RELATIONSHIP BETWEEN PROLACTIN HORMONE LEVEL, MOLTING AND DUCK EGG PRODUCTION

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ABSTRAK

Penelitian ini bertujuan mengetahui mekanisme rontok bulu dan hubungan kadar hormon prolaktin dengan produksi telur. Materinya adalah itik hasil persilangan Alabio dengan Peking yaitu AP (Alabio ♂ x Peking ♀) dan PA (Peking ♂ x Alabio ♀) sebanyak 180 ekor. Peubah yang diamati adalah lama berhenti bertelur sebelum dan setelah rontok, kadar hormon prolaktin periode rontok bulu, periode produksi sebelum dan setelah rontok. Data dianalisis dengan ANOVA, regresi dan korelasi. Hasil penelitian menunjukkan bahwa itik AP (23.33%) mengalami rontok bulu lebih sedikit dibandingkan itik PA (50.00%). Mekanisme rontok bulu diawali dengan berhenti bertelur, rontok bulu dan bertelur kembali. Lamanya berhenti bertelur sebelum dan setelah rontok pada itik AP tidak berbeda dengan itik PA. Konsentrasi hormon prolaktin itik AP dan PA sebelum dan setelah rontok sangat nyata lebih tinggi dibandingkan periode rontok bulu. Pada periode bertelur sebelum rontok, konsentrasi hormon prolaktin itik AP sangat nyata lebih tinggi daripada itik PA. Sehingga produksi telur itik AP sebelum rontok bulu (0-16 minggu) sangat nyata lebih tinggi daripada itik PA. Produksi telur itik AP lebih tinggi daripada itik PA yaitu 256.66±6.00 vs 232.22±6.64 butir selama 48 minggu. Sehingga dapat disimpulkan bahwa hormon prolaktin berpengaruh dalam kejadian rontok bulu dan produksi telur.

Kata kunci : rontok bulu, itik, hormon prolaktin, produksi telur

ABSTRACT

The aims of this study were to obtain information on the mechanism of molting and the prolactin hormone levels affecting egg production. The study utilized AP (crossbred of Alabio ♂ with Peking ♀) and PA (crossbred of Peking ♂ and Alabio ♀ ducks) with a total of 180 birds. The observed variables were the duration of cessation of egg production before and after molting, the prolactin hormone level in the period of molting, the egg production period before and after molting. The data was analyzed using ANOVA, regression and correlation. The results showed that AP crossbred had fewer molting (23.33%) compared to PA (50.00%). The mechanism of molting is always preceded by cessation of egg production, molting and relaying. The prolactin hormone concentrations of AP and PA in the period before and after molting were significantly higher than in the period of molting. At the egg production period before molting, the prolactin hormone concentration of AP ducks was higher than the PA ducks. So that the egg production of AP before molting (0-16 weeks) was higher than the PA. The egg production of AP was higher than PA, 256.66±6.00 vs 232.22±6.64 eggs for 48 weeks. So it can be concluded that the prolactin hormone affects the molting and egg production.

Keywords : molting, duck, prolactin hormone, egg production

INTRODUCTION

Local ducks have a high potential for egg production, but it has not been expressed optimally because of the nature of molting that appears on the production period. The molting is the loss of old feathers driven by the growth of new feathers (Spearman, 1971). The goal of molting is to rejuvenate of the reproductive tract, so that the molting is sometimes called as the break to produce eggs (Berry, 2003). The phenomenon of molting occurs in all adult female birds including Alabio ducks as one of Indonesia local ducks. Wild birds take their own rest to rejuvination of reproduction tract in certain seasons, especially when the lack of feed occured, so events molting only once a year (Bell, 2002). At the local ducks, many things trigger molting properties. Setioko (2005) reveals the factors that cause molting including the lack of availability of feed, changes in the composition of the ration on the ducks that are caged, displacement of cage, a nuisance animal, and an uncomfortable environment can cause molting. a number of trigger factor resulted in the emergence of molting can occur spontaneously at any time, together or sporadic. This indicates that the appearance of molting is caused by stress and its incidence depends on each individual's resistance to such stress (Webster, 2000; Duncan, 2001). Based on this phenomenon, it is possible to select ducks based on the molting as one of the selection criterion.

Currently the selection program is done using the gene marker controlling a trait, so selection response are more accurate, faster and more efficient. The search for the gene markers molting can be done by the approach using gene of broodiness in chickens as the main factors that initiate the occurrence of natural molting and this is controlled by the prolactin hormone (Berry, 2003). So that the gene controlling the nature of molting is the prolactin gene, because the hormone prolactin is encoded by prolactin gene (Bhattacharya *et al.*, 2011; Alipanah *et al*., 2011; Cui *et al*., 2006).

