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Analysis of Reproductive Potential and Hatchability of Naked Neck and Normal Hens

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ABSTRACT: The difference between a feather conditions, namely naked neck and normal feathered in chicken gives the qualitatively genetic differences by *Na* gene and its allele *na*. This study was conducted to analyze the relationship between the condition of the feather and of reproductive potential. Five males of Naked neck, each paired with four females of Naked neck and two females of Normal. Production of eggs from each female were collected and then incubated, to studies the reproductive potential through egg fertility and hatchability. Completely randomized designs by the variance analysis were used to determine the effects of the feather conditions, and the hierarchical analysis of variance was to determine of the genetic potential. The results showed that the feather conditions did not significantly affect the egg production. The fertility of naked neck chicken (95.72±03.88%) was significantly higher ($P<0.05$) than normal chicken (92.67±10.61%) and the hatchability of naked neck chicken (73.69±21.69%) was significantly lower ($P<0.05$) than normal chicken (83.76±04.84 %). Embryo mortality of naked neck chicken (19.85±11.04%) was significantly higher ($P<0.05$) than normal chickens (17.97±11.50%). Eggs weight and doc weight did not show a significant difference. Heritability of egg weight in chickens was low ($h^2 = 0.07$), and the repeatability ($R = 0.69$) was quite high. The heritability of doc was underestimated ($h^2 = -0.19$), although the repeatability was still high ($R = 0.59$).

Keywords: Naked Neck and Normal Native Chicken, production, reproduction, repeatability and heritability.

INTRODUCTION

Local chicken (Native Chicken) is a native Indonesian germplasm assets are very valuable. Its presence there was almost total throughout the countryside in Indonesia. Experts agree that today's modern chickens (layers and broilers) is a descendant of the red jungle fowl (*Gallus Gallus gallus* = bankiva) that originating from Southeast Asia (Scannes *et al.* 2004; North, 1984), and some experts said that since 5000 years BC domestication process had begun in Indonesia (Abelein, 1986 cit. Sidadolog, 2011). Local chickens grow and develop in according to the process of adaptation to the environment. Domestication process resulted in some changes morphologic as a result of natural selection to survive in harsh environments. The change caused of a very extensive phenotypic diversity and the ranging of the difference in weight, production and reproduction until the coat color and body as well as the shape and the structure of the body. The variation of local chickens became so widespread, for example in the form and body size, shape of comb, color, growth and spread of coat color.

One variation that is often found in the critical and hot conditions was the lake of feather growth on the neck, which was then referred to the Naked Neck Fowl. The naked neck feathered is a genetic trait controlled by autosomal genes *Na*-, as a dominant against its allele *na* (Devenport, 1914 cit. Rajkumar *et al.* 2009). Naked neck trait was inherited to the offspring with proportions

according to Mendel ratio. Allegedly the gene of naked neck was gene mutation that took place in the evolution of process that becoming immortal trait. It is a process of mutation experienced by local chicken (Schmitten, 1989 cit. Sidadolog, 1991). In tropical areas such as Indonesia, where the conditions of temperature and humidity was high and also coupled with the existence of climate change, especially the temperature variation is responsible for the decreased productivity and increased stress (Yuwanta *et al*., 1983; Yuwanta, 1999), reduced reproductive efficiency, decreased immune resistance (Rajkumar *et al.*, 2011). Patra *et al*., (2002) stated that the Naked Neck were more tolerant to heat stress than the normal feathered chicken, because the exhaust heat can take place better. Decreasing of mass of fur will increase the effective of surface area of the body for heat dissipation and simultaneously improve the heat dissipation through the area around the neck. The positive effect on the mechanisms of body thermoregulation was to improve heat dissipation through the skin (Sidadolog, 1991) and possibly also have an effect on reproductive ability and hatching results. Research was studying the genetic aspects of the role of heredity in reproducing ability and results in chickens hatching naked neck.

MATERIAL AND METHOD

This experiment were conducted with adult local native naked neck and normal feathered chickens, that all chicken used is the adult chicken with a lifespan of more than eight months, and are ready to spawn. Five males naked neck were paired with four females of naked neck and two females of normal, respectively, to produce chicks as next generations. Total hens needed were twenty naked neck and ten normal feathers hens. Each mating group was reared in five pen-floor stalls with trap-nested to make a simple identification of produced eggs and chicken. All chickens were fed by commercial feed as in followed table 1.

