

ACCELERATION OF TEGAL DUCK MOLTING PERIOD AND RE-LAYING USING CATTLE RETICULUM MEAL IN FEED

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Received December 15, 2013; Accepted February 05, 2014

ABSTRAK

Tujuan penelitian ini adalah untuk mengevaluasi pengaruh level tepung retikulum sapi sebagai sumber kolesterol yang digunakan dalam campuran pakan itik untuk mempercepat lama periode *molting* dan meningkatkan kecepatan bertelur kembali itik Tegal setelah terjadi *molting*. Penelitian ini menggunakan metode eksperimen. Materi yang digunakan adalah itik Tegal umur 68 minggu sebanyak 60 ekor induk. Perlakuan yang dicobakan adalah level tepung retikulum sapi dalam pakan (K), terdiri atas K₀ = 0% (kontrol), K₁ = 1,43% (setara 0,371g kolesterol), K₂ = 2,86% dan K₃ = 4,29%. Setiap perlakuan terdiri atas 3 ekor itik induk, yang diulang 5 kali. Peubah yang diamati adalah lama periode *molting*, kecepatan bertelur kembali, kadar kolesterol darah dan kadar hormon progesteron. Data dianalisis dengan analisis variansi berdasarkan rancangan acak lengkap, dilanjutkan dengan uji beda nyata jujur. Hasil penelitian menunjukkan bahwa level tepung retikulum sapi berpengaruh sangat nyata (P<0,01) terhadap lama periode *molting*, kecepatan bertelur kembali, kadar kolesterol darah dan kadar hormon progesteron. Sebagai kesimpulan, level tepung retikulum sapi 1,43% sudah mampu mempercepat lama periode *molting* dan level tepung retikulum sapi 2,86% sudah mampu mempercepat itik bertelur kembali.

Kata kunci : bertelur kembali, itik Tegal, periode *molting*, tepung retikulum sapi

ABSTRACT

This research was aimed to evaluate the effect of the level of cattle reticulum meal as cholesterol source in duck feed to accelerate molting period and post-molting re-laying process of Tegal duck. Experimental method was administered to sixty female Tegal duck aging 68 weeks old. Each treatment, comprised 3 layers with 5 repetitions, were cattle reticulum meal in feed (K), consisting of K₀ = 0% (control), K₁ = 1.43% (equal to 0.37 g cholesterol), K₂ = 2.86%, and K₃ = 4.29%. The observed variables were molting period, re-laying period, blood cholesterol level, and progesterone hormone level. Data were analyzed by analysis of variance based on Completely Randomized Design followed by Honestly Significant Difference Test. The result demonstrated that level of cattle reticulum meal significantly affected (P<0.01) molting period, re-laying period, blood cholesterol and progesterone level. It was concluded that 1.43% cattle reticulum meal could accelerate molting period and 2.86% cattle reticulum meal could accelerate re-laying.

Keywords : cattle reticulum meal, molting period, re-laying, Tegal duck

INTRODUCTION

Molting of traditionally reared Tegal ducks starts at 17 months old. Ducks in molting condition can cease laying eggs for 3 - 4 months (Suswoyo, 1990). Egg production can be increased by accelerating the process of molting

period. Ducks lay egg in condition of sufficient *Follicle de Graaf* in ovary when FSH and LH hormones are secreted.

The extremely low gonadotropin hormones such as FSH and LH lead to the absence of follicle growth since both hormones are required in follicle growth and development and

oviposition process (Anwar and Safitri, 2005). Progesterone produced by the ovary will contrarily give negative feedback to hypothalamus and anterior hypophysis that eventually suppress the secretion of gonadotropin produced by anterior hypophysis (Gan *et al.*, 1987).

One of the efforts on sustaining follicle growth and development is stimulating FSH and LH secretion by gonadotropin precursor hormone which can assumed from result of progesterone hormone measurement; in this case, the gonadotropin precursor hormone is cholesterol. Cholesterol is in fact much needed in various metabolic processes namely as cell wall building blocks and bile acid for fat emulsion. All these steroid hormones are synthesized from cholesterol through a common precursor steroid, pregnenolone, which is formed by the enzymatic cleavage of a 6-carbon side-chain of the 27-carbon cholesterol molecule, a reaction catalyzed by the cytochrome P450 side-chain cleavage enzyme (P450_{scc}, CYP11A1). Furthermore, cholesterol is needed to synthesize vitamin D and composing sexual hormones and corticosteroid (Tejayadi, 1991).

