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# *Egg Characteristics of Pelung Chickens in Four Different Areas in West Java, Indonesia as Technical Inputs for Conservation*

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***Abstract***
*Egg characteristics such as egg size and egg quality affect the hatchability rate of chicken eggs. The study objective was to determine egg characteristics of Pelung chickens that are endangered chickens of Indonesia. A total of 116 eggs from Garut, Bandung, Cianjur, and Sukabumi Regencies, West Java Province, Indonesia were selected using a purposive technique. The observed parameters were egg weight, egg-specific gravity, and thickness of an eggshell. Data were analysed using the nonparametric Kruskal-Wallis test followed by the post hoc Mann-Whitney U test. The former was used to determine data differences among research areas, while the latter was applied to compare data differences between the two research areas. The rank Spearman analysis was used to determine the correlation between observed parameters. The study showed that there were significant differences ($p < 0.05$) among research areas for all observed parameters. The egg weight and thickness of eggshells in the Sukabumi Regency were higher than other regencies, while egg-specific gravity in this regency was the highest ($p < 0.05$). There was a significant positive correlation ($p < 0.05$) between the observed parameters. The findings indicated variation in the rearing management system and the genetics of Pelung chickens in research areas.*
***Keywords: characteristic, egg, pelung, West Java, conservation***

## Introduction

The egg is a pivotal means of reproduction in chickens. The egg size and external quality of eggs such as the quality of eggshells are important factors for hatching eggs. Egg weight was highly correlated with chick weight at hatching (Duman & Şekeroğlu, 2017; Iqbal et al., 2017; Ayeni et al., 2018; Chimezie et al., 2020). Besides, egg weight influences the embryonic development of birds (Willems et al., 2014). Variation of egg weight occurs among individuals of the same breed due to parental age, laying period (Willems et al., 2014) parental average body weight (Anene et al., 2020) as well as feed intake (Li et al., 2011).

The quality of the eggshell influences the hatching success of eggs as the shell is a wall designed to preserve the developing embryo and conserve it with an ideal environment (Rozempolska-Rucińska et al., 2011). The quality of eggshells is influenced by egg weight (Willems et al., 2014) and the age of chickens (Padhi et al., 2013; Lee et al., 2016; Perić et al., 2017). The strength of eggshells determines the quality of the eggshell (Ketta & Tůmová, 2018). Egg-specific gravity is a common method to determine eggshell strength (Rozempolska-Rucińska et al., 2011; Ketta & Tůmová, 2016). Specific gravity describes the shell internal structure and microstructure which determine the hatchability success. Proper specific gravity is varied from 1.07 to 1.10 (Rozempolska-Rucińska et al., 2011).

The quality of hatching eggs is crucial for conserving the population of indigenous chickens such as Pelung chickens. According to Decree No. 2918/2011 issued by the Minister of Agriculture Republic of Indonesia, it was officially stated that Pelung is an indigenous chicken breed in Indonesia that requisite protection and conservation. Pelung chicken is a long crowing chicken originally from the Cianjur region, West Java Province, Indonesia. Pelung roosters can be recognized by their long crowing vocalization compared to other singing local chickens such as Kokok Balenggek. Pelung chickens have no specific plumage color (Figure 1A). However, the birds have a bigger body figure compared to other local chickens (Hidayat & Asmarasari, 2015).

Since Pelung roosters have been raised because of their long crowing traits, the Pelung contest (Figure 1B) conducted from local to the national level is a significant occasion for Pelung breeders and hobbies. The competitions are considered as a marketplace to find good breeds of Pelung chickens (Asmara et al., 2018). Due to the existence of contests, more people are interested in raising Pelung chickens; thus, the population of Pelung

develops outside its original area. Local knowledge is a crucial aspect of maintaining indigenous chickens (Partasasmita et al., 2017). Also, farmer preference is a significant aspect of developing chickens for a specific purpose (Komiyama et al., 2016; Bortoluzzi et al., 2018). Breeders and hobbies in different areas may have a different management system to raise Pelung chickens. The distinct management systems may result in the different performances of Pelung chickens including their egg features. The objective of the current study was to provide empirical evidence about egg characteristics of Pelung chickens in separate areas in West Java as technical inputs for its conservation system.


Figure 1. (A) Adult Male Pelung Chicken (Source: Abdurahaman, 2020)
(B) Pelung Contest (Source: Antara.com)

## Materials And Methods

### Description of Research Area

The study used a total of 116 eggs of Pelung chickens collected from four different regencies in West Java Province, Indonesia (Figure 2). The regencies were Sukabumi, Cianjur, Bandung, and Garut. Sukabumi and Cianjur Regencies are adjacent and situated in southwestern Java Island. The altitude of the Sukabumi Regency is 0 – 2,960 m, while Cianjur Regency is between 7-2,962 m. The location of Bandung and Garut Regencies is in the eastern part of West Java Province. Bandung Regency is a highland area in which several mountains have an altitude of more than 2,000 m, while Garut Regency is at an altitude of 100-1500 m.


