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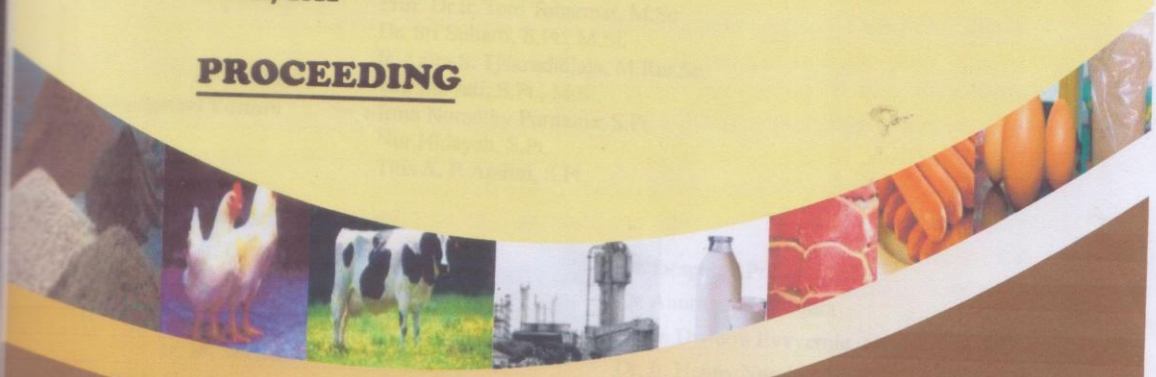

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Improvement the Genetic Potential of Local Chicken By Combination of Crossbreeding, Selection Method, Cellular Analysis and Nutritional Adjustment to Produce the Candidate of Local Layer

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Abstract

The present research has been conducted in five stages: genetic selection, crossbreeding, cellular analysis, evaluating the nutritional requirements and egg production. This research used 10 adult male chickens from crossing between female of Kampung chicken with male of laying chicken and 60 female Arab (silver and golden). Crossing carried out by artificial insemination and all parameters measured on offspring. The research design used was randomized factorial (2x4) and data was processed statistically using analysis of variance. To be able to show the maximum genetic potential then any growth stage of chicken during the selection process were examined by nutrient requirements mainly protein and energy balance using feed conversion and feed efficiency parameters. The treatments of energy: protein balance were; A (3000 Kcal:21%), B(2900 Kcal:20%), C(2800 Kcal:19%) and D(2700 Kcal:18%). Analysis of cellular parameters (protein, RNA and mRNA) in muscle tissue was performed on F3 derivatives of Kamaras to indentify as laying hens and also evaluated the ability of production.At the end of period, other parameters were measured: egg production, egg quality (Haugh Unit and grade of eggs, egg shape and eggshell color). Research results showed that crossbreeding and selection based on the performance of the exterior on local chicken produced two type of local layer hen that meet the criteria of commercial laying hens: medium and heavy type of Kamaras chicken. The cellular analysis results showed that chicken Kamaras has characteristics similar to the laying hens where the pectoral muscle growth was very slow. Egg production of both types of Kamaras chicken much higher than pure kampung chicken ranged between 144-170 egg/year. Egg quality analysis resulted that the Kamaras chicken (both medium and heavy type) produced eggs with high quality especially in terms of Haugh unit values (> 70), egg weight, eggshell thickness, grade (A) and quality of egg yolk (reddish yellow) better than Kampung chicken or Arab chicken. However, energy and protein content in diet significantly affected the egg production and egg quality in both type of Kamaras chicken. In conclusion, the egg productivity and egg quality of Kamaras chicken as a the result of selection and crossbreeding program were better than other types of

local chickens. In fact, Kamaras could be developed as a candidate of local laying chicken for future.

Keywords: cellular analysis, crossbreeding, local chicken, nutritional requirements, selection method

Introduction

Breeding program of local animal will be able to support economic stability and food security programs which are more valuable than the import of animal from abroad. This program will stimulate the Indonesian people to produce its own products and have alternative jobs for community. One of the great potential of local animal in Indonesia is local chicken (ayam kampung) which could be developed by genetic improvement to reduce the dominance of imported chicken (broiler or layer). This effort will support the genetic development of local chickens as a commercial layer chicken that is more productive and profitable for business activity. These objectives could be achieved by a sustainable strategic approach including genetic selection and nutritional adjustment (M. Aman Yaman *et al.*, 2000a: 2000b: 2010) and up-grading technology through genetic approach and breeding technology (May, 1971: Brillard, 2003).

The breeding technology developed for local chicken selection should have advantages in terms of output, applicative and more economical (Ansah *et al.*, 1985: Bennewitz *et al.*, 2007). The previous studies of local chicken have categorized two types of local chicken from Aceh Province resulted by genetic selection using exterior parameters, namely (a) the type of potentially meat chicken and (b) the type that can be oriented as laying hens. The previous results also showed that the average local chicken eggs only produced between 70 to 90 eggs /year. Until now, the conventional program of genetic selection for local chicken have not been able to raise the potential of local chickens as productive laying hens (M. Aman Yaman *et al.*, 2008: 2009). In order to solve such problems, the application of genetic programs for selecting local chicken needs to be done through a combination of a more comprehensive, more effective and applicable method using crossbreeding program.

