External Quality Of Merawangarab Chicken Eggs With Different Genetic Composition

Rafif Nurwansyah[1)], Harini Nurcahya[2)], Ikhsan Matodang[3)], Sri Darwati[1)]

[1)]Departement of Animal Production and Technology, IPB University
[2)] Biology Study Program, Postgraduate Program, Faculty of Biology and Agriculture, Universitas Nasional
[3)] Biology Study Program, Faculty of Biology and Agriculture, Universitas Nasional
*Correspondence Author : harininurcahya@yahoo.com

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Abstract

Eggs, as a food ingredient, possess complete nutritional value that is beneficial for human health, are readily available, affordable, and popular with the public. Likewise, hatching eggs provide the nutrients needed for the development of chicken embryos. Therefore, eggs for consumption as food and hatching eggs. The external quality of eggs is one indicator of egg quality. Merawang chickens and arab chickens are local Indonesian chickens. Crossbreeding of the two chickens is expected to produce superior offspring in production and egg quality. This study aimed to evaluate the external quality of merawangarab crossbred chicken eggs with different merawangarab genetic compositions (M), namely 25% M, 50% M, 62.5% M, and 75% M with a total of 30 hens. The materials used were eggs from merawangarab crossbred chickens. This study used a randomized block design (RAK) and continued with Tukey's further test. The external quality of eggs observed was shape index, egg weight, shell weight, and shell ratio. Different genetic compositions did not affect the external quality of merawangarab crossbred chicken eggs. Eggs from four crossbred merawangarab

Keywords: external quality, genetic composition, merawangarab eggs

INTRODUCTION

Egg quality is divided into two categories: external quality and internal quality. External egg quality refers to egg performance, including egg weight, egg shape, shell color, shell thickness, shell strength, and egg surface cleanliness. Abacı et al. (2023) reported that external quality includes egg weight, egg width, egg length, and shell weight. These external qualities can explain 91% of the variability in internal egg quality.

Quality can be influenced by both internal (genetic) and external (environmental) factors. Improving the quality of eggs for consumption is crucial to providing quality animal protein for the Indonesian people. Genetic improvement of chickens and providing a suitable environment are efforts to increase egg production and quality.

Local chickens play a significant role in supplying national egg needs. Local chickens have lower production than purebred chickens. Local chicken development is carried out by crossbreeding local chickens to obtain useful traits to increase their productivity. One effort is crossbreeding superior local chickens. The merawang chicken is concentrated in the Merawang District of South Sumatra (Diwyanto and Prijono 2007), merawang chicken is suitable as a producer of eggs and meat or a dual-purpose type with hen day production at the age of 31 weeks reaching 76.35% and male chickens can be slaughtered at the age of 10-12 weeks with a weight of around 1050-1400 g (Palupi 2023). Sembawa arab chickens have an average weekly egg production of 66.85% with peak production at week 32 at 76% with intensive maintenance at the age of 25-40 weeks (Budiyanto et al. 2017). Merawangarab crossbreed is a cross between a merawang chicken (M) and and arab chiken (A); both local chickens can produce high-quality eggs.

Merawangarab crossbreed has great potential to improve the egg quality of local chickens. The genetic composition of superior parents can produce chickens with the production traits of their parents. Different genetic compositions of the parents in crossbreed chickens are expected to have similar egg production performance.

This study was conducted to evaluate the external quality of merawangarab chickens with genetic composition of 25% M, 50% M, 62.5% M and 75% M, including egg length, egg width, egg volume, shell weight, shell index, shell ratio; and shell thickness.

METHOD

The materials used in the study were 30 hens of crossbred merawangxarab with varying merawangarab (MA) genetic compositions: 25% M, 50% M, 62.5% M, and 75% M. Other materials used included commercial laying hen feed, rice bran, antibiotics, vitamins, vaccines, rice husks, and water. The feed consisted of a mixture of commercial laying hen feed and rice bran in a 60:40 ratio, with a protein content of 14.58% (analysis results from ALIN, FAPET IPB). The tools used in the study included individual cages, feeders, drinkers, and a digital scale. Other tools included egg trays, vernier calipers, writing instruments, and micrometer screw.

Feeding was carried out in the morning at 9:00 a.m. Western Indonesian Time. Chickens housed in colony cages were fed a commercially mixed feed for laying hens and rice bran in a 60:40 ratio. Drinking water was provided ad libitum. Feeders and drinkers were cleaned before each feeding and drinking session.

This study examined four genetic compositions of merawangarab chickens. These four genetic compositions originated from crosses between merawang and arab chickens (MA). The crosses between merawang chickens and arab chickens used consist of four types, namely: 25% M (25% M; 75% A); 50% M (50% M; 50% A); 62.5% M (62.5% M; 37.5% A), and 75% M (75% M; 25% A).

