



THE EFFECT OF CAGE ENVIRONMENTAL ENRICHMENT ON THE INTERIOR QUALITY OF PADJADJARAN PARENT STOCK QUAIL EGGS

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ABSTRACT

This study aimed to determine the effect of cage environmental enrichment on the interior quality of hatching eggs of Padjadjaran parent stock quail. This study used 100 Padjadjaran parent stock quails, divided into 20 male brown and 80 female black quails reared from January to March 2025 at the Quail Breeding Center, Faculty of Animal Husbandry, Universitas Padjadjaran. The study used an experimental method with a completely randomized design (CRD) consisting of 4 treatments, namely T1 (wire ram cage), T2 (wire ram cage with litter), T3 (wire ram cage equipped with nesting facilities and synthetic grass), and T4 (wire ram cage with litter equipped with nesting facilities and synthetic grass). Each treatment was replicated five times, and each repetition consisted of 5 quails (1 male and 4 females). Variables observed included albumen index, haugh unit, yolk index, egg pH. Data were analyzed by ANOVA followed by Duncan Multiple Range Test (DMRT). The results showed that cage environmental enrichment did not affect the interior quality of Padjadjaran parent stock quail eggs.

Keywords : Padjadjaran Quail, environmental enrichment, interior quality.

Introduction

Quail is one of the poultry farmed to fulfill the need for animal protein for humans, both from eggs and meat. One type of quail that is widely farmed in Indonesia is the crossbreed and offspring of *Coturnix coturnix japonica* or Japanese quail. Japanese quail have several advantages such as easy maintenance, short generation interval, and high egg production (Mohammed & Gharib, 2017). Japanese quail is a laying type quail with egg production reaching 250 eggs per year (Lukanov & Pavlova, 2020). Padjadjaran quail is one of the genetic resources developed by the Breeding Center of Universitas Padjadjaran. Padjadjaran quail is one of the genetic resources developed by the Breeding Center of Universitas Padjadjaran from a crossbreed of male brown quail and female black quail (Anang et al., 2017).

The main factors that can affect egg production are genetic and environmental factors (Goto et al., 2019). One of the environmental factors is the cage. Cages are where livestock live and carry out production activities, so the shape and comfort of the cage must be considered to ensure livestock feel comfort-

able and produce well (Setiawati et al., 2016). The way to improve the comfort of quail in the cage is to enrich it by adding facilities that can channel the natural habits of quail, such as litter, nesting facilities, and synthetic grass.

Litter has an influence on the health, performance, welfare and production of livestock. Litter feeding can also be a means to channel the scavenging nature of quail and keep quail busy, which can reduce cannibalism (Wengerska et al., 2022). The addition of nesting facilities in the form of curtains covering the corners of the cage is one of the efforts that can be made to maintain the comfort and welfare of quail. Quails that find a comfortable place to lay eggs will have better productivity and egg quality than quails that do not have access to a nesting area (Hunniford & Widowski, 2018). Synthetic grass can reduce cannibalism behaviour and stress levels in quail (Laurence et al., 2015).

The impact of providing comfort to the quail will result in high production with good egg quality. Uncomfortable conditions will cause the quail to become stressed. Stress can cause a decrease in egg production, feed consumption levels and can cause

disease. Stress also has a negative effect on reproductive hormones in both female and male quails, so that it will affect mating frequency, production, and egg quality (Choeronisa et al., 2016).

This study was conducted to determine the effect of cage environment enrichment (nesting facilities, synthetic grass, and litter) on the interior quality (albumen index, haugh unit, yolk index, and pH) of Padjadjaran parent stock quail eggs, and also to maximize the function of the coop so that the quails can produce optimally and produce high-quality hatching eggs. This study provides new insights through the application of a combination of cage enrichment on Padjadjaran parent stock quails to assess its effect on egg interior quality, which has rarely been studied, and to understand the relationship between the cage environment and the interior quality of quail eggs.

Materials and Methods

The research object used was 100 Padjadjaran parent stock quails divided into 20 male quails of brown strains and 80 female quails of black strains from the Padjadjaran Quail Breeding Center, Faculty of Animal Husbandry, Universitas Padjadjaran. The quail reared from the starter phase to the layer phase, and data collection was carried out in the 11-week-old layer phase.

