The Effect of Storage Time on the Internal Quality of Chicken Eggs in the Second Phase in PS. Mandalan Jaya, Malang Regency

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ABSTRACT
This study aimed to determine the effect of storage time on the internal quality of Hy-Line strain chicken eggs in the second phase of chicken production. The research method used was a field and laboratory experiment with a completely randomized design (CRD). The research treatments included egg storage time: P0: 0 days, P1: 5 days; P2: 10 days; P3: 15 days. Each treatment was repeated 5 times. Each replication unit is 10 eggs. The research variables included: egg white index, egg yolk index, egg yolk color, and egg pH. Research data were analyzed using ANOVA if there were differences between treatments, then continued with Duncan's Multiple Distance Test. The results showed that the highest egg white index was at storage time P0 (0 days) = 0.09 ± 0.02; P1 (5 days) = 0.08 ± 0.01; P2 (10 days) = 0.05 ± 0.02 and P3 (15 days) = 0.04 ± 0.02. The highest egg yolk index was at storage time of P0 (0 days) = 0.41 ± 0.04; P1 (5 days) = 0.34 ± 0.02; P2 (10 days) = 0.28 ± 0.03 and P3 (15 days) with the lowest mean of 0.27 ± 0.03. The highest egg yolk color was found in the storage time of P0 (0 days) = 9±0.71; P2 (10 days) = 8.6 ± 0.13; P1 (5 days) = 8.2±0.447; P3 (15 days) with the lowest mean of 5.9±1.140. The highest egg pH was in the P3 treatment (15 days) = 6.898±0.162; P2 (10 days) = 6.548 ± 1.27 while in the long storage treatment P1. 5 days and P0. 0 days ranged between 6.438±0.206 and 6.43±0.147. It can be concluded that the internal quality of the Hy-Line strain of chicken eggs in the second phase of production still meets the standards up to 15 days of storage at room temperature.

Keywords: *storage time, egg quality, chicken production phase.*

1. INTRODUCTION

Eggs are food products that are needed by the body and have nutritional value as a source of protein, fat, and minerals that are cheap and can be reached by all levels of society. The laying hens business plays a very large contribution to meeting the needs of animal protein for the people of Indonesia. Laying hens are one of the leading commodities that are very efficient in producing eggs, and have great potential to be cultivated because of their easy maintenance and fast production [1].

The maintenance phase of laying hens is divided into three phases, namely the starter phase, the grower phase, and the layer phase. The layer phase is the phase where the laying hens begin to produce eggs. The layer phase is classified into two, namely the layer I phase starting from the beginning of production to the peak of production and the layer II phase starting from the end of the peak production until the end. The length of the production period of laying hens is 80-90 weeks. Production will increase at 22 weeks of age and peak at 28-30 weeks, then egg production will decrease slowly to 55% after 82 weeks of age [2]; [1].

Egg quality can be assessed through the external condition of the egg including cleanliness of the shell or shell, texture, and shape of the egg, while the internal quality assessment can be through breaking the egg to check the thickness of the egg white, egg yolk, and enlargement of the air cavity. The Fresh egg white index ranges from 0.050 – 0.174 according to the SNI standard 01-3926-2008 (BSN, 2008). The older the age of the egg, the diameter of the egg white will widen so that the egg white index gets smaller. Quality is not only an important indicator of the freshness of eggs, but also important for its suitability as a food ingredient to be consumed and needed especially by the egg processing industry. Egg quality can be influenced by genetic factors and environmental factors such as temperature and storage time [3]; [4].

Fresh eggs are eggs that have just been laid by the hen in the nest, have a short storage time, the longer the storage time the freshness of the eggs decreases. The freshness of the eggs decreases after more than one week of age, this is indicated when the eggs are broken, the contents of the eggs can no longer collect. The decrease in the freshness of the eggs was mainly due to the presence of microorganism contamination from the outside [5]; [6].[7] reported an increase in temperature and storage time during the peak period of laying hens causing a significant decrease ($p<0.001$) in egg weight, albumen percentage, Haugh unit (HU), and egg yolk color, and albumen weight also decreased significantly ($p<0.001$) with storage time.

