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Evaluation of quality eggs from different sources in the retail market, South Sulawesi, Indonesia

Anas Qurniawan[1*], Muhammad Basir Paly[1], Astati[1], Amriana Hifizah[1], Lilies Handayani[2], Nurfaisah Baharuddin[3], Rusny[1], Irmawaty[1] and A. Mustika Abidin[1]

[1] *University Islam Negeri Alauddin Makassar, Indonesia*
[2] *Graduate School of Natural Science and Technology, Kanazawa University, Kanazawa, Japan, and Department of Statistics, Tadulako University, Palu, Indonesia*
[3] *Department of Management, Sekolah Tinggi Ilmu Ekonomi AMKOP, Makassar, Indonesia*
[*]*Corresponding author:* anas.qurniawan@uin-alauddin.ac.id

Abstract

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Eggs are a vital nutritional source, providing high protein at a low cost. This study examines the quality of eggs from various retail sources in South Sulawesi, Indonesia. A total of 180 eggs were collected from four modern markets and assessed for both external and internal quality attributes. The results showed notable differences in egg quality depending on the source. Eggs from Source D had better external attributes, such as higher weights and cleaner shells.

In contrast, those from Source A had superior internal attributes, including greater albumen height and higher Haugh unit scores. Correlation analysis revealed a positive relationship between albumen weight and height and a negative relationship between albumen height and the albumen index. These findings underscore the importance of considering the source when purchasing eggs to ensure high-quality products. The study emphasizes the importance of improved handling and storage practices to maintain egg quality and meet consumer expectations.

Keywords: egg quality; retail market; South Sulawesi; albumen height; Haugh unit; shell thickness

Introduction

Eggs are a vital source of nutrition for humans, providing high protein value at a relatively affordable cost compared to other livestock products (Gautron et al., 2022). Eggs are commonly consumed after boiling, owing to their relatively simple preparation process (Réhault-Godbert et al., 2019; Zhang et al., 2022). However, information regarding egg characteristics, particularly from retail markets, remains limited (Sun et al., 2019). Previous studies have evaluated egg quality according to the quality standards set by the Indonesian National Standard (Qurniawan et al., 2022).

Egg quality is crucial for both consumers and producers alike. Factors influencing egg quality include the strain and age of hens, conditions of egg storage such as temperature, duration, and humidity, laying season, and feeding regimen (Lee et al., 2016). Consumers, particularly when purchasing eggs from supermarkets or hypermarkets, tend to consider physical characteristics such as size, weight, and shell color (Preisinger, 2018; Tolimir et al., 2017; Zeng et al., 2022). Additionally, the texture and sensory characteristics of the yolk also influence consumer preferences (Franco et al., 2020; Zhang et al., 2022). This shift in consumer perception was evident in the egg purchasing patterns observed in retail sectors like Walmart, Kroger, and McDonald's in the United States in 2016, reflecting an increasing demand for eggs with consistent quality and consumer-preferred attributes (Lusk, 2019).

In the U.S. retail market, eggs are available in various types, including those with white or brown shells, from cage and cage-free housing systems, and even pasteurized eggs (Jones et al., 2010). Meanwhile, in Ghana, eggs are sold not only through retail but also via direct sales to consumers, itinerant wholesalers, and sedentary wholesalers, showcasing a diversified distribution channel that can impact egg availability and pricing (Baagyere et al., 2023). These factors are also relevant in the Indonesian context, where issues related to poultry and egg production can influence technology adoption and marketing strategies in the poultry sector.

This study aims to evaluate the variability in egg quality across four retail markets in South Sulawesi, Indonesia. The research will consider aspects of external and internal quality, nutritional content, and consumer perceptions in egg purchases, with the expectation that findings will provide deeper insights into egg quality in the local retail market.

Materials and Methods

Equipment and materials

The equipment used in this study included a digital scale, digital caliper, digital pH meter, petri dishes, distilled water, spoon, knife, and plastic containers for egg storage. The materials used comprised a total of 180 eggs from commercial laying hens, with 45 eggs sampled from each of four different modern markets.