Quails were kept in brooder cages for 21 days. After that, the quails were moved to the experimental cage unit with a cage density of 25 birds per m². The cages were 50 cm long, 40 cm wide, and 25 cm high. Each experimental cage unit was filled with 5 quails, consisting of 1 male and 4 females. The experimental cage unit was made from steel ram wire, equipped with litter made from rice husks, a nesting facility in one corner of the back of the cage in the form of a plastic curtain, and synthetic grass. Each experimental cage unit was equipped with a feeder, drinker, and labeled according to the treatment and replication. The treatments are:

- T1: Wire ram cage
- T2: Wire ram cage with litter
- T3: Wire ram cages equipped with nesting facilities and synthetic grass
- T4: Wire ram cage equipped with litter, nesting facilities, and synthetic grass

This study used an experimental method with a completely randomized design (CRD), with 4 different types of cages. Each treatment was replicated

five times, and each repetition consisted of 5 quails (1 male and 4 females). Variables observed included albumen index, haugh unit, yolk index, and egg pH. Data were analyzed by ANOVA followed by Duncan Multiple Range Test (DMRT).

The variables observed in this study are:

1. Albumen Index

Albumen Index is calculated by comparing the albumen height with the albumen diameter. The egg to be measured is cracked on a flat glass, then the height of the albumen and the diameter of the egg at two points (long and short diameter) are measured using a caliper. Albumen index is calculated using the following formula (Indrawan et al., 2012):

$$\text{Albumen index} = \frac{\text{Albumen height}}{\text{average albumen diameter}}$$

2. Haugh Unit

Haugh unit is a value that expresses egg quality based on the relationship between weight (W) and albumen height (H) of the egg. Eggs are weighed using a digital scale, then broken on a flat glass, and then a measurement is made on the height of the albumen with a caliper.

The formula for calculating the haugh unit value is as follows (Juliambarwati et al., 2017):

$$HU = 100 \log (H + 7,57 - 1,7 \times W^{0,37})$$

3. Yolk Index

Yolk index was calculated by comparing yolk height to yolk diameter. The egg is broken and the yolk is separated from the egg white, then measure the height and diameter of the egg white using a caliper. The yolk index value can be calculated using the following formula (Indrawan et al., 2012):

$$\text{Yolk index} = \frac{\text{yolk height}}{\text{yolk diameter}}$$

4. Egg pH

Egg pH measurement is done by breaking the egg in a petri dish and homogenizing the yolk and albumen, then the pH of the egg is measured with a pH meter.

Results and Discussion

The results of the study of the effect of cage environmental enrichment on the interior quality of Padjadjaran parent stock quail eggs can be seen in Table 1.

Table 1. Average interior quality of quail eggs with cage environment enrichment

Variables	Treatments			
	T1	T2	T3	T4
Albumen Index	0.30	0.28	0.28	0.26
Haugh Unit	89.72	88.13	88.05	87.62
Yolk Index	0.42	0.41	0.40	0.41
Egg pH	7.22	7.16	7.22	7.21

Note: T1 (Wire ram cage), T2 (Wire ram cage with litter), T3 (Wire ram cage with nesting facilities and synthetic grass), and T4 (Wire ram cage with litter, nesting facilities, and synthetic grass)

Albumen Index

The results of the analysis of variance (Table 1) showed that cage environmental enrichment with the addition of litter, nesting facilities, and synthetic grass had no significant effect ($P>0.05$) on the albumen index of Padjadjaran parent stock quail eggs. Padjadjaran parent stock quail reared in various enrichment cage environments produced eggs with albumen index that were not significantly different. The average albumen index value of Padjadjaran parent stock quail eggs ranged from 0.26 to 0.30. According to SNI 3926:2008, all eggs are included in A quality, which an albumen index ranging from 0.134-0.175 (BSN, 2008).

The addition of egg-laying facilities and synthetic grass aims to improve the welfare of quail, which in turn can increase the production and quality of eggs produced. However, the results of this study showed that there was no effect of enriching the cage environment on the albumen index of the eggs. The researcher suspects that the addition of some facilities has more effect on the welfare and stress levels of quail rather than their reproductive physiology, which is directly related to the quality of quail egg albumen. This is supported by the results of research by Laurence et al. (2015), stated that the addition of nesting facilities and synthetic grass can reduce pacing behavior and stress levels in quail. Factors that can affect the amount and composition of albumen in hatching eggs are the age of the parent, the amount and quality of feed, environmental factors (temperature and light), and the storage conditions of the eggs before incubation (Willems et al., 2014). All of these factors were kept constant in each treatment in this

study. The researchers hypothesized that these similarities were the reason for the relatively similar albumen index.

Environmental factors that have more influence on egg quality are related to temperature, humidity, and light in the cage. Researchers suspect that the environmental enrichment carried out in this study did not cause changes in temperature, humidity, and light in the cage, so that the albumen index produced was the same. Environmental factors do not have a direct effect on the interior quality of quail eggs, therefore, this study produced insignificant results for each parameter. The results of this study are similar to the results of research by Badawi (2017) and El-Sheikh et al. (2016), which stated that there was no significant effect of litter feeding on the index value of egg albumen. In addition, research by (Vieira et al., 2024) stated that there was no effect of enrichment of the cage environment on the percentage of albumen in quail eggs.

