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Physical Quality Evaluation of Commercial Chicken Eggs (Gallus gallus domesticus) Sold in Traditional Markets in Ambon City

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A R T I C L E I N F O

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A B S T R A C T

Abstract Purebred chicken eggs are a strategic source of animal protein in Ambon City, yet their distribution system heavily relies on inter-island supply via maritime routes. The distribution time and storage conditions at room temperature in traditional markets have the potential to degrade both the interior and exterior quality of the eggs. This study aimed to evaluate the physical quality of purebred chicken eggs sold in the traditional markets of Ambon City based on the Indonesian National Standard (SNI) 3926:2008. The study used a quantitative descriptive method with a purposive sampling technique. A total of 60 egg samples were collected from two main trading centers: A Market and B Market. The observed variables included egg weight, air cell depth, Yolk Index (YI), and Haugh Unit (HU) values. Data were analyzed using descriptive statistics (mean and standard deviation) and then classified into SNI quality grades. The results showed that the average egg weight was 58.42 ± 3.15 g (medium-large category). The average air cell depth was 6.8 ± 1.2 mm (Grade II/III). The YI value was 0.31 ± 0.04, and the Haugh Unit was 64.5 ± 5.8 (Grade II). It is concluded that the physical quality of purebred chicken eggs in Ambon City's traditional markets is predominantly at Grade II (Grade B) moving towards Grade III (Grade C). This quality degradation is highly influenced by the duration of the supply chain and the high-temperature storage environment at the vendor stalls without any cooling system

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INTRODUCTION

Commercial chicken eggs are one of the livestock product commodities with high nutrient density, containing protein with a complete essential amino acid profile, and are easily accessible to all segments of society. In Ambon City, demand for commercial chicken eggs continues to fluctuate in direct proportion to population growth and the changing consumption needs of households and the culinary industry.

Unlike poultry production centers on the island of Java, the supply of commercial chicken eggs in Maluku Province, particularly Ambon City, is still largely sourced from outside the island (especially from Surabaya and Makassar) using sea transportation fleets. This lengthy logistics distribution chain extends the storage period of eggs before they finally reach retailers. At the retail level, particularly in traditional markets such as Market A and Market B, commercial chicken eggs are generally displayed in open areas at room temperature with high humidity, without the implementation of a cold chain system (cold chain).

Eggs are perishable. Although protected by a shell, they have microscopic pores that allow gas exchange. Exposure to the tropical ambient temperatures in Ambon City, which range from 28–32°C, accelerates the rate of evaporation of water (H2O) and carbon dioxide gas (CO2) from the egg contents. The release of CO2 triggers an increase in the pH of the egg white, which biochemically causes denaturation of the ovomucin-lysozyme protein complex. The physical effects are that the egg white becomes runny, the yolk flattens, and the air cell depth increases.

This decline in quality not only reduces the aesthetic value and functional suitability of eggs for processing, but also shortens the remaining shelf life of the product in the hands of the end consumer. Therefore, this study was conducted to quantitatively evaluate the physical quality parameters of commercial chicken eggs sold in traditional markets in Ambon City, and compare them with the eligibility parameters of the Indonesian National Standard (SNI 3926:2008) concerning Table Eggs.

LITERATURE REVIEW

Nutritional Composition of Commercial Chicken Eggs

Commercial chicken eggs (Gallus gallus domesticus) are globally recognized as one of the most affordable, nutrient-dense, and complete sources of animal protein in the human diet (Réhault-Godbert S., et al., 2019). Comprising high-biological-value proteins, essential amino acids, lipids, fat-soluble vitamins, and minerals, eggs play a pivotal role in addressing protein-energy malnutrition, particularly in developing regions and archipelagic nations like Indonesia. However, despite their natural protective barriers—namely the calcified shell, shell membranes, and antimicrobial enzymes such as lysozyme in the albumen—eggs are perishable commodities (Barbut S., 2022). Their physical and chemical integrity begins to deteriorate immediately post-oviposition, heavily influenced by handling practices, storage duration, and environmental conditions (Roberts, 2004; Kralik G, et al., 2021).