Sample collection

A total of 180 eggs were randomly sampled from four modern markets in Makassar City, coded as (A, B, C, and D), with each sample repeated three times. The eggs were between 1-14 days old and were packaged according to Indonesian National Standard (SNI) requirements. Each sample represented a different egg source. Subsequently, these eggs were evaluated for quality in the Integrated Laboratory of the Department of Animal Science at Universitas Islam Negeri Alauddin Makassar.

Statistical analyses

Analysis of variance was performed using straight run experimental design (one-way analyses of variance) and correlation persons, which is using SPSS 23 computer program using the following model (Hisasaga et al., 2020).

Exterior measurements

Egg cleanliness

Egg cleanliness was assessed using a 5-point scale as defined by Attia et al. (2014): 5 = excellent (absence of fecal and/or bedding material); 4 = remarkably clean (very clean with no visible fecal and/or bedding material); 3 = good (clean eggs with acceptable appearance); 2 = fair (eggs are not clean, but fecal and/or bedding material is absent); and 1 = dirty (eggs are not clean, and there is fecal and/or bedding material on the eggs).

Broken eggs

The percentage of broken eggs was calculated by dividing the number of broken eggs by the total number of eggs sampled from each source. Additionally, shell quality indices, such as egg shape and quality index, shell weight percentage, and shell thickness, were recorded based on the methods described by Attia et al. (1994).

Egg weight

The egg weight was formulated using a digital scale. Weighing eggs with digital scales aims to measure egg weight accurately.

Shell weight

The weight of the shell was measured using a digital scale. Before weighing, the shell is thoroughly washed and then weighed.

Shell thickness

Before measuring, eggshells were cleaned with clean water and then dried. The thickness of the eggshell was measured using a digital micrometer. The measurement was carried out by measuring the distance between the two surfaces of the eggshell, using a digital micrometer placed in the correct position and parallel to the surface of the eggshell. After obtaining several measurements of eggshell thickness at different points, the results can be averaged to calculate the overall eggshell thickness value.

Results

See Table 1, Table 2, Table 3, Table 4:

Discussion

In South Sulawesi, Indonesia, egg consumption per person per week has served as a crucial indicator of dietary habits and nutritional intake from 2018 to 2022. This period has been marked by significant trends in consumption patterns, as detailed in Table 1, which illustrates fluctuations influ-

Table 1. Consumption of eggs per person per week/pieces, South Sulawesi, Indonesia for the period 2018-2022

Regency/City	2018	2019	2020	2021	2022
Kepulauan Selayar	1.728	1.545	1.592	1.584	1.347
Bulukumba	1.895	1.669	1.638	1.809	1.734
Bantaeng	1.623	1.700	1.688	1.824	1.444
Jeneponto	1.526	1.592	1.345	1.586	1.595
Takalar	1.345	1.200	1.477	1.719	1.842
Gowa	1.710	1.655	1.831	1.748	1.970
Sinjai	1.559	1.440	1.606	1.911	1.704
Maros	1.911	1.983	2.079	2.192	2.138
Pangkajene dan Kepulauan	2.080	1.964	2.185	2.196	2.623
Barru	1.983	1.690	1.936	2.504	2.135
Bone	1.515	1.723	1.638	1.950	1.822
Soppeng	2.075	2.107	2.261	2.288	2.355
Wajo	2.474	2.330	1.922	2.353	2.566
Sidenreng Rappang	2.135	2.131	2.260	2.313	1.994
Pinrang	1.992	1.547	1.812	1.879	1.502
Enrekang	1.812	1.881	2.086	2.493	2.377
Luwu	1.583	1.311	1.593	1.696	2.368
Tana Toraja	1.055	1.016	1.166	1.538	1.190
Luwu Utara	1.424	1.355	1.809	1.759	1.799
Luwu Timur	1.834	2.143	2.218	2.097	2.261
Toraja Utara	1.120	1.345	1.061	1.364	1.395
Kota Makasar	2.660	2.313	2.365	2.514	2.767
Kota Parepare	2.167	1.959	2.052	2.678	1.992
Kota Palopo	2.053	1.939	1.931	2.247	2.150

Source: (BPS, 2023)

encing local food practices and market demands. The data presented provides a comprehensive overview of the consumption dynamics, highlighting the importance of eggs as a staple food in the region.