Cholesterol precursor is obtained from the feed and its biosynthesis occur in body organ such as intestines and liver. Feed consumption essentially contributes to cholesterol synthesis in which high consumption leads to high blood cholesterol. It was supported by Naber (1976) that almost 2/3 of cholesterol is bodily synthesized while 1/3 is obtained from treatment feed.

Cholesterol from feed can be obtained from cattle reticulum meal due to its high cholesterol level. The previous analysis demonstrated that cattle reticulum meal contained higher cholesterol (258.92 mg/g) than rumen (242.88 mg/g), omasum (254.14 mg/g) and abomasum (256.79 mg/g).

Supplementing cattle reticulum meal in feed will meet duck's cholesterol need, serving as gonadotropin hormone precursor to secrete FSH and LH, upon which the follicle will grow and develop so that molting period and relaying are accelerated.

This research was conducted to evaluate the effect of cattle reticulum meal level as the source of cholesterol used in duck feed to accelerate molting period and post-molting re-laying of Tegal duck.

MATERIALS AND METHODS

Materials used in this research were 60 Tegal ducks aging 68 weeks old (17 months), progesterone hormone kit to analyze progesterone level in blood, cattle reticulum meal, corn, rice bran, soybean meal, and "Chicken Mineral B12" to compose treatment rations or feed. Treatment feed was composed based on the calculation of feed composition table according to NRC (1999) and analysis result of Feedstuff Laboratory, Animal Science Faculty, Jenderal Soedirman University. Feed compositions and feed nutrients are presented in Table 1.

Experimental research applied completely randomized design (Steel and Torrie, 1980). Each treatment, comprised 3 female ducks with 5 repetitions, was cattle reticulum meal levels namely $K_1 = 1.43\%$ (equal to 0.37 g cholesterol), $K_2 = 2.86\%$, and $K_3 = 4.29\%$. Mathematical model used was

$$Y_{ij} = \mu + \alpha_i + \epsilon_{ij}$$

Y_{ij} = result of observed variables (molting period, re-laying rate, blood cholesterol level, progesterone level)

μ = mean of population

α_i = effect of the-*i* cattle reticulum

ϵ_{ij} = experimental error

The observed variables were molting period, and laying rate, as well as supporting data namely blood cholesterol and progesterone level from blood serum. Ducks were reared in compartment cages measuring 100 cm x 80 cm x 60 cm, each containing 3 female ducks/layers as experimental unit. Ducks were reared from 68 week old to re-laying during 3 months. Feed was measuredly administered as much as 150 g/duck/day and water was given *ad libitum*.

Blood sample was taken from vena axillaries for four weeks after molting ended. Five mL of blood was extracted using syringe, tilted $\pm 45^\circ$ for more than 1 hour until blood serum was formed on top layer, then was put into micro tube to analyze the progesterone hormone and to measure the blood cholesterol. Progesterone level was measured using *radioimmunoassay* (RIA) method in National Atom Power Institute /Badan Tenaga Atom Nasional (Batan) Jakarta. The obtained data were analyzed by Analysis of Variance according to Steel and Torrie (1980) in which significant result ($P < 0.05$) was further analyzed using Honestly Significant Difference Test.

Table 1. Treatment of Feed Compositions and Nutrient Contents

Feed (%)	K ₀	K ₁	K ₂	K ₃
Corn	29.70	31.07	32.64	34.71
Rice bran	42.00	40.50	38.80	36.50
Cattle reticulum meal	0.00	1.43	2.86	4.29
Soybean meal	21.30	20.00	18.70	17.50
Chicken Mineral B ₁₂	7.00	7.00	7.00	7.00
Total	100.00	100.00	100.00	100.00
Nutrient contents:				
EM (kcal/kg)	2765.64	2771.82	2778.56	2785.73
Protein (%)	17.31	17.32	17.31	17.32
Fat (%)	5.73	5.99	6.24	6.41
Cholesterol (g)*	0.00	0.37	0.74	1.11
Crude fiber (%)	6.93	6.88	6.81	6.68
Ca (%)	3.52	3.51	3.51	3.51
P (%)	1.05	1.05	1.05	1.05

*Cholesterol content in K₁ resulted from egg and meat cholesterol from feed (20%) given 150 g/duck/day. Feed was made of iso protein and iso energy

RESULTS AND DISCUSSION

Blood Cholesterol Level of Post-molting Duck

The average of post-molting blood cholesterol level was 159.78± 27.14 mg/dl, within the range of 111.11 mg/dl and 211.11 mg/dl. Level of cattle reticulum meal significantly affected (P<0.01) blood cholesterol (Table 2) The 0% cattle reticulum meal (K₀) produced cholesterol level relatively similar to that of K₁ and K₂, but lower (P<0.05) than that of K₃. Relationship between the level of cattle reticulum meal and blood cholesterol was highly significant (P<0.01), shown in linear equation $Y = 137.58 + 10.35 x$ (Figure 1), with coefficient of determination (R²) = 15.32 %.