Furthermore, egg yolk pH increased ($p<0.001$) with increasing storage time. Synergy with the research results of Eke *et al*. (2013) 4 weeks storage resulted in a decrease in HU, egg yolk index, and an increase in egg pH. Supported by research results [8] showed egg pH increased significantly with increasing egg storage time. The interaction between storage time and temperature significantly affected shell weight, shell density, egg weight, albumen height, HU, egg yolk color, egg yolk pH, albumen pH, and albumen viscosity. The age of laying hens can have a direct influence on egg quality both internally and externally, especially in fresh eggs [9]. Egg storage time can cause physicochemical changes in both egg yolk and albumen and can change taste, freshness, and palatability. The longer storage time can cause a decrease in the internal quality of eggs [10];[11]. Based on the description above, the study aimed to evaluate the effect of storage time on the internal quality of the Hy-Line strain chicken eggs in the second phase of egg production in PS. Mandalan Jaya, Mandalan Wangi Village, Wagir District, Malang Regency

2. MATERIALS AND METHODS

This research was conducted for two months. Research place in PS. Mandalan Jaya, Mandalan Wangi Village, Wagir District, Malang Regency and the Integrated Laboratory of the Faculty of Animal Husbandry, University of PGRI Kanjuruhan Malang.

The research material used Hy-Line strain chicken eggs in the second production phase (50 weeks of age) as many as 200 eggs. The research method used was a field and laboratory experiment with a completely randomized design (CRD). The research treatment included the length of egg storage:

P0: 0 days
P1: 5 days
P2: 10 days
P3: 15 days

Each treatment was repeated 5 times. Each replication unit consisted of 10 eggs so that the total number of eggs used was 200 eggs.

The observed variables are egg white index, measured egg white height, long and short diameter of thick egg white using a caliper [12]; [13]; egg yolk index, measured yolk diameter and yolk height using a caliper [12]; [13]; egg yolk color, measured using a yolk color fan, which is a color index measuring tool. The quality of the yolk color is measured by matching the color of the yolk compared to the color fan, the score ranges from 1--15 from pale to dark; and Egg pH, measured using a pH meter. This was measured by breaking eggs, then egg whites and egg yolks are put into a measuring cup, stirred until smooth, then measured using a pH meter.

The data obtained were analysed using Analysis of Variance (ANOVA). If the treatment shows a difference, it is continued with Duncan's Multiple Distance Test.

3. RESULTS AND DISCUSSION

3.1 Egg white index

Egg white index is the ratio between thick egg white height (mm) and the average longest and shortest diameter of thick egg white [9].

The results of the analysis of variance showed that the storage time treatment had a significant effect ($P<0.05$) on the egg white index of the second phase Hy-Line strain. In Table 1. Storage time of P0 (0 days) with an average of 0.09±0.02 mm. For storage P1 (5 days) with an average of 0.08 ± 0.01 mm while the storage time of P2 (10 days) with an average of 0.05 ± 0.02 mm and the storage time treatment with the lowest

Table 1. Average Egg White Index

Treatments	Egg white index
P0	0.09± 0.02^{a}
P1	0.08± 0.01^{a}
P2	0.05± 0.02^{b}
P3	0.04± 0.02^{b}

average was in the storage time of P3 (15 days) with an average of 0.04±0.02 mm. This shows that the longer the eggs are stored, the egg quality of the egg white index will decrease.