Furthermore, Table 2 presents the Pearson correlation coefficients among various egg quality traits from different sources of quality eggs in the same region. Parameters such as Albumen Weight, Albumen %, Albumen Height, Albumen Index, Yolk weight (g), Yolk weight %, Yolk Index, Yolk Colour Score, Haugh Unit, Air Pocket Depth, pH of Albumen, pH of Yolk, Egg weight (g), Shell Weight (g), and Shell Thickness (mm) are analyzed to understand the interrelationships among these quality indicators. These correlations offer valuable insights into how variations in one quality trait may impact others, thereby contributing to a deeper understanding of the overall egg quality profile observed in the local retail market.

Egg producers should pay attention to the relationship between albumen weight and albumen height. Optimizing albumen weight can result in higher albumen height, which is a potential advantage in egg production. However, it is also important to consider the albumen index. While a larger albumen height appears beneficial, a lower albumen index can negatively impact overall egg quality.

Data analysis reveals a significant positive correlation between albumen weight and albumen height ($r = 0.387$, $p = 0.002$), indicating that an increase in albumen weight generally accompanies higher albumen height. Conversely, there is a significant negative correlation between albumen height and the albumen index ($r = -0.31$, $p = 0.012$), suggesting that greater albumen height is associated with a lower albumen index. The positive correlation coefficient ($r = 0.387$) indicates that as albumen weight increases, so does albumen height, as larger albumen tends to result in greater albumen height. On the other hand, the negative correlation coefficient ($r = -0.31$) between albumen height and the albumen index suggests a potential trade-off between albumen quantity and quality in egg production.

Table 3 examines the effects of various egg sources on exterior egg quality parameters. These parameters include egg cleanness, percentage of broken eggs, egg weight, shell weight, and shell thickness from eggs sourced from Locations A, B, C, and D in South Sulawesi, Indonesia. Statistical analyses, represented by P-values, provide insights into the significance of differences observed among the egg sources for each parameter. This analysis contributes to a comprehensive understanding of how different sourcing locations impact the external quality attributes of eggs in the local market context.

Table 3 shows that eggs from Source D have significantly higher egg weights compared to other sources; eggs from Source C exhibit higher weights ($P < 0.05$) compared to Source B, while no difference is observed between Source A and Source C. Eggs from Source A significantly affect shell weight, with zero egg damage recorded from various supermarkets in Makassar.

Research findings indicate varying egg cleanliness due to differences in storage conditions, handling, cage sanitation, and harvesting methods. However, correlation analysis reveals no significant correlation between egg cleanliness and essential internal egg qualities such as albumen height, Haugh unit score, and yolk color ($P > 0.05$). It should be noted that the egg-laying hens used in this study were housed in controlled environment housing; however, facility age and housing conditions varied among different egg sources.

Table 4 illustrates the impact of eggs from different sources on internal egg quality parameters. These parameters include air cell depth, albumen weight, albumen percentage, albumen height, albumen index, yolk weight, yolk percentage, yolk index, yolk color score, and Haugh unit from eggs sourced from Locations A, B, C, and D in South Sulawe-

Table 2. Pearson correlation coefficients among egg quality traits of different sources of quality eggs