Data Analysis. This study used a randomized block design (RBD) consisting of four genetic compositions of merawangarab crossbred chickens within the crossbred (M) strain: 25% M, 50% M, 62.5% M, and 75% M. Statistical analysis was used to compare external quality of merawangarab eggs with different genetic compositions. According to Mattjik and Sumertajaya (2013), the randomized block design model is as follows:

$$Yij= \mu+\tau i+\beta+\varepsilon ij$$

Description: Yij = observed value for the i-th chicken species and j-th period; μ = general mean value of the treatment; τi = effect of the j-th period; βj = effect of the treatment on the i-th chicken species; and Ɛij = effect of experimental error on the i-th chicken species.

Observed Variables: Egg length and width (cm), measured using a vernier caliper; Egg weight (g), weighed using a digital scale; Egg index = (Egg width)/(Egg length)×100%; Shell thickness (mm), measured using a micrometer screw gauge; Shell weight (g), measured using a digital scale; and Shell ratio = (shell weight)/(egg weight)x100%;

RESULT

Egg quality was assessed by measuring and observing both internal and external quality. The external egg quality observed was length, width, weight, egg index, and shell ratio. Figure 1 shows the external performance of merawangarab chicken. External egg quality variables refer to Kabir et al. (2012) as presented in Table 1.

Table 1. External quality of local merawangarab crossbred chicken eggs with different genetic Compositions

Eggs External Quality	**Average±SD, CV (%) on Different Genetic Composition**			
	25%M	**50%M**	**62,5%M**	**75%M**
EL (cm)	5,02±2,21 (4,02)	4,92±1,63 (3,14)	5,02±1,98 (3,72)	4,94±1,17 (2,17)
EW (cm)	38,0±0,94 (2,46)	3,78±0,64 (1,68)	3,83±1,08 (2,81)	3,92±1,07 (2,73)
EV (g)	41,38±3,01 (7,28)	40,71±2,99 (7,34)	42,10±3,26 (7,75)	43,20±2,74 (6,34)
SW (g)	5,92±0,57 (9,66)	5,78±0,44 (7,62)	5,98±0,48 (8,10)	5,36±0,61 (11,39)
SI	0,76±0,02 (3,18)	0,77±0,03 (3,31)	0,76±0,02 (3,09)	0,80±0,02 (2,61)
SR	0,19±0,02 (10,03)	0,18±0,04 (22,39)	0,19±0,03 (14,55)	0,16±0,01 (6,20)
ST (mm)	0,38±0,07 (17,93)	0,41±0,04 (10,36)	0,41±0,04 (10,36)	0,40±0,05 (11,44)

EL= egg length, EW= egg width, EV= egg volume, SW= shell weight, SI= shell index, SR= shell ratio; ST= shell thickness; SD=Standard Deviation; CV=coefisien of variance

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Figure 1 Performance of merawangarab chicken eggs

The results of the statistical analysis of the observed external quality variables showed no significant differences (P>0.05) between different genetic compositions. This means that the external quality of chicken eggs of 25% M, 50% M, 62.5% M, and 75% M were same. The external quality of eggs were still varies namely SW, SR, and ST.

DISCUSSION

Egg Length and Width

Observations showed that egg length (EL) values ranged from 4.92 to 5.02 cm. The highest values were found in the 25% M and 62.5% M chicken breeds, with values of 5.02 cm. Egg width ranged from 3.78 to 3.92 cm. These values are relatively similar to the results of research by Prawira et al. (2021), which stated that the length and width of native chicken eggs were 5.01 to 51.6 cm and 39.70 to 40.74 cm, respectively. The length and width of these eggs are also relatively similar to those of fayoumi chickens in the study by Kabir et al. (2012), namely 5.06 cm and 3.92 cm.

Analysis of variance results showed that egg length and width were not affected by differences in the chicken's genetic composition (P>0.05). Egg length and width are related to the calcium content of the feed. Egg length and width are also influenced by age. According to Harmayanda et al. (2016), egg length and width are influenced by the calcium content of the feed. A uniform feed and age result in relatively similar egg length and width values.

Egg Weight

The largest egg weight was obtained by the 75% M chicken at 43 g, and the smallest was obtained by the 50% M chicken at 40.71 g. The study found an average egg weight of 41.38-43.20 g. These egg weight values are relatively similar to the results of the studies by Prawira et al. (2021) and Kabir et al. (2012) were 43.65-44.64 g and 40.73 g, respectively, in native chickens. According to the BSN (2024), these eggs are categorized as small (<50 g). The weight of merawangarab chicken eggs is lower than local tanuvas aseel chicken that produces the heaviest eggs with an average weight of 52.93 g and is the highest compared to other local chickens, namely Nicobari and Siruvidai, which have a lower average weight as reported Vasanti et al.(2025).

