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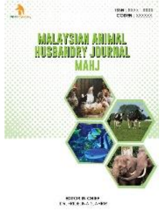

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REVIEW ARTICLE

EFFECTS OF AGE IN LAY AND STORAGE TIME OF EGG QUALITY PARAMETERS OF LAYING CHICKEN

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ABSTRACT

This study This was carried out at Prof. Lawal Abdu Saulawa Livestock Teaching and Research Farm, and Chemistry Laboratory, Federal University Dutsin-Ma, Katsina State, to determine the Effects of Age on Lay and Storage Time of Egg Quality Parameters of Laying Chicken. A total of 30 eggs were purchased from the Prof. Lawal Abdu Saulawa Livestock Teaching and Research Farm, Department of Animal Science, with fifteen each from early layers (5 weeks in lay) and old layers (52 weeks in lay). The results revealed that the egg weight of Late Lay (LL) was significantly higher (62.95g) compared to Early Lay (EL) (48.92g). Egg width and height were also influenced by hen age. LL hens produced wider (58.92 mm) and slightly taller eggs (44.93 mm) than EL hens (50.21 mm and 44.08 mm, respectively). However, yolk height showed no significant difference between age groups, with EL of 13.47 mm and LL of 13.23 mm. Albumen height was also similar in both EL and LL hens (7.99 mm and 7.69, respectively). Shell quality showed notable differences. LL eggs had significantly thicker shells (0.39 mm) and greater shell weight (5.88g) than EL eggs (0.31 mm and 4.78g, respectively). Fresh (59.50g), 1 week (56.01g), and 2 weeks (52.30g). Egg width increased slightly from fresh (51.99 mm) to 1 week (55.81 mm) and remained nearly the same at 2 weeks (55.90 mm), while egg height declined (Fresh = 46.78 mm, 2 weeks = 43.20 mm). Yolk height decreased sharply over time: Fresh (17.84 mm), 1 week (13.98 mm), and 2 weeks (8.23 mm). Shell thickness showed slight variation, peaking at 1 week (0.39 mm) and falling to 0.29 mm at 2 weeks. Yolk weight increased slightly after 1 week (15.25g) compared to fresh eggs (13.78g).

KEYWORDS

Age in Lay, Albumen, Yolk weight, Shell thickness, Early Lay

1. INTRODUCTION

Eggs are a staple in diets across the globe, valued for their rich supply of high-quality protein, essential amino acids, vitamins, and minerals. Two key factors that significantly influence egg quality are the time elapsed since the egg was laid (egg age) and the conditions under which it is stored. These variables can markedly affect both the external and internal attributes of eggs (Samli et al., 2005; Silversides and Scott, 2001). External quality pertains to the shell's features, cleanliness, texture, strength, and thickness. Internal quality includes indicators such as albumen height, yolk index, Haugh unit, yolk color, and overall freshness (Akyurek and Okur, 2009). These characteristics are crucial not only for consumer satisfaction but also for determining egg grading and pricing (Réhault-Godbert et al., 2019). Internal traits are important in the food processing industry, where consistency and functional properties like emulsification and foaming are essential (Jones and Musgrove, 2005). Fresh eggs exhibit optimal internal features: thick albumen and centered yolks. However, as eggs age, they undergo physical and chemical changes due to moisture and carbon dioxide loss through the shell. This leads to increased albumen pH and a thinning of the thick albumen layer (Groot et al., 2003).

Storage variables such as temperature, humidity, and duration play a critical role in maintaining egg quality. Eggs kept at higher temperatures degrade faster than those stored in refrigerated environments (Al-Batshan et al., 1994). Refrigeration helps preserve freshness by slowing microbial activity and biochemical changes (Akyurek and Okur, 2009). In contrast, storing eggs at room temperature, especially in warmer climates, accelerates moisture loss and microbial growth, hastening quality decline (Scott and Silversides, 2000). Studies have consistently shown that egg quality diminishes over time. That eggs stored at room temperature for 21 days had lower Haugh units, thinner albumen, and larger air cells (Samli et al., 2005). Albumen and yolk indices dropped significantly after just 15 days of ambient storage, with the rate of decline influenced by temperature and initial egg quality (Akyurek and Okur 2009).

Declining egg quality affects more than just taste it impacts marketability and food safety. Eggs that fail to meet quality standards are often rejected, reducing income for producers. Additionally, as albumen pH rises, its antimicrobial properties weaken, increasing the risk of bacterial contamination, particularly from pathogens like Salmonella enterica (Messens et al., 2005). This poses serious public health risks, especially in areas with limited food safety infrastructure. While extensive studies have explored egg storage under controlled conditions, there's limited understanding of how eggs deteriorate in real-world settings particularly in small-scale farms without refrigeration. Eggs are highly perishable, and both internal changes (like moisture loss and pH shifts) and external factors (like poor storage environments) contribute to their degradation (Samli et al., 2005; Akyurek and Okur, 2009).