		Albumen Weight	Albumen %	Albumen Height	Albumen Index	Yolk weight, g	Yolk weight, %	Yolk index	Yolk colour score	Haugh Unit	Air Cell (mm)	pH Albumen	pH Yolk	Egg weight (g)	Shell Weight (g)	Shell Thickness (mm)
Albumen Weight	Pearson's r	—														
	p-value	—														
Albumen %	Pearson's r	0.387	—													
	p-value	0.002	—													
Albumen Height	Pearson's r	0.008	0.133	—												
	p-value	0.953	0.31	—												
Albumen Index	Pearson's r	-0.038	-0.198	0.588	—											
	p-value	0.774	0.13	< .001	—											
Yolk weight, g	Pearson's r	0.112	-0.021	0.141	0.212	—										
	p-value	0.393	0.872	0.283	0.104	—										
Yolk weight, %	Pearson's r	0.058	0.438	0.262	-0.052	0.58	—									
	p-value	0.662	< .001	0.043	0.694	< .001	—									
Yolk index	Pearson's r	0.326	0.258	0.149	0.408	0.413	0.184	—								
	p-value	0.011	0.046	0.255	0.001	0.001	0.159	—								
Yolk colour score	Pearson's r	-0.048	0.106	-0.143	-0.518	-0.234	0.316	-0.586	—							
	p-value	0.713	0.42	0.275	< .001	0.072	0.014	< .001	—							
Haugh Unit	Pearson's r	0.145	0.243	0.745	0.62	0.27	0.283	0.638	-0.512	—						
	p-value	0.269	0.062	< .001	< .001	0.037	0.029	< .001	< .001	—						
Air Cell (mm)	Pearson's r	0.207	-0.416	-0.226	-0.147	-0.151	-0.176	-0.529	0.407	-0.535	—					
	p-value	0.113	< .001	0.083	0.262	0.248	0.179	< .001	0.001	< .001	—					
pH Albumin	Pearson's r	0.819	0.024	0.017	-0.093	-0.092	0.035	0.023	0.203	0.004	0.505	—				
	p-value	< .001	0.856	0.897	0.479	0.482	0.79	0.862	0.119	0.975	< .001	—				
pH Yolk	Pearson's r	0.413	-0.176	0.108	-0.067	-0.145	-0.062	-0.134	0.136	0.109	0.467	0.659	—			
	p-value	0.001	0.179	0.412	0.609	0.267	0.636	0.307	0.301	0.406	< .001	< .001	—			
Egg weight (g)	Pearson's r	0.034	-0.501	-0.167	0.301	0.404	-0.463	0.192	-0.541	-0.083	0.091	-0.142	-0.08	—		
	p-value	0.795	< .001	0.201	0.02	0.001	< .001	0.141	< .001	0.53	0.489	0.28	0.544	—		
Shell Weight (g)	Pearson's r	0.298	0.395	0.148	0.416	0.167	0.182	0.755	-0.524	0.673	-0.518	0.042	0.08	-0.061	—	
	p-value	0.021	0.002	0.258	< .001	0.203	0.163	< .001	< .001	< .001	< .001	0.751	0.544	0.643	—	
Shell Thickness (mm)	Pearson's r	0.565	-0.042	-0.039	-0.084	-0.177	-0.05	-0.051	0.113	0.029	0.467	0.738	0.833	-0.145	0.151	—
	p-value	< .001	0.75	0.767	0.521	0.176	0.704	0.696	0.391	0.829	< .001	< .001	< .001	0.27	0.251	—

Source: Authors' own elaboration

Table 3. Effect of different egg sources on the exterior egg quality

Parameters	Egg Source				Statistical Analyses
	A	B	C	D	P
Egg cleanness					
Broken eggs, %	0	0	0	0	–
Egg weight, g	57.65 ± 2.85[b]	45.62 ± 1.72[a]	59.05 ± 6.07[b]	62.34 ± 1.55[c]	0.001
Shell weight, g	3.48 ± 1.66[a]	7.40 ± 0.49[b]	7.44 ± 0.44[b]	7.83 ± 0.53[b]	0.001
Shell thickness, mm	0.57 ± 0.23	0.62 ± 0.35	0.51 ± 0.51	0.53 ± 0.13	0.582

