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PERBEDAAN *SHAPE INDEX, SPECIFIC GRAVITY*, SERTA KETEBALAN KERABANG TELUR AYAM SENTUL GALUR DEBU DAN KELABU

DIFFERENCES IN THE SHAPE INDEX, SPECIFIC GRAVITY, AND EGGSHELL THICKNESS BETWEEN THE DEBU AND KELABU LINES OF SENTUL CHICKENS

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ABSTRACT

Sentul chicken is a local Indonesian chicken breed consisting of several lines distinguished by feather color phenotypes. This study aimed to determine differences in shape index, specific gravity, and eggshell thickness between the Debu and Kelabu lines of Sentul chickens. The research was conducted at the Balai Pengembangan Perbibitan Ternak Unggas (BPPTU) Jatiwangi, Majalengka Regency, West Java. The samples consisted of 70 hatching eggs from each line, obtained from hens at 40 weeks of age maintained under uniform management conditions. This study employed a quantitative comparative method, and the data were analyzed using descriptive statistics and an independent samples t-test. The results showed that the mean shape index of the Debu and Kelabu lines was 78.05 ± 2.87 and 77.43 ± 3.66, respectively. The mean specific gravity of both lines was 1.088 ± 0.0053 g/cm^3 and 1.088 ± 0.0058 g/cm^3, respectively. The mean eggshell thickness of the Debu and Kelabu lines was 0.32 ± 0.024 mm and 0.32 ± 0.023 mm, respectively. The t-test results indicated no significant differences (P > 0.05) in shape index, specific gravity, or eggshell thickness between the two lines. Both lines exhibited relatively similar external egg quality and met the acceptable criteria for hatching eggs, suggesting that line selection in breeding programs need not be based on external egg quality alone.

Keywords : *Sentul Chicken, Shape Index, Specific Gravity, Eggshell Thickness, Eggs.*

Introduction

Local chickens are one of Indonesia's poultry genetic resources that play an important role in providing animal protein and supporting national food security. Based on the Central Statistics Agency (2025), the population of local chickens in Indonesia in 2024 reached 146.47 million birds, with egg production of 236,648.28 tons. This potential indicates that local chickens have great opportunities for further development, although their productivity and product quality still need to be improved to enhance their competitiveness against commercial broiler and layer chickens.

One local chicken with high development potential is the Sentul chicken, native to Ciamis Regency, West Java, which has been officially recognized as an Indonesian local chicken breed through the Decree of the Minister of Agriculture of the Republic of Indonesia Number 698/Kpts.PD410/2013. Sentul chickens are known as dual-purpose chickens with egg production ranging from 118-140 eggs per year and good adaptability to tropical environments (Ministry of Agriculture of the Republic of Indonesia, 2013; Kaleka, 2019). Sentul chickens consist of several strains distinguished by feather color phenotypes, including the Debu and Kelabu strains. Such phenotypic differences are believed to reflect underlying genetic variation, which may in turn influence production and reproductive performance. Debu Sentul chickens have been reported to show higher fertility and hatchability, whereas Kelabu Sentul chickens exhibit better growth performance (Fitriati et al., 2021; Suciati et al., 2023).

In poultry breeding programs, egg quality is one of the key factors determining reproductive success and hatchability. Egg quality can be evaluated based on internal and external characteristics. External egg characteristics are frequently used because

they can be assessed without breaking the egg and are closely related to hatchability and embryo quality. Commonly used external quality parameters include shape index, specific gravity, and shell thickness (Hartono & Isman, 2013).

Shape index is the ratio between egg width and egg length used to describe egg shape, with a higher value indicating a rounder shape and a lower value indicating a more elongated shape (Darmike et al., 2025). Egg shape is known to influence the distribution of internal components and storage efficiency, and is associated with embryo development success during incubation (Putranto et al., 2022). Genetic factors play an important role in determining egg shape through their influence on the size and function of the reproductive tract, particularly the isthmus, which is involved in eggshell membrane formation (Nggaba & Alexander, 2022).