The prolactin hormone is a hormone produced by the pituitary gonadotropins to stimulate the gland anterior reproductive tract in order to produce the sex hormones estrogen, progesterone and androgen. Hazelwood (1983) suggested that the prolactin hormone is involved in the formation of the egg, especially the egg shell-making process in shell gland. The gonadotropin hormones effect is negative feedback mechanism (Djojosoebagjo, 1996). So that when levels of the hormone prolactin in the bloodstream reach a state that has been in excess of that required, then the production continuously will disrupt the balance. Hence, the high concentration of the prolactin hormone will inhibit the pituitary to reduce production of the hormone gonadotropin FSH and LH (Tabibzadeh *et al.*, 1995), so no eggs is produced. Furthermore the prolactin hormone will stimulate the new feather growth (Steven, 1996). However, the mechanism of molting associated with the cessation of egg-laying and the prolactin concentrations during the egg production and molting have not been clear yet. Therefore, the purposes of this study were to obtain information on the mechanism of molting and the relationship between the prolactin hormone level and egg production before and after molting. The result of this study can be used as basic information of the relationship between prolactin hormone with molting and egg production to support the identification of prolactin gene as the gene controlling the nature of molting and egg production.

MATERIALS AND METHODS

Time and Place

Observations on the nature of molting and egg production were started since the ducks entering the laying period in January 2011 to January 2012. Research activities were carried out at the Indonesia Research Institute for Animal Production Ciawi Bogor and in the laboratory of Obstetrics and Reproduction, Faculty of Veterinary Medicine, University of Airlangga.

Birds, Feed, and Cage

This study utilized the AP and PA ducks of the progeny of Alabio (A) and the Peking ducks (P) crossed. AP is crossbred of Alabio male and Peking females, while the PA is crossbred of Peking male and Alabio female ducks. The reciprocal crossing between Peking and Alabio ducks was performed in order to study the incidence of molting associated with the egg production genetically from Alabio as egg producer and Peking known broiler duck.

This study utilized 180, 17-18 weeks old ducks i.e. 90 females of AP and 90 females of PA ducks. The ducks are reared using the basic standard that exist in the Indonesia Research Institute for Animal Production. Same type of feed was given to all types of the ducks with the amount of the 250-300 g/bird. The drinking water is given *ad libitum*. The ducks were placed in individual cage and given a wing band to facilitate the recording.

Measuring of Prolactin Hormone

Measurement of prolactin hormone refers to Yanhendri (2007) method. 5 mL of blood samples were taken from blood vessels in the duck wing vein using a syringe. The whole blood was stored in sterile tubes for 7-8 hours at 30°C. After separating blood serum from plasma, the serum was transferred to new smaller tube, centrifuged for 5 minutes at 2500 rpm to clear the serum from the clot of blood cells. The serum samples were stored at -20°C to measure the level of prolactin hormone. The releasing of prolactin hormone on duck was done in the evening i.e in the absence of light, including sunlight. So that blood sampling adapted to the natural physiological conditions of the ducks and conducted at around 20:00 pm. Measurement of prolactin level was done using an enzyme immunoassay (ELISA) technique utilizing kit solid-phase or Luteotropic Avian Prolactin hormone (PRL/LTH) ELISA manufactured by Biotech Cusabio China. The sampling of duck blood collection was carried out in three periods, i.e periods of molting, egg production before and after the molting. The period before molting was 7-9 weeks after the first of egg production and the the period after molting was 4-5 weeks after laying eggs again. While the period of molting was 2-3 days after the wing feathers was fallen.

The observed variables were the duration since stopped laying eggs before and after the molting, levels of the prolactin hormone in the period of molting, egg production periods before and after the molting. Egg production expressed as percent of the number of eggs produced for 48 weeks divided by the number of days for 48 weeks multiplied by 100%.

Data Analysis

The first analysis was performed to compare the concentrations of the hormone prolactin in molting condition, egg production before and after molting. The Analysis were done by ANOVA using the following model : $y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$

Where :

y_{ij} = concentration of the hormone prolactin, μ= the means, α_i = the effect of duck period (molting, egg production period before and after molting), ε_{ij} =error

The next analysis was to perform the scatter plot between concentrations of the prolactin hormone in the molting period and egg production for 48 weeks. The data were then analyzed with correlation and regression analysis to determine the relationship between these variables (Matjik and Sumertajaya, 2000). Correlation coefficient value will determine the relationship between two variables, while the regression coefficient will determine the level of change in egg production, if there is a change in the concentration of the hormone prolactin. The regression equation using the statistical model (Noor, 2010): $y = a + bx$

Where:

a = intercept, b = regression coefficient for molting and the egg production, x = the length of molting (days), y = egg production (%).