Haugh Unit

The results of the analysis of variance (Table 1) showed that cage environmental enrichment with the addition of litter, nesting facilities, and synthetic grass had no significant effect ($P>0.05$) on the haugh unit of Padjadjaran parent stock quail eggs. The average haugh unit value of Padjadjaran parent stock quail eggs ranged from 87.62 to 89.72. According to the haugh unit value, this quail egg is included in the AA quality egg, which is >72 (Jaelani & Zakir, 2016). Haugh Unit values can be influenced by several factors, such as egg age, poultry strain, poultry age, molting, feed nutrition, and disease (Roberts & Choct, 2006). All of these factors were the same in each treatment in this study, that similarities were the reason for the relatively similar haugh unit from each treatment.

Each treatment produced relatively similar haugh unit values. This indicates that the comfort level of the quails in each treatment was similar, resulting in no significant differences in the physiological processes of egg reproduction, which determine the quality of the eggs produced. This statement is supported by the results of research by Pangesti et al. (2016), which states that housing does not have a significant effect on the haugh unit value of quail eggs.

The addition of egg-laying facilities in the form of curtains is related to the light entering the cage.

Light has a significant effect on the release of reproductive and growth hormones (Sangi et al., 2017). Increased light will significantly increase egg production and quality (Fadhlurrohmah et al., 2021). The results showed that the haugh unit value produced was relatively the same in each treatment. This may indicate that the light intensity received by the quail in each treatment was the same.

Yolk Index

The results of the analysis of variance (Table 1) showed that cage environmental enrichment with the addition of litter, nesting facilities, and synthetic grass had no significant effect ($P>0.05$) on the yolk index of Padjadjaran parent stock quail eggs. The average of yolk index value of Padjadjaran parent stock quail eggs ranges from 0.40 to 0.42. This value is included in quality II, which is the yolk index range of 0.394-0.457 (BSN, 2008). The yolk index in this study was smaller than the results of the study by Mulyadi et al., (2017), which stated that the yolk index of quail eggs aged 8-14 weeks was 0.51. This occurred due to differences in feed nutrition and environmental conditions.

One of the parameters that can describe the quality of egg is yolk index. Factors that can affect the yolk index are nutritional and environmental factors. The environmental factors are the temperature and humidity of the cage (Mustakim & Irmayani, 2023). These two factors can be ensured to be the same in each treatment in this study. This is thought to be the reason the yolk index value produced in each treatment is the same.

Enrichment of the cage, such as providing litter in the cage, aims to create a comfortable atmosphere for the quail while in the cage. However, the provision of litter has no effect on the quality of eggs produced. This is supported by the results of research by Padmakumar (1993) and El-Sheikh et al., (2016), which stated that there was no real effect of cage floor (cage and litter) on the yolk index of eggs. Researchers suspect this occurs because the addition of facilities such as litter, egg laying facilities, and scratchers provides the same comfort as cages without the addition of these facilities.

Egg pH

The results of the analysis of variance (Table 1) showed that cage environmental enrichment with the

addition of litter, nesting facilities, and synthetic grass had no significant effect ($P>0.05$) on the egg pH of Padjadjaran parent stock quail eggs. The average pH value of Padjadjaran parent stock quail eggs ranged from 7.16 to 7.22. This pH is slightly higher than the opinion of Ningtiyas et al. (2023) that the pH of fresh eggs is 6.0-7.0 and the results of Rumngevur et al. (2022) which stated that the pH of quail eggs in control cages was 6.70. This is due to differences in temperature and feed provided during this study compared to previous studies. An increase in pH will weaken the vitelline membrane in egg yolks. pH is also a factor that can affect the quality of protein in eggs, which can influence embryo development and egg hatchability (Karoui et al., 2006).

pH is a factor that can affect the quality of protein in eggs that can affect embryo development and hatchability of eggs (Karoui et al., 2006). Research by Wijaya et al. (2019) stated that egg pH is influenced by parent age and topography. The topography in question relates to the temperature and humidity of the cage environment. An increase in temperature will cause physiological changes in the quail's body that will negatively affect production performance and the quality of eggs produced (Akramullah et al., 2023). Enrichment of the cage environment with the addition of litter, laying facilities, and synthetic grass did not significantly affect the temperature in the cage, which caused no difference in the pH of eggs produced in each treatment.

Conclusion

Enrichment of the cage environment with the addition of litter, nesting facilities, and synthetic grass did not affect the interior quality (albumen index, haugh unit, yolk index, and pH) of Padjadjaran parent stock quail eggs.

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