In newly laid eggs, the egg white index ranges from 0.050-0.174. The decrease in the egg white index is caused by the evaporation of CO_2 gas and water in the egg so that the alkaline nature of the egg white increases and then causes the ovomucin fibers to be damaged. Egg white values decreased more rapidly after 3 weeks of storage when stored at 25^0C. The decrease in the white index value was caused by the evaporation of CO_2 and H_2O that occurred through the pores in the eggshell, resulting in the degradation of organic matter in the egg white such as CO_2, NH_3, and N_2. Then, this condition results in a decrease in the consistency of egg whites, moreover the eggs become runny [15]. The quality of eggs will deteriorate when eggs are stored for a long time which may not be suitable for human consumption.

3.2 Egg Yolk Index

Table 2. Average Egg Yolk Index

Treatments	Egg yolk index
P0	0.41± 0.04[a]
P1	0.34± 0.02[a]
P2	0.28± 0.02[b]
P3	0.27± 0.03[c]

Note: different notation a-c in the same column has a very significant effect (P<0.01) on the egg yolk index of Hy-line strains.

Egg yolk index is a method to determine the condition of eggs in general in the form of measurable calculations. IKT is the ratio between the height of the yolk an*d* the diameter of the yolk [10]. The results of the analysis of variance showed that the length of storage of eggs had a very significant effect (P<0.01) on the egg yolk index. In Table 2, the highest egg yolk index was at storage time of P0 (0 days) with an average of 0.41±0.04 and for a storage time of P1 (5 days) with an average of 0.34±0.02. The storage time of P2 (10 days) with an average of 0.28±0.02 while the storage period of P3 (15 days) with the lowest average of 0.27±0.03. The yolk index ranged from 0.330-0.500. The longer the eggs are stored, the yolk index decreases due to the seepage of water from the egg whites into the yolks. This decrease in yolk index occurred due to the water content in the egg white surrounding the yolk being absorbed by the yolk, causing the diameter of the yolk to widen and the elasticity of the yolk to weaken due to the reduced permeability of the vitelline membrane.

The yolk index value is one indicator of the freshness of broiler eggs. The higher the yolk and the smaller the diameter of the yolk, the better the quality of the yolk index. Based on the value of the Indonesian National Standard (SNI) for Consumed Chicken Eggs [15], the egg yolk index is divided into three, namely Grade I with an egg yolk index value of 0.458-0.521, Grade II between 0.394-0.457, and Grade III between 0.330-0.393.

The yolk index decreased during the storage period along with the decrease in the quality of the egg whites, resulting in the transfer of water from the whites to the yolks. [7] reported that the egg white dilution factor was caused by an increase in pH which resulted in damage to protein fibers (ovomucin). As a result, the water from the egg white protein will come out and a dilution process occurs. According to [12] the decrease in egg yolk index can be influenced by the length of storage, storage place, temperature, quality of the vitellin membrane, and nutrition of the feed. There is a difference in osmotic pressure between egg yolks and whites, where the osmotic pressure in egg yolks is greater than egg whites. This results in the movement of water from the egg white to the yolk through the vitellin membrane, resulting in reduced yolk viscosity and damage to the protein fibers that make up the vitelline membrane. This process will result in a decrease in the height of the yolk and a widening of the diameter of the yolk so that the yolk index value decreases. [11] added that the reduced strength of the vitelline membrane was caused by microorganisms that entered through the egg white and produced proteolytic enzymes, causing the vitelline membrane to weaken.

3.3 Egg Yolk Color

The yolk is the deepest part of the egg which consists of: 1) vitelline membrane, 2) latebra canal, 3) dark yolk layer, and 4) light yellow layer [16]. The results of analysis of variance showed that the length of storage of eggs had a very significant effect (P<0.01) on the yolk color quality of Hy-line strains. In Table 3, the highest color was found in P0 storage time (0 days) with an average of 9.0±0.70 and P1 storage time (5 days) with an average of 8.6±1.34 followed by P2 storage time (10 days) with an average of 8± 0.00 Meanwhile, the storage period of P3 (15 days) with the lowest average was 5.6±1.14. The brightness of the yolk is an