Figure 2. Research Areas (Source: Maphill, 2013)
Left : A. Position of Indonesia in the world
B. Position of West Java in Indonesia
Right : A. Sukabumi Regency; B. Cianjur Regency
C. Bandung Regency; D. Garut Regency

## Research Methodology

The sample was eggs from chickens kept under the semi-intensive system. In this system, chickens usually searched their feed in confined areas with shelters built to protect chickens from bad weather and a place to sleep at night. Keepers provided supplementary feed for the chickens such as commercial feed, rice bran, and household waste products. Occasionally, farmers give additional feed as protein sources such as snail as well as vitamin sources such as papaya, banana, and tomato. In the semi-intensive system, keepers usually provided health protection such as vaccination for healthy chickens and traditional as well as modern medicine for sick chickens.

A total of 116 eggs were collected in this study aged less than seven days. The research used an official air-cell gauge to determine the depth of the air cell as an indicator of the freshness of eggs. The sample in the study is only eggs with AA quality or depth 1/8 inch (3.2 mm). Furthermore, the eggs were selected based on their soundness by which cracked eggs were not kept for further measurements. An egg tray was utilized to collect eggs during research. A digital weight scale was operated to determine egg weight; a micrometer screw gauge measured the thickness of an eggshell. A bucket, saltwater, and hydrometer were used to determine the Specific Gravity (SG) of eggs.

The selected eggs were cleaned using warm water, and then they were numbered using a marker pen. After that, the eggs were weighed and put in a bucket to determine their SGs. The eggs were dipped into the different salt solution (1,075; 1,080; 1,085; 1,095; 1,100) to determine SG of sample. Initially, eggs were dipped with the lowest salt solution (1.075) and then sank into the gradually higher salt solutions. Eggs with thinner shells would be floated in the lower salt solution. Afterward, the eggs were broken to measure the thickness of an eggshell.

The collected data was analyzed using The Statistical Package for the Social Sciences (SPSS) IBM SPSS statistics 22. The data analysis used a nonparametric Kruskal-Wallis test to assess data among research areas. The test works better for non-normally distributed data than that of the parametric ANOVA test (Hecke, 2012). Then, the nonparametric Mann-Whitney U test was used as post hoc testing to compare the differences between two independent groups. The nonparametric Rank Spearman correlation analysis was applied to determine the correlation between observed parameters. The correlation coefficient is between -1 (a perfect negative correlation), and +1 (a perfect positive correlation) determining the relationship strength between two variables.

## Results and Discussion

### Results

Table 1 shows that the egg weight of Pelung chickens in research areas varied from 43.678 – 46.421 g, with a coefficient of variation between 5.57-9.75 %. There were statistically significant differences in egg weight among research areas.

Tabel 1. Weight and External Characteristics of Eggs of Pelung Chickens

| Variable | Research Area (Regency) | | | | *p*-value |
|---|---|---|---|---|---|
| | Garut | Bandung | Cianjur | Sukabumi | |
| Egg Weight | | | | | |
| Average (g) | 43.676±3.775 | 45.176±2.515 | 45.628±4.450 | 46.421±4.06 | |
| Maximum (g) | 52.20 | 50.80 | 56.40 | 51.60 | |
| Minimum (g) | 37.90 | 41.80 | 39.70 | 36.60 | 0.031* |
| Coefficient of Variation (%) | 8.64 | 5.57 | 9.75 | 8.74 | |
| Specific Gravity | | | | | |
| Average | 1.081±0.006 | 1.081 ± 0.007 | 1.080 ± 0.007 | 1.084 ± 0.005 | |
| Maximum | 1.095 | 1.095 | 1.090 | 1.090 | |
| Minimum | 1.075 | 1.075 | 1.070 | 1.070 | 0.031* |
| Coefficient of Variation (%) | 0.54 | 0.63 | 0.63 | 0.44 | |
| Eggshell | | | | | |
| Average (mm) | 0.297±0.026 | 0.291 ± 0.031 | 0.340 ± 0.015 | 0.344 ± 0.001 | |
| Maximum (mm) | 0.35 | 0.35 | 0.36 | 0.36 | |
| Minimum (mm) | 0.25 | 0.24 | 0.30 | 0.32 | 0.000* |
| Coefficient of Variation (%) | 8.63 | 10.50 | 4.41 | 2.86 | |

* significant at the 0.05 level

Table 2 shows that the egg weights of Pelung chickens in Garut and Bandung Regencies being lower significantly compared to those in Sukabumi Regency. Table 3 displays correlation between egg weight and specific gravity.