Figure 1 shows cholesterol role in cattle reticulum meal in producing blood cholesterol. The higher cattle reticulum meal levels, the higher cholesterol produced. Lovita (2005) stated that the response of cholesterol in blood is related to the change of free fatty acid degree in feed, because free fatty acid will be converted into acyl co-A turning into Acetyl co-A which is the main precursor of cholesterol synthesis. Murray *et al.* (2000) also stated that the influencing factors of

blood cholesterol are on the speed of cholesterol synthesis in body and environment. Feed is one of the environmental factors that highly contributes to fat and cholesterol metabolism. Cholesterol precursor was obtained from the feed and its biosynthesis occur in body organ such as intestines and liver. Feed consumption essentially contributes to cholesterol synthesis in which high consumption leads to high blood cholesterol. It was supported by the findings of Naber (1976) that almost 2/3 of cholesterol is bodily synthesized while 1/3 is obtained from treatment feed.

Progesterone Level of Post-molting Duck

The average progesterone level was 9.85 ± 2.22 nmol/L in the range of 6.31 nmol/L to 14.05 nmol/L. Cattle reticulum meal significantly affected (P<0.01) progesterone hormone level (Table 2). The 0% of cattle reticulum meal (K₀) produced 7.56 ± 0.9 nmol/L progesterone, significantly different (P<0.05) from 2.86% cattle reticulum meal (K₂) and 4.29% (K₃), namely 10.10 ± 1.38 nmol/L and 12.75 ± 0.98 nmol/L, respectively. K₀ and K₁ (9.01nmol/L) produced relatively similar progesterone hormone (P>0.05).

Table 2. Cattle Reticulum Meal Level toward Post-molting Duck Performance

Duck Performance	Level of Cattle Reticulum Meal				Significance
	K ₀	K ₁	K ₂	K ₃	
Molting period (days)	101.80 ^a	41.80 ^b	40.60 ^b	36.60 ^b	**
Post-molting re-laying rate (days)	108.20 ^a	100.00 ^a	94.20 ^{ab}	85.40 ^b	**
Post-molting blood cholesterol level(mg/dl)	146.67 ^a	136.89 ^a	170.89 ^{ab}	184.67 ^b	**
Post-molting progesterone hormone level (nmol/L)	7.56 ^a	9.01 ^a	10.10 ^b	12.75 ^c	**

** = highly significant (P<0.01), ns = non significant (P>0.05), values bearing different superscript in the same line shows significant difference (P<0.05)

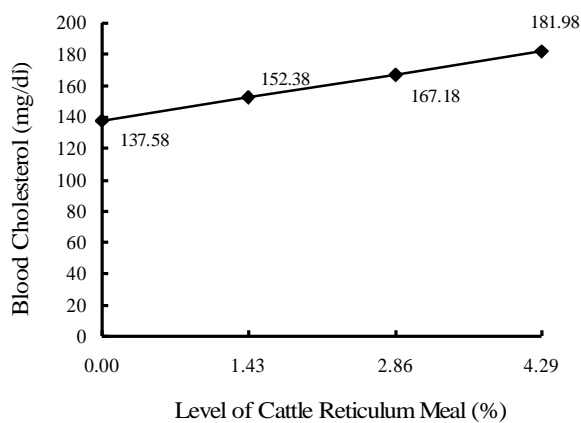


Figure 1. Relationship between the Level of Cattle Reticulum Meal and Ducks' Blood Cholesterol