In addition to shape index, specific gravity is a parameter commonly used to evaluate eggshell quality, as it reflects the ratio of egg density to water density and is closely related to eggshell strength (Hartono & Isman, 2013). A higher specific gravity value generally indicates better shell quality, thereby reducing the risk of breakage during storage and incubation (Inca et al., 2020). This parameter can also serve as a non-destructive method for predicting hatching egg quality prior to incubation (Ketta & Tůmová, 2018).

Another important external quality parameter is eggshell thickness, which protects the egg contents from mechanical damage and microbial contamination. Shells that are too thin increase water loss during incubation and raise the risk of egg breakage, whereas excessively thick shells may hinder hatching, as chicks have difficulty breaking through them. Eggshell thickness is influenced by several factors, including hen age, nutrition (particularly calcium and phosphorus intake), environmental conditions, and genetics (Hujannah et al., 2024; Herni et al., 2022).

The process of egg formation in chickens involves a series of hormonal activities and reproductive organ functions, particularly in the isthmus and uterus. Genetic variation among strains can influence oviduct function and eggshell formation, resulting in differences in both external and internal egg quality (Habashy et al., 2025; Dirgahayu et al., 2016). Phenotypic differences among breeder hens, such as feather color, are believed to reflect this underlying genetic variation and may therefore indicate differences in the quality of eggs produced (Bobbo et al., 2013).

Although Sentul chickens of the Debu and Kelabu strains have been widely used in breeding and development programs for local chickens, scientific information on differences in external egg quality between these two strains remains very limited. Most previous studies have focused on growth performance, production, fertility, and hatchability, while studies on egg quality characteristics, particularly shape index, specific gravity, and shell thickness, remain scarce. This gap highlights the lack of sufficient scientific basis for determining which Sentul strain produces eggs of better quality to support breeding programs and the conservation of local poultry germplasm.

Based on this background, this study was conducted to compare the shape index, specific gravity, and eggshell thickness of Sentul chicken eggs from the Debu and Kelabu strains. The results of this study are expected to provide scientific information on the external egg quality of both Sentul chicken strains, which can serve as a basis for selection programs, breeding strategies, and the development of Indonesian local chickens.

Materials and Methods

This study was conducted in April 2026 at the Poultry Breeding Development Center (BPPTU) Jatiwangi, Majalengka Regency, West Java, using a comparative method based on field observation of Sentul chicken eggs from the Debu and Kelabu strains. Samples were selected using the simple random sampling method.

The research samples consisted of 140 hatching eggs, comprising 70 eggs from the Sentul chicken Debu strain and 70 eggs from the Kelabu strain. Eggs were collected from hens aged 40 weeks that were maintained under identical management, feeding, and environmental conditions. Sampling was randomly conducted from eggs that met the hatching egg criteria, namely normal shape, intact shell, no cracks, clean surface, and within the standard hatching egg weight range. The eggs were obtained from 95 hens of the Debu strain and 95 hens of the Kelabu strain.

The observed variables included shape index, specific gravity, and eggshell thickness.

1) Shape index
Shape index was calculated as the percentage ratio between egg width and egg length (Tharuklil-ing, 2024), using the following formula:

$$\text{Shape Index} = \frac{\text{Egg Width}}{\text{Egg Length}} \times 100$$

2) Specific gravity
Specific gravity is an indicator of eggshell quality that reflects the ratio of egg density to water density. Measurement was performed using the salt solution (NaCl) immersion method at density levels of 1.075, 1.080, 1.085, 1.090, 1.095, and 1.100 (Asmara et al., 2021). Eggs were gradually immersed starting from the lowest density solution, and the specific gravity value was determined based on the density level at which the egg began to float.

3) Eggshell Thickness
Eggshell thickness was measured using a micrometer screw gauge at three points on the egg: the pointed end, the middle, and the blunt end (Siahaan et al., 2020), using the following formula:

$$\text{T (mm)} = \frac{\text{T1+T2+T3}}{3}$$

Description :
T = Eggshell thickness (mm)
T1 = Thickness at pointed end (mm)
T2 = Thickness at middle part (mm)
T3 = Thickness at blunt end (mm)

The data obtained were analyzed using descriptive statistics to determine the mean, minimum value, maximum value, standard deviation, and coefficient of variation for each observed parameter. Descriptive analysis was used to describe the egg quality characteristics of each Sentul chicken line.