Source: Authors' own elaboration

Table 4. Effect of different egg sources on the internal egg quality

Parameters	Egg Source				Statistical Analyses
	A	B	C	D	P
Air Cells	12.54 ± 0.99	8.79 ± 3.55	6.55 ± 0.72	9.71 ± 1.96	0.001
Albumen quality					
Albumen weight, g	29.01 ± 6.51[a]	32.25 ± 10,20[b]	37.48 ± 6.23[c]	33.03 ± 6.35[b]	0.001
Albumen, %	29.67 ± 1.37[a]	36.29 ± 1.35[ab]	37.48 ± 8.07[b]	33.02 ± 0,54[a]	0.001
Albumen height, mm	3.05 ± 1,37[a]	4.48 ± 1.35[ab]	6.47 ± 8.07[b]	3.09 ± 0.54[a]	0.001
Albumen Index	0.03 ± 0.18[a]	0.05 ± 0.18[ab]	0,09 ± 0.04[b]	0.18 ± 0.04[c]	0.001
Yolk quality					
Yolk weight, g	22.66 ± 3.35[a]	22.57 ± 2.83[a]	26.21 ± 2.86[b]	24.99 ± 2.42[b]	0.002
Yolk weight, %	39.29 ± 5.47[a]	49.48 ± 6.07[c]	43.70 ± 6.61[b]	40.11 ± 3.99[ab]	0.001
Yolk Index	0.09 ± 0.03[a]	0.23 ± 0.06[b]	0.32 ± 0.03[c]	0.30 ± 0.02[c]	0.001
Yolk colour score	13.95 ± 2.03[a]	14.33 ± 3.36[a]	8.97 ± 0.84[b]	8.62 ± 0.45[b]	0.001
Haugh Unit	45.11 ± 15.31[a]	69.23 ± 11.72[b]	85.63 ± 20.80[b]	70.59 ± 4.48[c]	0.001

Source: Authors' own elaboration

si, Indonesia. Statistical analyses, represented by P-values, highlight significant differences observed among the egg sources for each parameter. This analysis contributes to a comprehensive understanding of how different sourcing locations influence the internal quality attributes of eggs within the local market context.

Table 4 illustrates the effect of eggs from various sources on internal egg quality. Albumen weight (g) is significantly greater in eggs from Source A compared to other sources, with eggs from Source D exhibiting the smallest albumen weight. Sources B and C fall in between these extremes. Albumen percentage significantly varies, with eggs from Sources A, C, and D having more albumen compared to Source B. Albumen height is significantly higher in eggs from Source A compared to other sources, followed by Source B and D, with Source C showing the lowest height. The significant differences among these groups strongly support eggs from Source D. Eggs from Source D significantly influence higher Haugh unit scores compared to other sources. Haugh unit scores for eggs from Sources A and B are similar and both higher than Source C. Eggs from Source A significantly weigh more in yolk weight (g) compared to other sources. In contrast, Source D has a smaller yolk weight (g) than Sources B and C, with the latter also significantly lower than Source B. Differences in yolk weight (%) and yolk/albumen ratio clearly show that Source B has significantly higher values compared to Source C or D. At the same time, Source A is larger than Source C only. Yolk index is significantly greater in eggs from Source B compared to others, with Source D lower than Source A and C, the latter group having larger values than Source A. Yolk color is significantly influenced by egg source, showing darker yolks from Sources C and D compared to Sources A and B, with Source B exhibiting darker yolks than Source A. Blood spots are significantly higher in eggs from Sources A and C compared to eggs from Sources B and D.

Based on the above analyses of egg quality from various sources in South Sulawesi, Indonesia, it can be concluded that factors such as albumen weight, albumen height, yolk weight and color, and Haugh unit score play crucial roles in determining internal egg quality. These findings are significant in terms of consumer perception of egg products, where preferences for these attributes can influence purchasing decisions. The significant differences among egg sources in these parameters indicate that a better understanding of egg origin and its impact on internal quality could enhance consumer satisfaction and support more effective marketing strategies in retail markets.

Conclusion

This study highlights the importance of understanding the relationships between various egg quality parameters in the context of both production and consumer preferences. By considering factors such as albumen weight, albumen height, yolk weight and color, and Haugh unit score, producers can focus their efforts on improving production processes and delivering eggs of superior quality. A deeper understanding of how these variables interact not only has the potential to enhance consistency in egg quality but also to increase consumer satisfaction. Furthermore, through the implementation of more precise management practices and appropriate technologies, the egg industry can meet stricter standards and compete more effectively in the global market, thereby creating significant added value in the food supply chain.

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