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Egg Quality of Layer Hens Reared in Two Different Housing Systems

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Abstract

This study aims to determine whether there is a significant difference in the quality of eggs from chickens raised in closed-house and open-house cages. This study was conducted in Close housed and house cages for Isa Brown strain layer chickens in the Blitar Regency area in May 2024. The materials used in this study were 40 eggs of 68-week-old Isa Brown strain chickens kept in closed houses and open houses. This research was conducted using an experimental quantitative method using an unpaired t-test, which was analyzed using the Microsoft Excel application. The results showed that the egg weights of chickens reared in the closed house and open house were 63.80 g and 59.68 g; the egg index was 79.06 from the closed house cage and 76.19 from the open house cage. The Yolk index was 0.65 from the closed-house cage and 0.74 from the open-house cage. Haugh Unit (HU) 61.90 from the closed house cage and 64.40 from the open house cage. This study concludes that there is a significant difference in the quality of eggs from chickens reared in closed and open houses. The best egg weight and index were found in chickens reared in a closed house. At the same time, the best yolk index and HU were found in eggs from hens reared in open houses.

Keywords : Close House; Open House; Egg Quality

Introduction

The need for eggs, especially laying hens in Indonesia, is increasing. According to data from the Central Bureau of Statistics (2023), egg consumption from 2020 to 2022 has increased. In 2020, egg consumption reached 5,141,570 tons; in 2021, it reached 5,155,997; and in 2022, it reached 5,566,339 tons. Eggs are a food product that contains animal protein, milk, and meat. The egg protein content is high quality because it has complete essential amino acids. The average protein content in eggs can reach 12.8% with 11.8% fat (Z. Wulandari and I. I. Arief 2022). (Ramadhani, Herlina, and Pratiwi 2019) added that there is a difference in protein content between purebred chickens and native chickens. The protein content of native chicken eggs is 945.07 mg/mL in egg white and 1,229.5 mg/mL in egg yolk while purebred chickens have a protein content of 863.3 mg/mL in egg white and 930.9 mg/mL in egg yolk.

Based on the high public interest and demand for egg consumption, small and large farmers flock to raise laying hens, which sell eggs from the harvest to provide economic benefits (Unmabsi and Afriyatna 2021). However, due to the intense competition among farmers to meet consumer demand for egg consumption, farmers also need to pay attention to the quality of egg production (Tama, 2023). Egg consumption by the public is not only determined in terms of protein content but several types of quality are used as a benchmark for people to buy eggs (Ellyvia 2022)—it also stated that the external quality and internal quality of eggs could influence consumers to buy eggs. The external quality of eggs includes structure, resistance, and cleanliness of the eggshell, while the internal quality of eggs includes aspects of egg albumen, yolk, color, aroma, and taste (da Silva Pires et al., 2021).

The productivity of an animal can be influenced by the environment and husbandry management (Samur, 2023). One maintenance management is housing management, which

can also affect the quality of chicken eggs (Rizqita, Haryuni, and Lestariningsih, 2023). Two types of cages are often used for raising laying hens: open-house systems and closed-house systems (Rastina et al., 2023).

Open-house cages are cages that have open sides. The effect of the open sides causes air to enter and exit without being controlled. This cage's advantage is that the equipment and construction costs are relatively cheap so that farmers can use it. The disadvantages of open-house cages are that it is difficult to control the temperature in the cage, and diseases can be transmitted more quickly from outside to inside the cage and vice versa (Setiawati, Afnan, and Ulupi 2016). Closed house cages are closed cages that have a sound ventilation system. An automatic control panel system assists this ventilation system. The advantages of closed-house cages are that birds are not easily stressed due to the influence of temperature, they prevent contact with laying hens from disease vectors outside the cage, and they regulate temperature and humidity. The disadvantage is that building the equipment is expensive for middle to lower-breeders (Primaditya and Hidanah 2015).

Based on the description above, the researcher wants to carry out research by comparing egg quality, which includes egg weight, egg index, yolk index, and Hugh Unit, in laying hens reared in two different cages: closed-house cages and open-house cages.