Subsequently, normality and homogeneity tests were performed as prerequisites for parametric analysis. Differences in shape index, specific gravity, and eggshell thickness between the Sentul chicken Debu and Kelabu lines were analyzed using an independent samples t-test at a 5% significance level. Differences were considered significant when $P < 0.05$. The t-test formula used was as follows, according Fauzi et al. (2023).

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{(n_1 - n_2)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1}\right)\left(\frac{1}{n_2}\right)}}$$

Description:
$\overline{X_1}$: mean of sample 1
$\overline{X_2}$: mean of sample 2
s_1^2 : variance of sample 1
s_2^2 : variance of sample 2
n_1 : sample size of sample 1
n_2 : sample size of sample 2

Results and Discussion

The results of descriptive statistical analysis of shape index, specific gravity, and eggshell thickness of Sentul chicken eggs from the Debu and Kelabu lines were further analyzed using an independent samples t-test with the separated variance method (Welch's t-test) to examine the significance of differences between the two lines. The descriptive analysis results are presented in Table 1, while the t-test results are presented in Table 2 below.

Table 1. Descriptive statistical analysis of shape index, specific gravity, and eggshell thickness of Sentul chicken eggs from the Debu and Kelabu lines

No	Description	Shape index		Specific Gravity (g/cm^3)		Eggshell Thickness (mm)	
		Debu	Kelabu	Debu	Kelabu	Debu	Kelabu
1	N (Eggs)	70	70	70	70	70	70
2	Mean	78.05	77.43	1.088	1.088	0.32	0.32
3	Minimum value	71.01	64.22	1.075	1.075	0.27	0.26
4	Maximum value	85.63	85.71	1.100	1.100	0.38	0.39
5	Standard deviation	2.87	3.66	0.005	0.006	0.02	0.02
6	Coefficient of variation (%)	3.67	4.73	0.49	0.53	7.72	7.22

Table 2. Results of the difference test for shape index, specific gravity, and eggshell thickness of Sentul chicken eggs from the Debu and Kelabu lines

No	Description	Shape index		Specific Gravity (g/cm³)		Eggshell Thickness (mm)	
		Debu	Kelabu	Debu	Kelabu	Debu	Kelabu
1	N (Eggs)	70	70	70	70	70	70
2	Mean	78.05	77.43	1.088	1.088	0.32	0.32
3	Variance	8.22	13.39	2.82×10^{-5}	3.38×10^{-5}	0.0006	0.0005
4	Df	138		138		138	
5	T Stat	1.124		0.607		-0.035	
6	T Critical Two-Tail	1.977		1.977		1.977	
7	P(T<=t) two-tail	0.263		0.545		0.972	

The results of the study show that all observed external egg quality parameters exhibited relatively uniform values between Sentul chicken Debu and Kelabu lines. The t-test results indicated that phenotypic differences in feather color between the two lines did not cause significant differences in external egg quality traits. The mean values also remained within the normal range of good quality local chicken eggs suitable for hatching purposes.

Shape Index

The shape index of Sentul chicken eggs from the Debu and Kelabu lines was 78.05 ± 2.87, and 77.43 ± 3.66, respectively. Statistical analysis showed that there was no significant difference (P > 0,05) between the two lines.

These similar results indicate that differences between chicken lines with relatively comparable physiological characteristics do not necessarily produce significant differences in egg shape index. The absence of significant differences is presumed to be due to relatively similar metabolic capacity and reproductive organ development between the Debu and Kelabu Sentul chicken lines.

Sutra et al. (2025) also reported that differences in native chicken types did not significantly affect egg shape index (P > 0,05), with values ranging from 77.41 ± 1.02 to 78.15 ± 1.47. A good egg shape index is generally considered to be within a 3:4 ratio and ranges from 71-79, which is optimal for hatching purposes (Darmike et al., 2025).