The F test with SAS software 9.0 (SAS, 2002) were performed to study for variables influences, whereas to study the influence of independent variables tested partially calculated by t-student (Mattjik and Sumertajaya, 2000). Furthermore, the regression equation was determined, the value of the coefficient of determination (R^2) and the Error Mean Square (EMS). The greater coefficient of determination and the smaller value of EMS indicate the better model.

RESULTS AND DISCUSSION

Pattern of Molting

The results show the AP ducks had less molting than PA ducks (21 vs 45 birds or 23.33 vs 50.00%). The incidence of molting is always preceded by cessation of egg production, followed by molting in a condition to stop laying eggs for several days, and then laying again (Figure 1). Sequence events of molting and laying eggs again as follows :

The observation duration of stops laying eggs before and after molting, and onset of molting are presented in Table 1. The beginning of molting on AP and PA ducks did not significantly different, i.e 135.10 ± 17.21 and 129.18 ± 11.67 days, respectively, counted from the first of egg produced. The results indicate that the starting time of the occurrence of molting was relatively delayed (week 17 and 18, respectively on the duck PA and AP). Ellis (2004) stated that generally the molting was occurred at week 6 after the first production.

The duration of stops laying eggs before and after the molting of AP and PA ducks did not different significantly (12.80 ± 1.50 vs 14.56 ± 1.23 days) before molting and 36.70 ± 4.64 vs 54.00 ± 7.44 days after the molting. The total time of stop laying egg was 48.57±5.01 vs 69.00± 8.11 days respectively in AP and PA ducks. These observations indicate that the duration stops

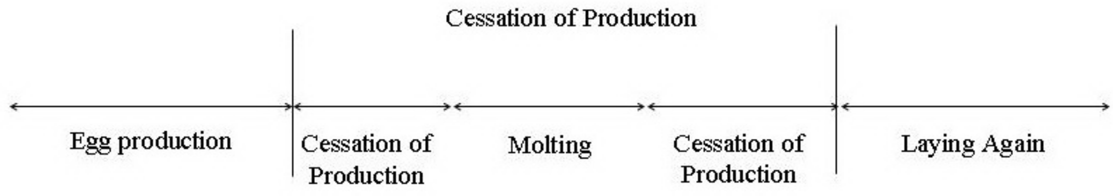

Figure 1. The Pattern of Molting AP and PA Ducks

Table 1. Onset of The Molting Occurrence, Duration of Stops Laying Before and After The Molting of AP and PA Ducks

Variable	AP Duck	PA Duck
The onset of molting (days)	135.10±17.21	129.18±11.67
The duration of stop egg production :		
Before molting (days)	12.80± 1.50	14.56± 1.23
After molting (days)	36.70± 4.64	54.00± 7.44
Total of duration of stop egg production (days)	48.57± 5.01	69.00± 8.11

AP: Progeny of AP (Alabio ♂ x Peking ♀), PA (Peking ♂ x Alabio ♀)

laying eggs is relatively short, because Purba *et al.* (2005) obtained a longer time to stop laying 90.70 and 90.90 days on Mojosari and Alabio ducks. Based on the above observations it appears that the incidence of molting is always preceded by stop laying. This may be result of the regress of reproductive tract organs (Berry, 2003; Park *et al.*, 2004).

Concentration of Prolactin Hormone

The process of stop laying associated with molting caused by physiological changes involving reproductive hormones (Bell, 2003). One of these hormones is prolactin, which plays a role in the process of egg formation and feather growth (Steven 1996). Measurements of the hormone prolactin in duck populations who are experiencing molting period, the period before and after molting are listed in Table 2.

The prolactin hormone concentration in the condition of molting is lower than the level in the conditions of the period of egg-laying ducks, both in AP and PA. The prolactin hormone PA in condition of molting was 79.18±4.98 ng/mL which was lower than the condition before and after molting those were 166.50±8.85 and 170.00 ± 22.00 ng/mL. Similarly, in AP ducks, the concentration of the prolactin hormone in the period of molting was lower than that in the condition before and after the molting i.e 75.38±11.84, 174.20±31.31 and 196.50 ±17.56 ng/mL, respectively. Similar results occurred in the female turkey prolactin concentration in nesting period that is higher than in the molting period or do not lay of eggs (Gulde *et al.*, 2010). This may be related to the role of the prolactin hormone, which is needed in the production of eggs, so its concentration is high (Hazelwood, 1983). While in the molting condition, duck does not produce. However, the feather growth is occurred, this resulted in low prolactin hormone.