Internal Physical Quality Parameters

Internal egg quality reflects the freshness and functional properties of the albumen (egg white) and yolk. Standard evaluation metrics include the Haugh Unit (HU), Albumen Index, Yolk Index, air cell depth, and yolk color score (Kralik et al., 2021).

Albumen Quality and Haugh Unit

The Haugh Unit, calculated from egg weight and the height of the thick albumen, remains the universal gold standard for assessing internal egg. Immediately after laying, eggs exhibit a dense, viscous thick albumen maintained by the ovomucin-lysozyme complex (Barbut, 2022). Over time, the diffusion of carbon dioxide (CO2) through the eggshell pores increases the albumen pH from approximately 7.6 to 9.5. This alkalinity induces the dissociation of the ovomucin-lysozyme complex, resulting in the liquefaction and thinning of the thick albumen, thereby drastically reducing the HU value (Scott & Silversides, 2000; Pires et al., 2019).

Yolk Index and Air Cell Depth

The Yolk Index (ratio of yolk height to yolk diameter) measures the mechanical strength of the vitelline membrane. As eggs age, osmotic pressure gradients drive water migration from the albumen into the yolk, causing the yolk to swell, flatten, and eventually rupture (Jones & Musgrove, 2005). Concurrently, the evaporation of water and CO2 through the shell causes the inner and outer shell membranes to separate at the blunt end, progressively enlarging the air cell depth—a direct physical indicator of storage age (Samli et al., 2005; Kralik et al., 2021).

Traditional Market Supply Chains

In Eastern Indonesia, particularly in archipelagic cities like Ambon, the commercial egg supply chain faces distinct logistical challenges. A substantial portion of commercial eggs distributed in Ambon City is transported via inter-island maritime shipping from major poultry production centers in Java or Sulawesi, followed by open-air display in traditional wet markets. Traditional markets typically lack cold-chain infrastructure, exposing eggs to high ambient temperatures, fluctuating humidity, direct sunlight, and extended retail display periods (Yusuf & Rahman, 2025).

While several studies have documented egg quality degradation in mainland Indonesia, empirical data evaluating the combined impact of inter-island maritime logistics and tropical traditional market environments in Maluku remains scarce. Evaluating the physical quality of eggs in Ambon City's traditional markets is therefore essential to establish baseline quality standards, identify critical points of deterioration, and formulate localized post-harvest handling interventions.

METHODS

This observational study uses a quantitative approach. Sampling was conducted at two major traditional markets in Ambon City, namely Market A and Market B.

Sample Selection

The sampling method used was purposive sampling. The inclusioncriteria were wholesale or retail traders who had been selling commercial chicken eggs for more than one year and had a consistent daily sales volume. A total of 5 traders were selected from each market. From each trader, 6 eggs were randomly collected from the top, middle, and bottom display shelves. The total sample tested was 60 egg.

Testing Instruments and Variables

The physical quality of the interior and exterior was assessed in the laboratory by measuring four main variables:

1. Egg Weight (g): Measured using a digital analytical balance with an accuracy of 0.01 grams.
2. Air Cell Depth (mm): Measured using calipers at the blunt end of the egg after the shell has been carefully peeled off.
3. Yolk Index (YI): Calculated by dividing the yolk height by the average yolk diameter. Measurements are taken using calipers.
4. Haugh Unit (HU): The main parameter for thick egg white quality. Calculated using an empirical mathematical equation (Raymond Haugh, 1937):

$$HU = 100 \log (H + 7.57 - 1.7 W^{0.37}$$

Description:
HU= Haugh Unit
H= Height of thick albumen / egg white (mm), measured using a tripod micrometer.
W = Whole egg weight (grams)

Data Analysis The quantitative data obtained were tabulated and analyzed using descriptive statistics to determine the mean and standard deviation. The calculation results were then compared and classified into quality grades based on SNI 3926:2008 concerning Commercial Chicken Eggs for Consumption (Quality I, II, and III).

RESULTS

Based on the examination of 60 egg samples from Market A and Market B, a summary of the physical quality data was obtained, as presented in Table 1.