Table 3. Average Egg Yolk Color

Treatments	Egg yolk color
P0	9.0± 0.70[a]
P1	8.6± 1.34[a]
P2	8.0± 0.00[b]
P3	5.6± 1.14[c]

Note: different notation [a-c] in the same column gave a very significant effect (P<0.01) on the egg yolk color of Hy-line strains in the second phase.

indicator that can be used to determine egg quality. To measure the quality of egg yolks, a Roche Yolk Color Fan can be used. The color of the egg yolk is influenced by the content of xanthophyll, beta-carotene, chlorophyll, and cytosan from the feed ration. The difference in egg yolk color is thought to be caused by differences in metabolic ability in digesting rations and differences in absorbing xanthophyll pigments in rations. In addition, the eggs experience water seepage from the egg whites into the yolks which result in stretching of the vitelline membrane, so that the yolk volume becomes larger which causes the yolk color to become pale [10]; [3].

Things that can affect the yolk color score include high productivity of broilers and low xanthophyll pigment content in the ration. if the ration contains more carotenoids, namely xanthophylls, the yolk color will be more reddish orange. At the time of egg storage, there will be a migration of H_2O from the egg white to the yolk. Usually, the color of the yolk will decrease with the longer the egg storage. However, in this study, this has not happened. This is presumably because the H_2O migration from the egg white to the yolk is not yet large so that the yolk condition is still good and has not affected the color of the yolk.

3.4 Egg pH

One of the internal egg quality measurements is egg pH. The pH of freshly released eggs or fresh eggs will increase to a maximum depending on temperature and storage time [11]. The results of the analysis of variance showed that storage time had a very significant effect (P<0.01) on the pH of Hy-line strain chicken eggs in the second phase. In Table 4 The pH of eggs in the treatment of P3 storage time (15 days) with an average of 6.90 ± 0.16 while in the treatment of P2 storage time (10 days) with an average of 6.55 ± 0.13 and in the treatment of storage time of P1 (5 days) 6 .44±0.20 and P0 (0 days) 6.43±0.14. Storage can increase the pH value of eggs. The increase in the pH value of eggs occurs due to the decomposition of NaHCO compounds into NaOH and CO_2. The formed NaOH will be decomposed into Na+ and OH- while the formed CO_2 will evaporate thereby increasing the pH of the albumen. The increase in pH will form an ovomucin-lysozyme complex which causes the albumen to become dilute [18]. A good egg pH ranges from 6.00-7.62. The increase in albumen pH mainly depends on the buffering capacity of the albumen, not only that, but also depends on the temperature, storage duration, environmental gas in the storage chamber, and the conductance of the eggshell [7];[19].

Table 4. Average Egg pH

Treatments	Egg yolk color
P0	6.43 ± 0.14[a]
P1	6.44 ± 0.20[a]
P2	6.55 ± 0.13[a]
P3	6.90 ± 0.16[b]

Note: different [a-b] notations in the same column gave a very significant effect (P<0.01) on the pH of Hy-line strain chicken eggs in the second phase.

Storage of eggs for 0 days, 5 days, and 10 days did not differ on egg pH. This is presumably because the long-time interval of egg storage which is not too long causes low CO_2 evaporation so that the mechanism of the buffer system is still good. CO_2 that is lost through the pores of the eggshell causes the concentration of bicarbonate ions in the egg white to decrease and damage the buffer system. The increase in egg storage time, the height of the egg white thick layer will decrease. This occurs due to changes in the gel structure so that the surface of the egg white expands due to the dilution that occurs in the egg white due to the evaporation of CO_2 and increased pH [17]; [4].

4. CONCLUSION

Based on the results of the study, it can be concluded that the internal quality of the Hy-Line strain chicken eggs in the second phase of production in PS. Mandalan Jaya, Mandalan Wangi Village, Wagir District, Malang Regency still meets the standard of up to 15 days of storage at room temperature.

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