Egg weights were not significantly different (P>0.05) from the analysis of variance. Differences in genetic composition (25% M, 50% M, 62.5% M, and 75% M) did not affect egg weight. This is due to the genetic stability of crossbred chickens. Genetic stability can reduce variation in egg weight traits. The relatively similar egg weight values are due to the provision of the same amount and composition of feed. Egg weights differ between chicken strains, as reported by Ucar and Kahya (2023). The average egg weight for the sire line genotypes was 69.89 g, ross (308 69.10 g), anadolu-

T (62.84 g), lohmann brown (59.59 g), Atak-S (59.58 g), Dam Line (59.51 g), lohmann selected leghorn (56.81 g), sultan (45.87 g), and ameraucana (43.03 g) (Ucar and Kahya 2023).

Feed with a composition of 60% commercial feed for the laying phase with 40% rice bran ini this study met the needs for egg production for all four genetic compositions. The nutritional content of crossbred chicken feed supports egg weight performance, as stated by Purtanto et al. (2022), who found that high or low nutrient content in feed can affect egg weight.

Shape Index

The study found egg index or shape index was 0.76-0.80. This value is relatively similar to the study by Darwati et al. (2019) that found the egg index of merawang and arab crossbred chickens was 0.77-0.80. Yuwanta (2010) stated that the egg index ranges from 0.65-0.82, with an ideal value of 0.70-0.75. The egg index value in this study is within the ideal range according to Yuwanta (2010). This egg index was relatively similar to the egg index of lohmann brown strain chickens in the studies of Dirgahayu et al. (2016) and Kabir et al. (2012), which were 75.94 and 77.64, respectively. Genetics influences egg shape, resulting in rounder eggs than others. Research results (Shaker et al. 2017; Kraus and Zita (2019); Kraus et al. (2020) indicate that genetics cause significant differences in egg shape index. However, the shape index of the different genetic compositions of merawang in this study did not differ. Based on SNI (2023), the shape of chickens 25% M, 50% M, and 62.5% M are included in the category for normal egg shape quality II (SI 72-75), while eggs from chickens 75% M with 80% egg shape are included in the category of normal egg quality III.

Analysis of variance results showed that the egg index was not affected by genetic differences (P>0.05). The egg index is influenced by egg length and width. According to Harmayanda et al. (2016), egg length and width are influenced by the calcium level in the feed. The same feed composition and quantity resulted in relatively similar egg length and width values. Jing et al. (2018) reported a highly significant positive correlation between egg weight and longitudinal diameter, transverse diameter, and egg shape index.

Shell Thickness

Shell thickness in this study averaged 0.38-0.41 mm. The best values were obtained by chickens with a genetic composition of 50% M and 62.5% M. This value was higher than that of arab, kampung, and kettaras chickens in the study by Marlya et al. (2021), which were 0.34, 0.33, and 0.33 mm, respectively. This value may be due to differences in nutrition in the feed ration and the age of the hens when they first laid eggs. Husna (2022) stated the eggshell is the outermost layer of the egg, and its quality is crucial because it protects the egg contents from bacterial contamination, which can cause spoilage and degrade egg quality.

Differences in genetic composition did not affect eggshell thickness (P>0.05). The similar thickness differences were due to uniform feed, age, and environmental conditions. According to Wijaya et al. (2019), shell thickness is influenced by age and environmental topography. Increasing age results in eggs with thinner shells. Moreki (2025) explained that the external quality of egg weight, size, and shell of consumable eggs is influenced by different egg marketing channels. Ketta and Tumova (2016) stated shell thickness is determined by plasma Ca balance and shell formation time 18–20 hours. Heat stress reduces blood Ca, resulting in a thinner shell. Shell thicknessis influenced by ability to absorb Ca and P from feed (Herni et al. 2022). According to Rayan et al. (2023), brown-shelled eggs exhibited a significantly higher percentage of calcium in their shells than white-shelled eggs. Brown-shelled hens also produced a statistically significant greater number of pores per egg than white-shelled hens. Ultrastructurally, the overall shell thickness of brown eggs was approximately 3.7% greater than that of white eggs.

Eggshell Weight and Ratio

The results showed that eggshell weight was 5.36-5.98 g. The eggshell ratio of chicken eggs ranged from 0.16-0.19. The best eggshell ratio was found in chickens with 25% M and 62.5% M eggs, at 0.19. This value was higher than the study by Sudrajat et al. (2019), which found 0.09-0.10.

Analysis of variance results showed that eggshell weight and eggshell ratio were not affected by genetic differences (P>0.05). Eggshell ratio was related to the amount of calcium in the feed. This aligns with the opinion of Purnamayana et al. (2020) that increased egg weight and eggshell thickness are due to calcium mineral content. According to Wijaya et al. (2019), eggshell thickness is influenced by age and environmental topography. Cheng and Ning (2023) reported an interaction between the rearing system and the age of the chicken on eggshell weight and quality.

CONCLUSION

The external quality of eggs in crossbred chickens of 25% M, 50% M, 62.5% M, and 75% M were same. SW, SR, and ST were still diverse. Eggs from four crossbred merawangarab chickens were classified as small eggs (<50 g).

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