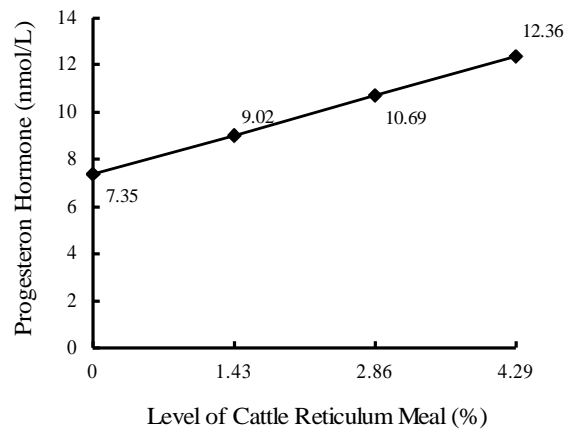


Figure 2. Relationship between the Level of Cattle Reticulum Meal and Progesterone Level

K₂ and K₃ produced significantly different progesterone hormone (P<0.05). The relationship between cattle reticulum meal level with progesterone hormone was highly significant (P<0.01) as shown in linear equation $Y = 7.35 + 1.17 x$ (Figure 2), with coefficient of determination (R²) of 54.76%.

Figure 2 shows cholesterol role in cattle reticulum meal in the building of progesterone hormone. As reported by Tejayadi (1991), besides body metabolism process, cholesterol is required in the formation of vitamin D, and in building blocks of sexual hormones and corticosteroid. Gonad produces sexual hormones and managed reproductive function. Sexual hormones in female

duck produced in ovary are estrogen and progesterone. Since luteinizing hormone (LH) and follicle stimulating hormone (FSH) are produced by two different cell populations in chickens, it is possible that different combinations of GnRHs and GnRHRs differentially mediate the synthesis and release of these gonadotropins (Gregoy, 2006).

Molting Period

The average molting period was 55 ± 28.51 days within the range of 27-107 days. Level of cattle reticulum meal significantly affected (P<0.01) molting period (Table 2). The 0% cattle reticulum meal (K₀) resulted in 101.80 ± 3.90

days of molting period, significantly different ($P < 0.05$ from that of 1.43% (K_1), 2.86% (K_2) and 4.29% (K_3) namely 41.80 ± 3.77 , 40.60 ± 10.55 and 36.60 ± 9.07 days, respectively. K_1 , K_2 and K_3 induced relatively similar molting period ($P > 0.05$). The relation between level of cattle reticulum meal with molting period was very significant ($P < 0.01$) as shown in equation $Y = 101.0 - 76.88x + 29.44x^2 - 3.51x^3$ (Figure 3), with coefficient of determination (R^2) of 88.78%.

The different molting period between K_0 and K_1 , K_2 and K_3 was due to different progesterone hormone level (Table 2). K_0 produced 7.56 nmol/L, lower than that of K_3 (12.75 nmol/L), K_2 (10.10 nmol/L) and K_1 (9.01 nmol/L). Lower progesterone hormone caused high prolactin hormone level, as reported by Anwar and Safitri (2005) that molting was affected by prolactin hormone either directly induced ovary regression in gonad or indirectly competed with progesterone produced by ovary. With high prolactin, molting took longer period. Progesterone produced in K_1 and K_2 was lower than K_3 ; therefore, molting period slightly increased.

Traditionally reared Tegal ducks had molting period of 3-4 months from 17 months old (Suswoyo, 1990). With cattle reticulum meal supplemented in the feed as the source of cholesterol, molting period can be accelerated 60 to 65.2 days. This faster molting period proved that cholesterol can be the precursor of gonadotropin hormone marked by the increased progesterone level in treatment K_1 , K_2 and K_3 . The higher cattle reticulum meal level, the higher blood cholesterol and progesterone level (Table 2). Progesterone (P_4) can determine the status of embryo and hormones of goiter, thyroxine (T_4) and triiodothyronine (T_3), essential for molting (Pethes *et al.*, 1982; Verheyen *et al.*, 1983). In the first two steps synthesis of all steroid hormones, cholesterol will be converted into progesterone. Cytochrome P450_{scc} inside mitochondria membrane emitted 6 carbons from cholesterol chain, forming pregnenolon which was converted into progesterone, catalyzed by 3 β -hydroxysteroid dehydrogenase. The other steroid hormones built from progesterone in reaction involving family member of P450.1. (Rizka, 2010).