The concentrations of the prolactin hormone differences between PA and AP ducks in the production period before the molting was significantly different i.e 166.50±8.85 vs 196.50±17.56 ng/mL respectively. While the level in the molting and the laying period after molting was not significantly different. Concentration of the prolactin hormone in the period of molting PA and AP ducks was 79.18±4.98 and 75.38±11.84 ng/mL respectively, while in the egg-laying period after molting the level in the PA and AP ducks

Table 2. Concentrations of the Prolactin Hormone on Laying Period, Molting and Spawn Again on the Crossbred PA and AP Ducks

Duck Condition	Concentration of Prolactin Hormone (ng/mL)	
	AP Duck	PA Duck
Laying period	196.50±17.56^{aA}	166.50± 8.85^{aB}
Molting period	75.38±11.84^{bA}	79.18± 4.98^{bA}
Spawn again period	174.20±31.31^{aA}	170.00±22.00^{aA}

The different superscript of small letters (a, b) on the same column indicate significant different (P<0.01); the different superscript of capital letters (A, B) on the same row indicate significant different (P<0.01)

Table 3. The Egg Production of AP and PA Duck during 48 Weeks

Production Periode (weeks)	AP Duck (eggs)	PA Duck (eggs)
0-4	25.53 ±0.36^{a}	23.76±0.54^{b}
4-8	24.55±0.57	23.36±0.63
8-12	23.86±0.69^{a}	20.64±0.88^{b}
12-16	24.19±0.61^{a}	20.54±0.85^{b}
16-20	22.16±0.82	21.47±0.76
20-24	22.12±0.69	20.23±0.89
24-28	22.30±0.83^{a}	19.92±0.84^{b}
28-32	21.94±0.84	21.00±0.89
32-36	21.96±0.83	20.39±0.99
36-40	21.78±0.88	20.10±1.00
40-44	20.71±0.96	17.97±1.04
44-48	20.11±1.24	15.67±1.44^{b}
Average (0-48)	256.66±6.00^{a}	232.22±6.64^{b}

The different superscript letters (a, b) in the same row indicate significant different (P <0.01)

were 170.00±22.00 and 174.20±31.31 ng/mL, respectively.

Egg Production

The prolactin hormone affect egg production, especially during the process of shell formation (Hazelwood, 1983). The egg production AP and PA ducks are shown in Table 3.

The egg production of AP ducks before molting, at the period 0 to 16 weeks was markedly higher than the PA ducks. The result is consistent with the incidence of molting and the results of measurements of concentrations of the prolactin hormone. The onset of molting on AP and PA ducks started to occur at week 17 and 18, so it can be determined that the egg production prior to the molting in week 16. The egg production of AP ducks at the beginning of production up to 16 weeks was significantly higher than those of PA ducks. These results are consistent with the results of measurements of concentrations of the prolactin hormone before molting. The level in AP ducks (196.50±17.56 ng/mL) was significantly higher than the PA ducks (166.50 ± 8.85 ng/mL). This occurred because the duck with a higher egg production will require more prolactin hormone to the process of egg shell formation. The egg production for 16 weeks in this study is lower than the production of Tegal duck eggs (Ismoyowati *et al*., 2006).

The egg production of AP and PA ducks at the period of 16 to 48 weeks were not significantly different. These results are consistent with the results of measurements of the hormone prolactin, which was not significantly different during the period of laying eggs again after molting. The average of egg production AP ducks (256.66 ± 6.00) was markedly higher than the PA ducks (232.22 ± 6.64) during 48 weeks of egg production.

The influence of the prolactin hormone in the period of molting with egg production can be presented by Figure 2.