Tabel 2. Comparison of Weight and External Characteristics of Eggs of Pelung Chickens

| | Egg weight (g) | Specific gravity | Eggshell (mm) |
|---|---|---|---|
| *Garut - Bandung* | | | |
| Mann-Whitney U | 323.500 | 412.500 | 361.000 |
| Z | -1.509 | -0.130 | -0.932 |
| Asymp. Sig.(2-tailed) | 0.131 | 0.897 | 0.351 |
| *Garut-Cianjur* | | | |
| Mann-Whitney U | 337.000 | 415.000 | 74.000 |
| Z | -1.299 | -0.088 | -5.432 |
| Asymp. Sig.(2-tailed) | 0.194 | 0.930 | 0.000* |
| *Garut-Sukabumi* | | | |
| Mann-Whitney U | 240.000 | 248.500 | 53.000 |
| Z | -2.808 | -2.841 | -5.788 |
| Asymp. Sig.(2-tailed) | 0.005* | 0.004* | 0.000* |
| *Bandung-Cianjur* | | | |
| Mann-Whitney U | 409.500 | 413.000 | 76.000 |
| Z | -0.171 | -0.120 | -5.396 |
| Asymp. Sig.(2-tailed) | 0.864 | 0.905 | 0.000* |
| *Bandung-Sukabumi* | | | |
| Mann-Whitney U | 295.000 | 282.500 | 53.000 |
| Z | -1.952 | -2.230 | -5.782 |
| Asymp. Sig.(2-tailed) | 0.051* | 0.026* | 0.000* |
| *Cianjur-Sukabumi* | | | |
| Mann-Whitney U | 327.500 | 276.000 | 372.000 |
| Z | -1.446 | -2.354 | -0.792 |
| Asymp. Sig.(2-tailed) | 0.148 | 0.019* | 0.429 |

* significant at the 0.05 level

Tabel 3. The correlation coefficient of Egg Weight, Specific Gravity and Shell Thickness

| | | Egg weight (g) | Specific gravity | Eggshell (mm) |
|---|---|---|---|---|
| Egg weight | Correlation Coefficient | 1.000 | 0.234* | 0.251** |
| | Sig. (2-tailed) | . | 0.012 | 0.006 |
| | N | 116 | 116 | 116 |
| Specific gravity | Correlation Coefficient | 0.234* | 1.000 | 0.572** |
| | Sig. (2-tailed) | 0.012 | . | 0.000 |
| | N | 116 | 116 | 116 |
| Egg shell | Correlation Coefficient | 0.251** | 0.572** | 1.000 |
| | Sig. (2-tailed) | 0.006 | 0.000 | . |
| | N | 116 | 116 | 116 |

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

**Discussion**

The egg weight in Sukabumi Regency was the highest, while the egg weight in Garut Regency was the lowest. All egg weight found in the current study was lower than that reported by Exwal et al. (2020) that stated that the egg weight of Pelung chickens was an average of 52.50 g. It expects that Pelung chickens in Sukabumi Regency will have bigger chicks. There was a positive correlation between egg weight and chick weight (Duman & Şekeroğlu, 2017; Iqbal et al., 2017; Ayeni et al., 2018; Chimezie et al., 2020). Albumen was the significant determinant of egg weight (Willems

et al., 2014). The higher egg weight would have more albumen as well as water content since albumen was the primary source of water in the egg (Finkler et al., 1998). About 10.5 % of protein and 88.5 % of water were found in the domestic fowl (Willems et al., 2014). The quantity of water available to the embryo influenced the body mass of chicks (Finkler et al., 1998). In addition to water content, the amount of protein in albumen was crucial for the synthesizing of embryonic tissue. Thus, different amounts of albumen will affect embryonic and postnatal development (Finkler et al., 1998; Willems et al., 2014).

The differences in egg weight found in the current study may reflect differences in management systems, particularly, the feeding system. It believes that feed intake, feed composition, and nutrient content affect performance including the egg weight of chickens. Decreased feed intake caused a decrease in egg and albumen weights (Li et al., 2011). An increase in dietary energy to a ratio of 282 kcal of ME/g lysine increased egg weight (Wu et al., 2005). Lowering dietary lysine intake might result in decreasing albumen (Novak et al., 2004). As the methionine content of the diet increased, egg weight increased (Harms et al., 1998). Methionine and lysine were critical amino acids in poultry diets (Novak et al., 2004). The current finding indicates that the chicken feed in Sukabumi Regency is likely to meet the amount and nutritional requirement of Pelung to produce optimal egg weight. Then, it is required to explore further the feeding management in the regency to support this finding.