Table 1. Average Physical Quality of Commercial Chicken Eggs in Traditional Markets in Ambon City

Test Variables	Market A	Market B	Average	SNI Standar Grade B
Egg Weight (g)	58,10 ± 3,21	58,74 ± 3,09	58,42 ± 3,15	≥ 50 (Bebas)
Air Cell Depth (mm)	6,9 ± 1,4	6,7 ± 1,0	6,8 ± 1,2	5 – 9 mm
Yolk Index (YI)	0,30 ± 0,03	0,32 ± 0,05	0,31 ± 0,04	0,39 – 0,45
Haugh Unit (HU)	63,8 ± 6,1	65,2 ± 5,5	64,5 ± 5,8	60 – 72

DISCUSSION

Egg Weight

The average egg weight in both markets was 58,42 grams. Based on size classification, these eggs fall into the large size category (Large). There is no significant difference between the egg weights at Market A and Market B because most distributors are supplied by the same cargo ships from production centers in East Java. These eggs are still considered normal in weight and have not undergone drastic shrinkage that could alter their commercial size classification.

Air Cell Depth

Air cell depth is the easiest visual indicator to use for determining egg age. The air cell forms due to the separation of the outer and inner shell membranes caused by temperature contraction after the egg is oviposited, and continues to enlarge due to water evaporation during storage.

The test results showed an average air cell depth of 6,8 mm. Referring to SNI 3926:2008, a depth of < 5 mm is classified as Grade I, 5-9 mm as Grade II, and > 9 mm as Grade III. Thus, eggs sold in traditional markets in Ambon City fall into the Grade II category, approaching Grade III. This high figure correlates with the duration of cargo ship journeys to Maluku, which can take 4 to 7 days, in addition to the time spent at port distributor warehouses before being distributed to retail stalls.

Egg Yolk Index (EYI)

The EYI indicates the viscosity and sphericity of the egg yolk. The longer eggs are stored at room temperature, the weaker the vitelline membrane surrounding the yolk becomes, its elasticity decreases, and the yolk flattens or spreads out. Normally, fresh Grade I eggs have an EYI between 0.458–0.521. The research results show an average EYI value of 0.31. This value is below the SNI

Grade II standard threshold (0.39–0.45) and indicates that the yolk has undergone significant flattening.

The microclimatic conditions at traditional market stalls, where eggs are displayed on open racks at an average temperature reaching 30°C during the day, accelerate the movement of water from the egg white (which is more dilute) into the yolk through osmosis. This causes the yolk to stretch and its index to decrease drastically.

Haugh Unit (HU)

The Haugh Unit is the global gold standard for measuring the internal quality of eggs. The higher the height of the thick albumen, the higher the HU value. Based on empirical calculations, the average HU value is 64.5. According to SNI provisions, an HU value > 72 falls into Grade I, 60–72 into Grade II, and < 60 into Grade III. These results place eggs in Ambon City in the Grade II category (Grade B).

The albumen undergoes degradation (thinning) due to the loss of carbonic acid through the shell pores, which changes the albumen pH from the neutral range (7.6) to alkaline (up to 9.2). Under alkaline conditions, ovomucin fibers break down, reducing the viscosity of thick egg white. The fact that the eggs are neither washed nor given a protective coating to seal the shell pores during transport from Java to Maluku further accelerates the rate of decline in this HU value.

CONCLUSIONS AND RECOMMENDATIONS

The physical quality of commercial chicken eggs available in the traditional markets of Ambon City (Market A and Market B) predominantly falls within the Grade II (Grade B) standard, approaching Grade III (Grade C). The Haugh Unit parameter (64,5) and air cell depth (6,8 mm) still meet the requirements for Grade II consumption suitability, but the Egg Yolk Index has shown significant degradation, falling below the standard.

The main factors contributing to this decline in quality are the lengthy inter-island supply chain and storage at tropical room temperatures without a cold chain mechanism at the retail level. Wholesale and retail traders in traditional markets are advised to implement strict stock rotation management (the First In First Out system) and avoid placing egg racks in areas exposed to direct sunlight to reduce the rate of evaporation of the egg contents.

FURTHER STUDY

This research still has limitations; therefore, further studies on the physical, chemical, and biological quality of eggs are needed to refine this work and broaden the insights for both readers and the author

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