the level of Ca and P treatments showed no significant difference in results (P> 0.05) on FRC. The results of feed conversion ranged from 2.73 (Ca 3.75%, P 0.45%) to 3.22 (2.75% Ca, 0.35% P) (Table 3). According the graph in Figure 3, it is clear that decreasing levels of Ca tend to increase feed conversion ratio. Based on the results presented in Figure 3, it can be seen that the decrease in Ca levels at all levels of P, increasing the feed conversion.

Based on the calculation of feed conversion for the production of each egg, it was found out that the average yield was 182.2 g (Ca 3.75, P 0.45%) to 212.4 g (Ca 2.75, P 0.25%), as shown in Table 3, apparently, the conversion of feed in grams per gram egg produced similar results of feed conversion per egg produced. A decrease in the calcium content of feed tends to increase the amount of feed used to produce each egg. At each level of P, the pattern of feed conversion results showed similarities, i.e. at P 0.45; 0.35, and 0.25 decrease in Ca content increases the amount of feed (Figure 4), while the phosphorus levels did not show a different pattern.

CONCLUSION

Calcium and phosphorus with the levels of 3.75 to 2.75% and 0.45 to 0.25%, respectively,

did not show statistically significant difference on production performance. Increasing Ca level on feed showed an increasing trend of egg production. The average feed consumption ranged from 151-159 g/duck/day; egg production was 75-84%, and the feed conversion was 184-212 g/egg.

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