In principle, to stimulate the gene expression of local chicken as layer requires the supply of nutrients according to their requirements since the starter, grower, pre-laying and laying period (M. Aman Yaman *et al.*, 2002: Wattiaux, 2006). Development of methods of selection, crossbreeding and nutritional approaches in an effort to generate a new strain of local chickens for egg production will be highly appropriate for a local chicken. It is possible to perform crossbreeding program using artificial insemination to increase the expression of genetic potential (Szwaczkowski

et al., 2000: Sapp *et al.*, 2004). The present research will focus on producing a layer chickens resulted by crossbreeding between local chicken, Arab chicken and Hy-Line Brown layer. The combination of breeding and nutritional approach could be considered to produce a new strain of local chicken which genetically able to produce egg higher than the original local chicken. The characteristic of egg produce by this chicken also must be qualified for market standard as a commercial chicken egg.

Materials and Methods

Ten adult male selected chickens (crossing between female of Kampung chicken with male of laying commercial chicken) and sixty female Arab chicken were used to evaluate the quality of offspring as a candidate of layer chicken. Crossbreeding was carried out by artificial insemination and all parameters were performed on offsprings (F1 – F3). The research design used was randomized factorial (2x4) and data was processed statistically using analysis of variance. Evaluation of genetic potential was performed in any growth stage of chicken during the selection process. The effect of nutritional adjustment on selection program was examined by treatment of protein and energy balance to evaluate feed conversion parameter.

The treatment of energy and protein balance were A (3000 Kcal:21%), B(2900 Kcal:20%), C(2800 Kcal:19%) and D(2700 Kcal:18%). At 90 days of age, analysis of cellular parameters (protein, RNA and mRNA) in muscle tissue was performed on breast muscle sample of offspring (F3) to indentify selected chicken as a candidate of laying chicken. At the end of period, other parameters were measured: egg production, egg weight, haugh unit (HU), egg grade, egg shape and eggshell color.

Sampling of hatching egg resulted by crossbreeding to produce F1-F3 offspring were selected by the following criteria ; eggshell color is reddish-white, oval shape, egg weight from 35 to45 gram and fertile. Sample of breast muscle and liver tissue were collected from chicken to evaluate the response of chicken type and nutritional treatments on cellular parameters for selection program carried out by the method of dislocation neck (cervical spine fracture) and chemical analysis. All sample tissue was preserved by immersing into liquid nitrogen and stored at -80° C until analysis. Protein, RNA and mRNA contents were analyzed by chemical treatment and measured by spectrophotometer (M. Aman Yaman *et al.*, 2000).

Results and Discussion

The present result showed that crossbreeding between local chicken, layer chicken and Arab chicken produced two types (heavy and medium types) of productive laying hen (called as Kamaras chicken) with a specific performance and difference in egg productivity (Table 1). Both of Kamaras chickens have a similar body shape but difference in body weight during mature sex and dominant color.

Heavy type chicken has a black dominant color and gray dotted, while medium type has a black dominant color and white/golden dotted. At the age of mature sex, body weight was 1580 gram (heavy type) and 1420 gram (medium type). The average of egg production of both types of Kamaras chicken ranged between 171 to 177 eggs /year. There was no difference in egg quality of both types of chicken. However, the FCR of medium was lower (2.6 kg) compared to the heavy type chicken (2.9 kg) during 90 days of rearing period. The results also show that through crossbreeding program and combination of selection methods produced a derivative type of local chicken which has an ability to produce eggs was higher than the origin of local chicken but still has a similar characteristic in egg quality.

Table 1. Parameter of Kamaras chicken (female line) resulted by cross breeding program as a candidate of local productive laying hens

Specification	Heavy type	Medium type
Body shape	Layer	Layer
Dominant color	Black and gray dotted	Black and white dotted
Body weight of *pra-laying* (gram)	1580	1420
First laying age (week)	19	18
Clutch (egg/week)	5	4
Mean of egg production (egg/year)	177	171
Egg weight (gram)	35-47	32 - 43
Haugh unit	74	72
Egg shell color	Creamy white	Creamy white brown
Hatchability (%)	93	91
Feed conversion rate (FCR) for 90 days	2.9	2.6

Combination selection program and mating strategy to explore the potential of genetic during breeding process will largely affect the derivative type of chicken (M. Aman Yaman *et al.*, 2008 and 2009). On poultry breeding program, the dominant characteristic that appears in exterior parameter followed by analysis of cellular parameter will be used as a very useful parameters to produce a new type of chicken in accordance with the breeding purpose (Brah, 2005; Bennewitz *et al.*, 2007) including breeding program to stimulate the increase in egg production and egg quality of local chicken. The combination of selection program on a local chicken through cellular and exterior parameters influenced the appearance of the chicken peformance and egg production (Wattiaux, 2006) . The present result approved that crossbreeding followed by a strike selection method using local chicken, layer

chicken and female Arab produced a new type of chicken which can replace the role of local chickens as laying hens in the future.