In many rural and small-scale poultry operations, eggs are stored at ambient temperatures for extended periods, leading to rapid quality loss. Most existing research focuses on industrial settings, leaving a gap in knowledge about egg preservation in tropical and subtropical climates where cold storage is often unavailable (Réhault-Godbert et al., 2019).

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This study seeks to address that gap by examining how varying storage durations and egg ages affect quality in small- and medium-scale poultry farms. The findings aim to guide better storage practices, reduce food waste, and enhance food safety in regions where refrigeration is not always accessible.

2. Materials And Methods

2.1 Experimental site

This was carried out at Prof. Lawal Abdu Saulawa Livestock Teaching and Research Farm, and Chemistry Laboratory, Federal University Dutsin-Ma, Katsina State. A total of 30 eggs were purchased from the Prof. Lawal Abdu Saulawa Livestock Teaching and Research Farm, with fifteen each from early layers (5 weeks in lay) and old layers (52 weeks in lay). The eggs were stored at room temperature (25°C) throughout the study in a completely randomized design (CRD) with a 2 x 3 factorial arrangement. The factors were age in lay (5 and 52 weeks in lay) and storage time (0, 7, and 14 days). Five fresh eggs each were randomly picked from early layers and old layers to determine the egg quality parameters. Data were collected on the following parameters:

- Egg weight:

The eggs were weighed using a sensitive electronic scale to the nearest 0.01g.

- Albumen and yolk height:

Each egg was broken around the middle; care was taken to keep the yolk intact. The albumen and yolk heights were measured with the aid of digital vernier calipers

- Albumen weight, yolk weight and shell weight:

Albumen weight and yolk weight were measured for individual egg to the nearest 0.01g using a sensitive electronic scale. Shell weight was also measured after sun drying to remove moisture.

- Shell thickness:

Shell thickness was measured for individual dry egg shells to the nearest 0.01mm using a micrometer screw gauge.

The remaining eggs were then stored for seven and fourteen days at room temperature and five eggs each were also collected from the early layers and old layers at these periods to determine similar egg quality parameters as shown above.

The collected data obtained from the study were analyzed using Analysis of Variance (ANOVA) with a completely randomized design. A significance level of $p < 0.05$ was used to determine whether any differences in egg quality were statistically significant.

3. Results And Discussion

The result of the effect of age and storage on external and internal egg quality parameters of laying chickens is shown in Table 1:

Table 1: Effect of age in lay and storage time on external and internal egg quality parameters of laying chickens

Layer	Egg Weight	Egg Width	Egg Height	Yolk Height	Albumen Height	Albumen Wt	Shell Thickness	Shell Weight	Yolk Weight
EL	48.92^{b}	50.21^{b}	44.08	13.47	7.99	29.54	0.31	4.78^{b}	14.82
LL	62.95^{a}	58.92^{a}	44.93	13.23	7.69	-	0.39	5.88a	-
SEM	1.07	0.73	0.73	0.32	0.28	1.14	0.02	0.18	0.44
Storage									
Fresh	59.50^{a}	51.99^{b}	46.78^{a}	17.84^{a}	10.37^{a}	40.21a	0.36	5.51	13.78
1 week	56.01^{ab}	55.81^{a}	43.54^{b}	13.98^{b}	6.88^{b}	35.18^{b}	0.39	5.47	15.25
2 weeks	52.30^{b}	55.90^{a}	43.20^{b}	8.23^{c}	6.26^{b}		0.29	5.00	
SEM	1.31	0.89	0.90	0.40	0.35	1.68	0.03	0.23	0.65

abc : means within column bearing different superscripts differ significantly, EL: Early Lay, LL: Late Lay, SEM: standard error of the mean

3.1 Effect of age in lay on external and internal egg quality parameters of laying chickens

Eggs laid during the Late Lay (LL) period were notably heavier, averaging 62.95g, compared to those from the Early Lay (EL) phase, which weighed 48.92g. This trend mirrors findings by Roberts (2004) and carries both economic and qualitative significance. Heavier eggs not only offer greater market value but also tend to exhibit enhanced shell strength and increased internal volume. These observations support earlier research suggesting that egg weight generally rises as hens age (Silversides and Scott, 2001).

Hen age also affected the physical dimensions of the eggs. LL hens produced eggs that were wider (58.92 mm) and marginally taller (44.93 mm) than those from EL hens (50.21 mm in width and 44.08 mm in height). The increased width and rounder shape are likely due to the extended reproductive maturity and increased flexibility of the oviduct in older hens. That aging hens tend to have more elastic oviducts, which facilitates the production of larger, more rounded eggs (Silversides and Scott 2001). These dimensional shifts are relevant to consumer preferences and contribute to the structural integrity of the eggshell.

Interestingly, yolk height showed no significant difference between age groups, with EL at 13.47 mm and LL at 13.23 mm. This indicates that age alone may not have a marked effect on yolk elevation at the time of lay. However, yolk height is known to decline with storage rather than age, making it a more sensitive marker for egg freshness than for hen age (Scott and Silversides, 2000).