Materials and Methods

This study was conducted in May 2024 in closed-house and open-house cages for layer chickens in the Blitar Regency area. The materials used in this study were 40 eggs of 68-week-old Isa Brown strain chickens kept in closed-house and open-house cages. The tools used in this study were a vernier caliper and analytical scales.

This study used the experimental quantitative method by taking Isa Brown strain chicken eggs from two different cages previously given feed and drink ad libitum. Then, after the eggs were collected, their quality was measured, including egg weight, egg index, yolk index, and Haugh Unit, and then recorded for data analysis using an unpaired t-test. The formula for the unpaired t-test can be seen below:

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_{2)}}{\sqrt{S^2 p}(\frac{1}{n_1} + \frac{1}{n_2})}$$

$$db = n - 1$$

$$s = \sqrt{\frac{\Sigma x_1^2 - (\Sigma x_1)^2/n}{n-1}}$$

Note:

$\bar{x}_1$: the mean of egg quality from chickens reared in Close housed
$\bar{x}_2$: the mean of egg quality from chickens reared in open-house
db : degree of freedom (df)
s : standard deviation
n_1 : the total of eggs from chickens reared in Close housed
n_2 : the total of eggs from chickens reared in open-house

The results are then compared to the hypothesis where the hypothesis used is:

Ho: µ1 = µ2 à (there is no difference in the quality of chicken eggs raised in close-housed and open-house cages)

H1: μ1 ≠ μ2 à (There is a difference in the quality of chicken eggs reared in close-housed and open-house cages)

Results and Discussion

Table 1 shows the data generated from this study for the values of egg weight, egg index, yolk index, and Haugh Unit based on two different cages (Closed house and Open House).

Table 1. Average Results of Egg Quality Based on Two Different Cages

Egg quality	Average Value	
	Close House Cage System	Open House Cage System
Egg Weight (g)	63,80	59,68
Egg Index	79,06	76,19
Yolk Index	0,65	0,74
Haugh Unit (HU)	61,90	64,40

Egg Weight

The results showed a significant difference (t statistic > t table) in the egg weight of chickens reared in closed and open-house cages. The highest average weight is found in eggs from chickens reared with a close-house cage system, which is 63.80 grams, while the average weight of eggs in open-house cages is 59.68 grams. There is a difference in egg weight with other research, which states that the weight of chicken eggs reared in closed houses produces a weight of 66.42 grams, and the weight of chicken eggs reared in open houses produces weight of 66 grams (Rastina et al. 2023).

The size of egg weight in this study is large egg class with an egg weight range of 60 - 65 g and an extra extensive egg weight range of 55 - 60 g (Dirgahayu et al. 2016). The egg weight of chickens reared in closed-house cages has an Extra Large class, while in open-house cages, it has a Large class. This difference occurs due to temperature regulation in closed and open-house cages. In house cages, setting the environmental temperature in the cage to suit the needs of chickens is more accessible than setting the temperature in open-house cages. Chickens in open-house cages tend to experience heat stress because the weather from outside directly influences the temperature (Fattah et al., 2023). High temperatures in the cage can reduce egg weight in chickens because chickens consume more water than feed (Yuwanta 2010).

Egg formation and weight are also influenced by how much feed the chicken consumes (Rastina et al., 2023). In addition, egg weight is influenced by genetics and age (Yuwanta 2010). It is reported that the increase in egg weight is also influenced by lighting intensity. Low (11.9 lux) and medium (57.4 lux) light intensity produced heavier egg weights of 61.6 g and 61 g compared to high intensity (121.8 lux) of 59.6 g (Erensoy et al. 2021). This light intensity is closely related to the lighting distribution in the cage. In house cages, the spread of light is more even than in house cages (Rastina et al., 2023).

Egg Index

The egg index value of the study gave significantly different results between eggs produced by chickens kept in closed houses and chickens kept in open-house cages (t statistics > t table). The highest average egg index is the egg produced by chickens kept in close house cages, which is 79.06. At the same time, the egg index by chickens reared in open-house cages was 76.19. The ideal egg shape index value range is 70 - 75. Slightly lower than the egg-shape index results in this study (Dirgahayu et al. 2016).