Table 1. Nutrition composition of feed for experiment chicken

Feed	Water (max. %)	Protein (%)	Fat (min.%)	Fiber (max.%)	Ash (max. %)	Ca. (min.%)	P. (min.%)
Parents	13.00	17.0-18.0	4.00	6.00	12.00	3.70	0.60
Chicks	13.00	19.0-21.0	3.00	5.00	7.00	0.90	0.60

Sperms of male naked neck were collected periodically four weeks to measure volume and concentration, and also from normal feathered as comparative things. Eggs production were collected as hatching eggs every day and hatched weekly to produce day old chicks and to measure fertility and hatchability of naked neck and normal feathered hens. Data with relating to production, reproduction and hatching results were analyzed by variance analysis with mathematical-statistical model:

$$Yijk = \mu + Gi + Fj + GFij + eijk$$

Where, Yijk is the observation data, μ is the average data, Gi is the effects of group mating I (=1,2,3,4 and 5), F is the effects of feather condition j (=1, 2), GF is the interaction of group mating i and feather condition j, and eijk is the individual error.
To estimate the heritability and the repeatability were used the hierarchical analysis of variance with mathematical-statistical model as:

$$Yijk = \mu + Mi + Fi{:}j + eijk$$

Where, Yijk is the observation data, μ is the average, Mi is the effect of male i, Fi:j is the effect of female j within male i, and eijk is the individual error. Based on this analysis were followed the estimation of variance components of σ^2 male (♂), σ^2 female (♀), $\sigma^2\dot{e}$ and σ^2Total.

RESULT AND DISCUSSION

The chicken paired with a ratio of one male to six females, respectively, have a body weight data can be seen in table 2. The average body weight of male was 2.319 g with deviation standard of 388.23 g. The weight of naked neck hens was 1.522 ± 235.75 g was lighter than normal hens (1.696 ± 290.14 g), but both of hens group was not different significantly.

Table 2. The average of body weight (g/bird) of males and females based chicken feather condition

Body Weight	Numbers	Naked Neck	Normal feathers	Population	Stat.
		x ± sd	x ± sd	x ± sd	
Male	5	2.319 ± 388.23	-	2.319 ± 388.23	ns
Female	30	1.522 ± 235.75	1.696 ± 290.14	1.609 ± 274.42	ns

ns = statisticaly not significant

The sperm production of naked neck cocks (table 3) was higher in volume (0.52 ml/bird) and concentration (1.95%) than in normal feathers, 0.32 ml/bird and 1.53%, respectively, but the difference was not significantly.

Table 3. Sperms quality of naked neck and normal cock

Males	Sperm Volume (ml/bird)	Sperm Concentration (%)	Stat.
Naked neck	0.52 ± 0.17	1.95 ± 0.85	ns
Normal feathers	0.32 ± 0.28	1.53 ± 0.95	

The egg production between naked neck and normal feathered did not show the significant difference in the overall population, although the variations tended to be different for each mating group. The egg production of both feather condition was high, 40.91 ± 5.38% in naked neck and 49.93 ± 11.37% in normal feathered. Naked neck hens shown more uniform homogeneous in production (13.15%) compared to normal feathered (22.77%). These results have not been consistent with the results of research conducted by El-Safty *et al.* (2006) which states that egg production of naked neck chicken was higher than normal feathered, especially in the tropical environments. While the sperm volume and concentration of naked neck was higher than normal feathered cock (table. 2), then it was seem that the egg fertility of naked neck chicken (95.72 ± 3.88%) was significantly higher ($P<0.05$) than normal feathered hens (92.67 ± 10.61%), In other site, the hatchability of normal feathered (83.76 ± 4.84%) was also significantly higher ($P<0.05$) than naked neck hens (73.69 ± 21.69). This statement was consistent with previous studies (Sidadolog, 1992; Rahayu, 2000). It was caused of the embryo mortality in naked neck hens (19.85±11.04%) was also significantly higher ($P<0.05$) than normal feathered hens (17.97±11.50%). Egg production, egg fertility and sperm volume and concentration were better at naked neck chickens showed that the gene *Na* on naked neck chicken have a positive influence on the production and reproduction in chickens. The egg weight of naked neck and normal feathered chicken were 42.35 ± 4.08 g

and 42.66 ± 4.70 g and doc weight were 28.46±2.96 and 28.35±3.34 g, respectively, were not significantly different.

Table 4. Production of eggs, hatching eggs, fertility, hatchability and quality hatching chickens naked neck and normal females during 75 days of observation.