Nggaba dan Alexander (2022) stated that the size and diameter of the isthmus directly influence egg shape. In addition, both lines were maintained under the same environmental conditions, management system, and feed supply, which minimized environmental effects on egg shape formation.

Specific Gravity

The specific gravity value of Sentul chicken eggs from both Debu and Kelabu lines was the same, at 1.088 g/cm^3, with standard deviations of 0.0053 and 0.0058, respectively. The t-test results showed no significant difference (P > 0,05) between the two lines.

Asmara et al. (2021) reported that the average specific gravity of Pelung chickens ranged from 1.080 to 1.084 g/cm^3 across different regions. This finding is consistent with Valentim et al. (2019), who also found no significant differences (P > 0.05) in specific gravity between Hisex Brown and Black Chicken Avifran strains, with mean values of 1.083 g/cm^3 and 1.081 g/cm^3, respectively. In commercial laying hens, specific gravity generally ranges from 1.080 to 1.100 g/cm^3. A decrease in specific gravity is associated with reduced eggshell thickness, which subsequently lowers egg resistance to pressure and cracking (Almeida et al., 2021).

The absence of significant differences in specific gravity is presumed to result from similar physiological capacity in eggshell formation between the two Sentul chicken lines. Eggshell formation is influenced by mineral deposition processes, particularly calcium deposition in the uterus. When the metabolic capacity for mineral utilization is similar between lines, specific gravity values tend to be uniform. In addition, similar environmental conditions, management practices, and nutrient composition during the

study may also have contributed to the absence of differences in specific gravity (Tanaffasa et al., 2023).

Eggshell Thickness

The average eggshell thickness of Sentul chicken eggs from the Debu and Kelabu lines was 0.32 ± 0,024 mm and 0.32 ± 0.023 mm respectively. Statistical analysis showed no significant difference (P > 0.05) between the two lines. The observed values were close to those reported by Hasanah et al. (2021), who stated that Sentul chicken eggshell thickness ranges from 0.33 to 0.34 mm.

This result is consistent with Sutra et al. (2025), who reported that native chicken types did not significantly affect eggshell thickness (P > 0.05). The absence of differences in eggshell thickness is also associated with similarities in reproductive physiology, particularly in the uterus, which plays a key role in calcium deposition during shell formation. Similar reproductive tract conditions among chickens tend to produce relatively uniform egg characteristics, especially eggshell thickness (Khusnawati et al., 2022).

Eggshell thickness is an important indicator of hatching egg quality because it is related to shell strength, egg durability, and embryo protection during incubation. Thin shells are more susceptible to physical damage, water loss, and microbial contamination, which may reduce hatching egg quality (Jajuk et al., 2025).

A similar pattern was observed between eggshell thickness and specific gravity in this study, as the relatively similar specific gravity values between the two lines were accompanied by relatively similar eggshell thicknesses. In addition, higher specific gravity values appeared to be accompanied by thicker eggshells. This finding supports Inca et al. (2020), who reported a positive correlation between specific gravity and eggshell quality and thickness.

The results of this study indicate that phenotypic differences in feather color between Sentul chicken Debu and Kelabu lines do not affect external egg quality. This condition may occur because both lines originate from the same breed, are maintained at the same hen age, and are subjected to uniform feeding and environmental management. Shape index, specific gravity, and eggshell thickness in both lines were relatively similar and met the criteria for good hatching egg quality. Therefore, the selection of Debu or Kelabu lines in breeding programs does not need to be based on external egg quality, but rather on production objectives such as egg production improvement in the Debu line or growth performance enhancement in the Kelabu line.

Conclusion

The results of the study showed that Sentul chicken eggs from the Debu and Kelabu lines did not exhibit significant differences in shape index, specific gravity, and eggshell thickness. Both lines showed relatively similar external egg quality and were within the acceptable range for hatching eggs. Therefore, the selection of Debu or Kelabu lines in breeding programs should not be based solely on external egg quality, but should also consider other parameters such as fertility, hatchability, egg production, and growth performance.

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