The calculation of the egg shape index can also be used to determine the shape of the egg itself. An index value of 68.78-78.93 indicates an oval shape, an index value of 78.94-

86.45 indicates a standard shape, and an index value of 86.46-98.59 indicates a round shape (Kurnianto and Kismiati 2019). The shape of the eggs in this study, when viewed in terms of the index, is categorized as a standard shape in eggs from chickens reared in close-house cages and an oval shape from chickens reared in close-house cages.

According to previous research, the egg shape index is not affected by the housing system, but temperature can affect egg production in chickens (Setiawati et al. 2016). Temperature control in open-house cages is more difficult compared to open-house cages. In addition, chickens kept in open-house cages are more susceptible to heat stress due to outside environmental temperatures (Fattah et al., 2023). On the other hand, the egg shape index is internally influenced by the size of the isthmus. If the isthmus of the chicken is narrow, it tends to produce oval eggs, but if the isthmus of the chicken is vast, it tends to produce more round eggs (Dirgahayu et al. 2016).

Yolk Index

The results showed a significant difference (t statistic > t table) between the yolk index of chickens reared in closed-house cages and open-house cages: 0.65 for chicken eggs reared in closed-house cages and 0.74 for chicken eggs reared in open-house cages. The yolk index in this study was higher than the yolk index from other studies, namely 0.45 in closed-house cages and 0.40 in Open-House cages (Rastina et al., 2023).

The yolk index value is influenced by several things, such as storage duration, storage temperature, feed, disease, and environmental temperature of the mother (Nurliana and Sugito 2017). However, in this study, the yolk index was higher in open-house cages than in-house cages, where the temperature and humidity can be adjusted according to the mother's needs. Another factor that can affect the yolk index is in terms of feed, where food that is high in protein and fat can increase the yolk index (Dirgahayu et al. 2016).

Eggs are fresh with a yolk index of 0.33 - 0.50, with an average of 0.42 (Sudarto 2019). In this study, the yolk index was 0.65 and 0.74, which is higher than the literature. The yolk index is also used to determine egg quality. Quality I has a yolk index of 0.458-0.521, quality II has a yolk index of 0.394 - 0.457, and quality III has a yolk index of 0.330 - 0.39 (Dirgahayu et al. 2016).

Haugh Unit (HU)

The HU value in this study showed a significant difference between HU in eggs from chickens reared in closed houses and chickens reared in open houses. HU in eggs produced by hens from close-house rearing is lower than HU in eggs produced by hens from close-house rearing, which is 61.90 and 64.40. This result is lower than the results of another study, which states that the HU value of eggs from chickens reared in Close House and Open House cages is 85.72 and 76.17 (Rastina et al., 2023). The egg grade in this study based on Haugh Unit determination is A, ranging from 60 to 71 (Ibrahim et al. 2018).

The higher the HU value indicates, the better the egg quality. Fresh eggs that chickens have just released have an HU value of 100. The HU value is more than 70 if the egg is still fresh. Meanwhile, the HU value below 50 indicates that the egg is rotten (Purwati, Djaelani, and Yuniwarti 2015). The low HU value in this study is caused by other factors, such as protein feeding, which can affect egg albumin, especially in the ovomucin section. This type of egg protein can affect the height of the egg white used in determining HU (Nurliana and Sugito 2017).

The difference in HU results between eggs produced by chickens from closed-house and open-house cages can be caused by the temperature of the cage environment (Rastina et al., 2023). However, in this study, the HU value in open-house cages was higher than that of closed houses. This can happen because environmental temperature affects the HU in eggs, as

does the length of storage, the age of the eggs, and the quality of feed given to chickens (Novita et al., 2021).

Conclusion

This study concludes that there is a significant difference in the quality of eggs from chickens reared in Close House and Open House. The best egg index and weight results are found in eggs from chickens raised in Close House. At the same time, the best yolk index results and HU values are found in eggs from chickens raised in open houses.

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