Albumen height was also similar in both EL and LL hens (7.99 mm and 7.69 respectively). Albumen height is a critical quality metric and a standard indicator of egg freshness. Albumen height tends to decrease with hen age due to weakening of albumen proteins (Haugh 1937) and (Jones 2007).

For albumen weight, only data for EL hens (29.54g) was provided, limiting comparative interpretation. However, albumen typically constitutes the majority of the egg's internal content and tends to increase with overall egg size. The absence of LL data is a limitation in understanding the full scope of age-related changes in albumen mass.

Shell quality showed notable differences. LL eggs had significantly thicker shells (0.39 mm) and greater shell weight (5.88g) than EL eggs (0.31 mm and 4.78g respectively). These results are somewhat surprising, as shell quality often declines with age. However, individual hen genetics and dietary supplementation can counteract this trend (Sekeroglu et al., 2010). While, older hens tend to produce thinner shells, this study suggests favorable conditions may have sustained shell development in LL hens (Roberts 2004).

Only yolk weight for EL hens (14.82g) was provided, making it difficult to draw conclusions regarding the effect of age. Nonetheless, yolk weight generally increases with egg size, and by inference, LL eggs likely contain heavier yolks (Scott and Silversides, 2000). The lack of complete data warrants further investigation.

3.2 Effect of storage time on external and internal egg quality parameters of laying chickens

Egg weight decreased progressively with storage: Fresh (59.50g), 1 week (56.01g), and 2 weeks (52.30g). This is a well-documented phenomenon, primarily attributed to the loss of water and carbon dioxide through the eggshell over time (Samli et al., 2005). The result is consistent with literature indicating that prolonged storage leads to a reduction in egg mass, especially under non-refrigerated conditions.

Egg width increased slightly from fresh (51.99 mm) to 1 week (55.81 mm) and remained nearly the same at 2 weeks (55.90 mm), while egg height declined (Fresh = 46.78 mm, 2 weeks = 43.20 mm). The width increase may be due to slight expansion as internal pressure changes with moisture loss. However, the decrease in height reflects yolk flattening and the redistribution of internal contents. Similar dimensional changes during egg storage (Silversides and Scott 2001).

Yolk height decreased sharply over time: Fresh (17.84 mm), 1 week (13.98 mm), and 2 weeks (8.23 mm). This indicates a progressive degradation of

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the yolk membrane, leading to flattening and mixing with the albumen. That yolk index is one of the most reliable indicators of egg freshness, and these results confirm that longer storage periods compromise yolk integrity (Scott and Silversides 2000).

There was a parallel drop in albumen height, from 10.37 mm (Fresh) to 6.26 mm (2 weeks). The albumen becomes more watery over time due to the breakdown of ovomucin, reducing its ability to support the yolk. That albumen thinning is a key metric in monitoring egg quality decline (Haugh 1937) and (Jones, 2007).

Shell thickness showed slight variation, peaking at 1 week (0.39 mm) and falling to 0.29 mm at 2 weeks. This variability is minor, as shell thickness generally remains constant in the short term. Shell weight decreased from 5.51g (Fresh) to 5.00g (2 weeks), possibly due to handling or changes in structural integrity. However, these differences are within a narrow range and may not be statistically significant.

Yolk weight increased slightly after 1 week (15.25g) compared to fresh eggs (13.78g). This is likely due to the absorption of water from the albumen into the yolk, a process that makes the yolk more fluid and heavier. Such fluid migration is common during egg storage and can alter yolk texture and cooking properties (Jones, 2007).

4. Conclusion

The findings of this study clearly demonstrate that storage duration at room temperature (25°C) significantly impacts both the internal and external quality parameters of chicken eggs. As storage time increased from one to three weeks, key quality indicators such as albumen height, yolk height, and yolk weight showed marked declines, signifying a reduction in freshness and nutritional value. Similarly, external parameters such as egg weight and shell weight decreased over time due to moisture loss and changes in structural integrity. Notably, large eggs exhibited more rapid quality deterioration compared to small eggs, likely due to their larger surface area and potentially thinner shells, which accelerates gas exchange and water loss. The shell, while more resistant to immediate changes, still showed signs of weakening, suggesting that even the egg's primary barrier to microbial entry is compromised with time.

Recommendations

Based on the findings of this study, the following recommendations are suggested:

Eggs should be stored under refrigerated conditions (4–7°C) as soon as possible after lay to significantly delay degradation and maintain both internal and external quality, particularly in warmer climates. Consumers should aim to use eggs within one week if stored at room temperature, especially for applications that require high internal quality such as baking or direct consumption. Producers and retailers should invest in cool storage facilities, particularly in open markets and farm settings, to prolong shelf life and ensure food safety.

Further research is recommended to evaluate the effects of different storage temperatures (e.g., cool room vs. refrigeration) and humidity levels on a broader range of egg qualities, including microbiological safety. Incorporating the Haugh unit and pH measurements in future studies will provide a more comprehensive understanding of internal egg degradation.

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