According to the egg weight found in the current study, the chicken weight in Sukabumi may be higher compared to those in other regencies, mainly in Garut Regency. Heavier hens would have higher egg weights (Edeh et al., 2020). Since egg weight differences could reveal the scale of Pelung hens, the hen weight indirectly reflects the genetic variety of Pelung. Uncontrolled crossbreed practice may have occurred predominantly in Garut Regency. Some studies reported that crossing Pelung with other local chickens resulted in lighter chickens (Iskandar et al., 2002) and egg weights (Depison, 2009). In terms of vocalization, the hybrid rooster Pelung was unable to display their pure parents (Daryono et al., 2020). Also, trait differences in chickens might attribute to geographic differences (Melesse & Negesse, 2011). Figure 2B shows that Sukabumi Regency (the highest egg weight) is apart from Garut Regency (the lowest egg weight). The chicken migrations between the two regencies maybe not have or rarely occurred.

In addition to the weight of hens, older hens may have higher egg weights. As the age of the hen increased, the mass of the hen increased. Older hens produced higher egg weights (Padhi et al., 2012; Willems et al., 2014; Perić et al., 2017; Marzec et al., 2019). However, age was a limiting factor of fertility and hatchability because these traits were lower in older hens (Nasri et al., 2020). The ability of older female chickens decreased to maintain spermatozoa in the uterovaginal sperm host gland. It was also possible that older hens had a low quality of follicle that caused the follicle might not survive to hatch (Fasenko et al., 1992). Early embryonic mortality frequently occurred in older hens (Novo et al., 1997). If older hens dominate the flock structure of Pelung in Sukabumi Regency, hen replacement is needed to avoid decreasing the population in this region.

In terms of egg-specific gravity, Table 1 indicates that there were statistically significant differences among research areas. Table 2 shows that egg-specific gravity in Sukabumi Regency was the highest. Table 3 displays that egg weight has a significantly low positive correlation with specific gravity. It can state that with the increasing weight of eggs, the egg-specific gravity increases. The current study finding is contrary to earlier studies as reported among others by Iqbal et al. (2017) and Silva et al. (2013) that stated that heavier eggs would have lower specific gravities.

As the egg-specific gravity in Sukabumi was the highest, it can expect that hen age in Sukabumi might be younger. The egg-specific gravity was higher for younger hens (Silva et al., 2013; Iqbal et al., 2017). Eggs with higher specific gravity had the potential to hatch more successfully (McDaniel et al., 1979; Rozempolska-Rucińska et al., 2011) and had lower early embryonic mortalities than that with low specific gravity (McDaniel et al., 1979). A higher specific gravity would have lesser water loss during incubation; hence, a higher egg-specific gravity would also have higher hatchability (McDaniel et al., 1979). The decline of egg-specific gravity in older hens might be due to no proportionate increase in

shell deposition as egg weight increased (Novo et al., 1997).

The current study found that there were statistically significant differences in the thickness of eggshells among research areas (Table 1). Table 3 indicates that egg weight has a significantly low positive correlation with the width of eggshells. Higher egg weights have thicker eggshells. The result is in agreement with Padhi et al. (2012) that stated that higher egg weight was estimated to have higher shell weight. Also, Table 3 specifies that egg-specific gravity has a significant moderate positive correlation with the thickness of an eggshell. This finding supports Rozempolska-Rucińska et al. (2011) who stated that specific gravity had a positive correlation with the shell thickness of eggs. The egg-specific gravity indirectly formed the shape of an egg as well as the resistance and structure of the shell (Rozempolska-Rucińska et al., 2011).

However, the finding in the current study is contrary to Rozempolska-Rucińska et al. (2011) that stated that a higher egg weight might have a smaller proportion of the shell as the mass gain of the whole egg was quicker than the improvement of the shell weight. Besides, the increasing egg weight over a production period would decrease eggshell thickness and strength (Rozempolska-Rucińska et al. 2011; Willems et al. 2014). Furthermore, the shell quality in chickens declined with age (Perić et al., 2017). Table 2 shows that the thickness of eggshells in the Cianjur and Sukabumi Regencies was highest than those in other regencies. This result may indicate that the age of hens in the two regencies is younger and in the early stage of egg production.

## Conclusion

The current study indicates that the egg characteristics of Pelung chickens in research areas are varied. Based on egg weight, it expects that the chickens in study areas may have differences in terms of body weight, age, and rearing managing system, particularly in the feeding system. Egg weight may also indicate a variety of genetics of Pelung birds. According to data of specific gravity and thickness of eggshells, the hens in study areas may be in different age and production stages. Further exploration about rearing management systems, for example, feeding and mating systems, as well as flock structures, should be carried out in the future. Different areas may have different input and technical supporting systems to maintain the population of Pelung chickens.

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