Mating Group			Egg Production (%)	Egg Fertility (%)	Hatchability (%)	Embryo Mortality (%)
Male	Female (n)					
Naked Neck 1	Naked Neck	(2)	36.67±10.61	100.00±0.0	35.71±50.51	-
	Normal	(2)	38.00±21.92	100.00±0.0	87.50±17.68	-
Naked Neck 2	Naked Neck	(4)	42.67±12.36	95.50±5.26	84.21±17.52	-
	Normal	(2)	34.67±2.83	95.83±0.25	80.49±1.87	-
Naked Neck 3	Naked Neck	(3)	48.89±3.06	98.99±1.75	81.01±2.09	-
	Normal	(1)	60.00±0.00	97.30±0.00	88.89±0.00	-
Naked Neck 4	Naked Neck	(4)	41.00±7.80	90.57±4.94	77.78±11.35	-
	Normal	(2)	30.67±11.31	96.30±5.24	84.67±12.26	-
Naked Neck 5	Naked Neck	(2)	35.33±10.61	93.54±0.29	89.76±4.38	-
	Normal	(2)	41.33±12.73	73.91±36.89	77.27±19.28	-
Total	Naked Neck	(19)	40.91±05.38	95.72±03.88 [a]	73.69±21.69 [a]	19.85±11.04 [a]
	Normal	(9)	40.93±11.37	92.67±10.61 [b]	83.76±04.84 [b]	17,97±11,50 [b]

ns. = not significant. Superscript *a* and *b*, shown the significant different by P<0.05.

Based on the mating group of naked neck x naked neck chicken and naked neck x normal feathered shown that the egg weight of the naked neck x naked neck (42.35 ± 4.08 g) was not significantly different from the egg weight naked neck x normal feathered (42.66 ± 4.70 g). These results differ from previous studies (Sidadolog, 1992) which found that egg weight of naked neck greater than egg weight normal feathered chicken.

Table 5. Egg Weight and DOC Weight (g) produced in mating of Naked Neck Males with Naked Neck and Normal Females for 75 days observation

Item		Group Mating		Population	Statistic
		Naked(♂):Naked(♀)	Naked(♂):Normal(♀)		
A. Egg weight					
Numbers of females	(bird)	12	11	23	-
Numbers of eggs	(stuck)	398	306	704	-
Egg weight average	(g/stuck.)	42.35 ± 4.08	42,66 ± 4,70	42.49±4.31	ns
Heritability					
h^2(♂)		- 0.07	0,07	0.07	-
h^2(♀)		2.52	0,49	2.69	-
h^2(♂ + ♀)		1.22	0,28	1.38	-

Repitability of Egg weight R	0.60 ± 0.076	0.77 ± 0.06	0.69 ± 0.07	-
VPñ/VP of Egg weight	0.64	0.79	0.72	-
B. Doc weight				
Numbers of females (bird)	12	11	23	-
Number of DOC (bird)	152	128	280	-
Doc weight average. (g)	28.46±2.96	28.35±3.34	28.41±3.13	ns
Heritability				
h²(♂)	1.09	-0.33	-0.19	-
h²(♀)	0.99	2.49	1.82	-
h²(♂+♀)	1.04	1.08	1.01	-
Repitability of doc weight. (R).	0.56 ± 0.112	0.65 ± 0.109	0.59 ± 0.08	-
VPñ/VP doc weight	0.60	0.69	0.63	

♂= male, ♀ = female
ns. = not significant

Heritability (h^2) of egg weight was low (0.07) in all populations, and in the group of naked neck x naked neck (-0.07) and in the group of naked neck x normal feathered (0.07). This was supported by the high appearance of dominant genes by heritability in h^2(♀), for group naked neck x naked neck was over estimate (2.52) and the group naked neck x normal feathered was high (0.48). Repeatability value of egg weight was indicating a high value of 0.60 ± 0.076 in group of naked neck x naked neck, and 0.77 ± 0:06 in the group of naked neck x normal feathered and 0.69 ± 0.065 for all of population. This value illustrated that the genetic potential egg weight is high.

The average of doc weight from naked neck x naked neck and the naked neck x normal feathered were not significantly different. These were 28.46 ± 2.96 g and 28.35 ± 3.34 g, respectively. The heritability of doc weight of naked neck x naked neck was over estimate of 1.09 and of naked neck x normal feathered was underestimate of -0.33. It shown that the effects of dominance gene for doc weight was high, as shown in the h^2(♀) 0.99 and -2.49. The repeatability value of doc weight was still high, 0.56 ± 0.112 and 0.65 ± 0.109 respectively.

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