This result was in accordance with Beyer and Jensen (1992) and Sim (1998) that chicken egg cholesterol was 195 to 230 mg/egg affected by hen genetic factor, feed and production rate. Elkin (2006) reported two factors responsible to egg cholesterol; the first is related to relative

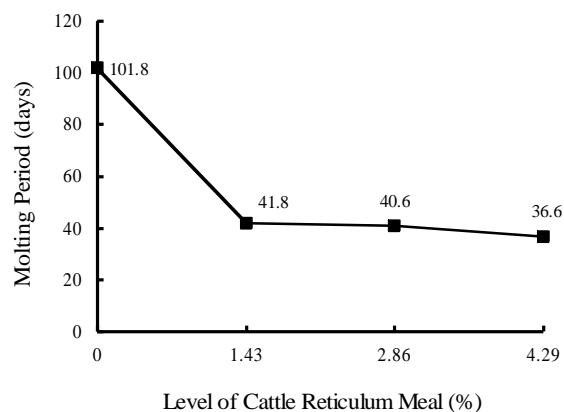


Figure 3. Relationship between the Level of Cattle Reticulum Meal and Molting Period

resistance to yolk cholesterol to manipulate genetic selection, and the second is related to the availability of supplement and pharmacology matters to reduce biosynthesis of liver cholesterol and metabolic pathways regardless safety aspect.

Re-laying Rate

The re-laying rate was 97 ± 11.19 days, within the range 71 to 114 days. Level of cattle reticulum meal significantly affected ($P < 0.01$) the re-laying rate (Table 2). The 0% cattle reticulum meal (K_0) resulted in re-laying rate of 108.20 days, relatively similar to that of 1.43% (K_1 (100 days) and 2.86% (K_2) (94.20 days), but significantly different ($P < 0.05$) from 4.29% (K_3), namely 85.40 days. Treatment of K_2 and K_3 resulted in relatively similar re-laying rate ($P > 0.05$). Relationship between level of cattle reticulum meal with the re-laying rate was highly significant ($P < 0.01$) as shown in linear equation $Y = 108.08 - 5.189x$ (Figure 4), with coefficient of determination (R^2) = 33.42%.

The re-laying rate gap between K_0 and K_3 was 22.8 days due to different blood cholesterol level (Table 2). K_0 produced 146.67 mg/dl blood cholesterol, that was lower than that of K_3 (184.67 mg/dl). Low blood cholesterol also made progesterone secretion low, because according to Sutton *et al.* (1984) progesterone was formed from cholesterol) in all steroidogenic tissues in an enzymatic reaction. Low progesterone produced by ovary would give negative feedback to hypothalamus and anterior hypophysis (Gan *et al.*, 1987). PMSG hormone injections on the final phase of laying ducks can increase egg production

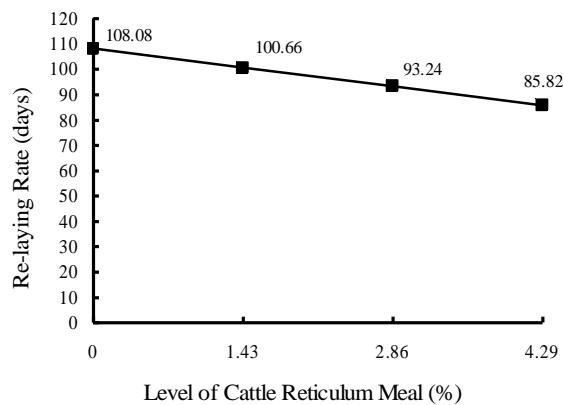


Figure 4. Relationship between the Level of Cattle Reticulum Meal and Post-molting Re-laying Rate

(quantity) PMSG dose of hormones that influence most effectively to the increasing egg production is a dose of 15 IU (Latifa dan Sarmanu, 2008). Very low gonadotropin hormones like FSH and LH in chicken will cause the absence of follicle growth because both hormones are inquired in follicle growth and development also the oviposition process (Anwar and Safitri, 2005). Prolactin levels did not appear to be influenced by T_4 but were mainly dependent on photoperiod and reproductive stage, whereas luteinizing hormone levels remained low throughout. In summary, dietary supplementation with 40 ppm (45.76 mg/kg) T_4 was successful in inducing molt in turkey breeder hens. However, dropping the photoperiod was necessary to completely reset the reproductive system (Gulde *et al.*, 2009). According to Pethes *et al.*, (1982) and Verheyen *et al.* (1983) progesterone (T_4) could mark the status of embryo; however, Dickerman and Bahr (1987) reported that supplementing GnRH to hens did not affect the ovary regression.

CONCLUSION

From the result and discussion, it was concluded that 1.43 % cattle reticulum meal could accelerate molting period and at 2.86 % level could accelerate the re-laying of duck.

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