The egg production of AP ducks were

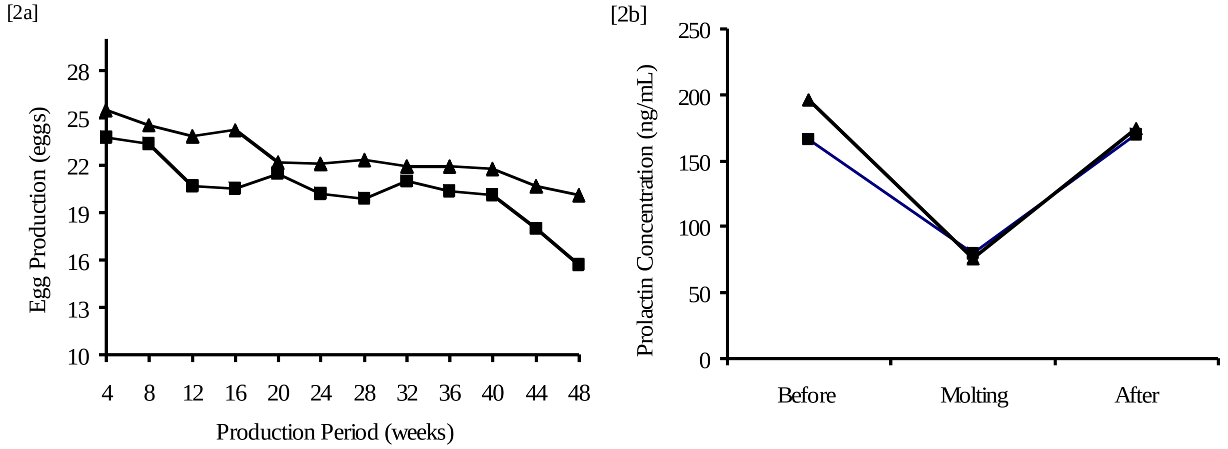

Figure 2. Trends in Egg Production (a) and Concentration of the Prolactin Hormone (b) of AP and PA Ducks during 48 Weeks of Egg Production. ▲: AP; ■: PA

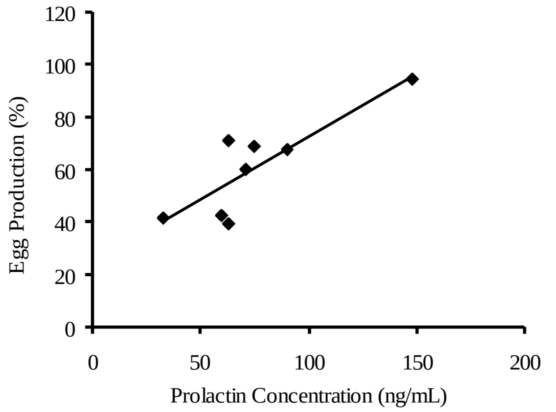

Figure 3. Plotting of Polactin Hormeone Concentration in the Molting Period with Egg Production for 48 weeks AP Duck

relatively higher than PA ducks in the early production period i.e. 0-16 weeks (Figure 2a). The early production period (0-16 weeks) is a time before molting. So, this result is similar to the level of prolactin hormone that the AP was higher than the PA ducks (Figure 2b). However, both the egg production of AP and PA ducks after molting were statistically the same. The result is match with the concentration of prolactin hormone which is the same between AP and PA ducks. This suggests both Figure 2a and 2b showing the prolactin hormone is involved in egg production, especially in the process of egg shell (Hazelwood, 1983). This support the notion that there is a strong relationship between the concentration of prolactin hormone and egg production.

The Relationship between Prolactin Hormone in Molting Period with Egg Production

The scatter plot analysis was performed to determine the relationship or correlation between the prolactin hormone level in the period of molting and the 48 weeks egg production. The results of the analysis is shown in Figure 3.

The relationship between the hormone prolactin on molting period and 48 weeks egg production is positively strong (Figure 3). This was confirmed by a correlation coefficient of 0.85. Warwick *et al*. (1995) stated that a correlation coefficient close to 1, it can be presumed that the relationship is linear.

The regression equation: Y = 24.45 + 0.48 X with the coefficient of determination (R^2) was 0.72 which means that only 72% of these equations can describe the diversity of variable concentrations of theprolactin hormone with egg production. This is understandable because the prolactin hormone, which will be negative if the concentration has reached a certain concentration. So that the sampling taken in a shorter period does not result in the shape of the linear graph. In this study the highest prolactin concentration which inhibits the formation of the egg was not able to be detected, so it is suggested to extend the period of observation in order to obtain such information.

CONCLUSIONS

The mechanisms of molting is always preceded by cessation of egg production, molting and relaying. The total of cessation of egg production associated with molting was not significantly different between AP and PA ducks. The level of the prolactin hormone on AP and PA ducks in the egg production period before and after molting was significantly higher than that in the period of molting. In the egg production period before molting, the prolactin hormone level of AP ducks was markedly higher than the PA ducks. The egg production of AP ducks was higher than PA ducks, 256,66±6.00 vs 232.22±6.64 eggs for 48 weeks. There was a high correlation between egg production and prolactin hormone level on duck.

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