Analysis of cellular parameters (Table 2) in the two types of chicken Kamaras showed that protein, RNA and mRNA contents in the pectoral muscle has equal to those in commercial laying hens. These indications show that the chicken Kamaras could be categorized as slow-growing type of chicken similar to the characteristics of laying hens. Cellular content in breast muscles of poultry could be used as a reference for functional selection of laying hens or broilers, in which the concentration of protein, RNA and mRNA of chicken breast muscle layer is lower than broilers due to the different types of fiber muscle (Kita *et al.*, 2002 and M. Aman Yaman, 2010). The results of this study approved that the chicken Kamaras have a very strong character as laying hens that can be developed into a productive laying hens.

Table 2. The concentration Protein, RNA and mRNA contents on breast muscle of Kamaras chicken (F3) resulted by crossbreeding between male selected chicken and female Arab chicken

Parameter	Medium type	Heavy type
Chicken age (days)	90	90
Body weight (gram)	857	993
Breast muscle weight (gram)	17.15	18.49
Protein (mg)	3023	3155
RNA (mg)	12.93	13.24
mRNA (*ug*)	3276	3340

It was also observed that protein and energy balance in the feed significantly affected on egg production rate and egg quality (HU value) in both type of Kamaras chicken. However, there was no influence of chicken type (heavy and medium types) on egg production of Kamaras chicken. It was known that adjustment of protein and energy balance increased the number of eggs and egg quality. The egg production of Kamaras chicken fed on diet containing 19% of crude protein and 2800 Kcal of energy significantly increased than other nutritional treatments (Table 3). It was also informed that the requirement of protein and energy balance was different between Kamaras chicken and commercial layer chicken. In general, commercial laying hens require 17% of protein and 2900 Kcal of energy in ration. It was due to the difference in genetic characteristic as the result of crossbreeding between 3 types of chicken. The present result also showed that breed and chicken type, genetically affected the egg production but the nutritional balance in particular; protein, energy and minerals is a important factor affecting the production and egg quality of laying hens (Kino, 1993; Bennewitz *et al.*, 2007). The two types of Kamaras chicken

produced between 147-170 eggs/year higher than origin chicken (70-90 eggs / year). The influence of genetic characteristic from the Arab and layer chickens as male and female line during crossbreeding program caused an increase in egg production of Kamaras chicken.

Table 3. The effect of chicken type and nutritional treatment on number and egg quality of Kamaras chicken (F3) resulted by crossbreeding between male selected chicken and female Arab chicken

Type of offspring	Nutritional treatments	Number of egg/year	HU	Egg weight (g)	Egg grade	Egg yolk color	Eggshell thickness (mm)
Heavy	A	157^{b}	68^{b}	33	A	Reddish yellow	0.33
	B	162^{c}	71^{b}	35	A	Reddish yellow	0.34
	C	167^{c}	73^{b}	36	AA	Reddish yellow	0.37
	D	142^{a}	64^{a}	32	B	yellow	0.32
Medium	A	156^{b}	67^{a}	34	A	Reddish yellow	0.32
	B	164^{c}	70^{b}	34	A	Reddish yellow	0.35
	C	170^{c}	73^{b}	36	AA	Reddish yellow	0.36
	D	147^{a}	65^{a}	32	B	yellow	0.32

Different superscript in the same line means significantly different ($P<0.05$)

The differences in protein and energy balance in ration also effected egg weight, shell thickness, albumen height, yolk color of egg. It was also observed that the value of HU and grade eggs on both types of chicken Kamaras was significantly affected by protein and energy balance in ration. The egg weight of Kamaras chicken fed on ration contained 19% of crude protein and 2800 kcal of energy was higher and it was also followed by an increase in egg components, egg grade and HU. The results are consistent with several previous studies that nutritional adjustment resulted in increased egg weight and albumen quality that have an impact on increasing the Haugh Unit of egg (M. Aman Yaman *et al.*, 2008:2009 and 2010).

Conclusions

Cross breeding program between selected local chicken, Arab chicken and Layer Hy Line Brown has produced a potential local laying chicken called as Kamaras chicken. The third offspring of crossbreeding use 3 type chickens generated two types of local laying chicken (medium and heavy types) with the high egg production than the origin local chicken. It was also known that the egg production and egg quality of Kamaras chicken could be stimulated by fed on ration contain 19% of protein and 2800 Kcal of metabolizable energy (ME).

In conclusion, egg production and egg quality of Kamaras chicken from cross breeding, genetic selection and nutritional adjusment was better than their origins so it could potentially be developed as a local chicken laying.

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