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Assessment egg quality parameters in the morning and evening for Local and commercial chicken breeds in Kurdistan

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Abstract:

Eggs are a vital food source, rich in protein, vitamins, and minerals. However, egg safety has become a subject of debate. This study aimed to determine the quality standards of eggs collected in the morning and evening from local and commercial chicken breeds in Kurdistan. A total of 240 eggs were collected for quality measurements. 120 eggs were collected from local hens and 120 from commercial hens, with 60 eggs collected in the morning and 60 in the evening for each breed. The weight of the morning eggs was significantly higher from local hens. In commercial hens, significant differences ($p<0.05$) were observed in egg weight and shell weight. Significant differences ($p<0.05$) were also observed between local and commercial hens in egg weight, length, shell weight, and thickness. Eggs collected in the morning from local hens showed a significant advantage ($p<0.05$) in albumin weight, albumin index, and yolk percentage. For commercial chickens, significant differences ($p<0.05$) were observed in a greater proportion of egg quality characteristics based on whether the eggs were collected in the morning or evening. Specifically, significant differences ($p<0.05$) were found in albumin height, albumin weight, albumin percentage, albumin index, Howe unit, yolk width, and yolk weight. A statistically significant increase in the number of blood spots was also observed in evening eggs compared to morning eggs in both local and commercial breeds. However, no significant difference was observed between the two breeds. Therefore, it can be concluded that morning eggs have a higher nutritional value than evening eggs.

Keywords: Egg-Laying, External Egg Quality, Internal Egg Quality, Chicken Breeds.

Introduction

Egg production for human consumption has undergone a radical transformation, from small retail outlets to large markets, and from local hens to hybrid hens. These hybrid breeds were selected for their high egg production, with their eggs differing primarily in quality characteristics. They are consumed as table eggs or other egg products worldwide. Recently, intensive egg production systems, as well as the health status of hybrid hens, have become major ethical concerns. Another important aspect of intensive egg production is biodiversity. Egg production relies on hybrid hens. Recently, there has been a growing global focus on local breeds and production processes as key elements in achieving these goals. Consumer interest in traditional diets is also increasing (Fernyhough et al. 2020).

Livestock production in general, and poultry production in particular, plays a significant social and economic role in providing inexpensive sources of high-quality animal protein in the form of eggs and meat. Chickens are raised in various management and production systems. Egg quality characteristics refer to the egg's properties that directly influence its acceptance by producers and consumers, as well as its suitability for hatching and the egg market (FAO, 2020).

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Egg quality characteristics are influenced by many factors, including nutrition, environment, genetic makeup, and age (Lordello et al., 2020). Egg quality is assessed through its external and internal characteristics (Mohammed et al., 2023). The egg quality of different chicken breeds (local and imported) is crucial for studying breed differences and developing measures to improve productivity in the region. This study aims to identify differences in egg quality between local and commercial chickens based on egg-laying time and to explore ways to mitigate the negative effects of egg-laying timing.

Materials and Methods

Two hundred and forty eggs were used to evaluate egg quality criteria, including one hundred and twenty eggs from local hens and one hundred and twenty eggs from commercial hens. Sixty eggs were collected in the morning and sixty in the evening from each breed.

1. External Egg Quality Criteria

Each egg was weighed using an electronic scale with an accuracy of 0.01 g. A steel vernier was used to measure the length and width of each egg. The shape index was then calculated according to the following formula [shape index% =width of egg (mm)/ length of egg (mm) *100] which has been previously described by several researchers (Anderson, 2004).

2. Internal Egg Quality Criteria

To determine shell thickness, the egg was cut in half. The eggshells were dried with a paper towel and turned upside down to drain any remaining albumen. After drying, three repeated measurements were taken from the center and each end of the egg using a vernier caliper (General Tools & Instruments, New York, USA). The average of the three measurements was recorded as the shell thickness with membrane in millimeters.

After weighing the eggs, the internal quality criteria were determined: albumen height, yolk height, yolk width, yolk color, and yolk index (Haw's unit). Yolk color was checked using a yolk color fan (ROCHE). The diameter of the yolk and albumen was measured using a steel vernier caliper, and the diameter was recorded in millimeters.

After cracking the egg onto a flat glass surface, which is part of the instrument's attachments, a tripod micrometer was placed over it, and the pointer was carefully lowered until it touched the yolk. The reading displayed on the screen was recorded as the height of the yolk, in millimeters. The height of the thickened egg white was then measured using the same micrometer. Blood and flesh spots were observed immediately after the egg was cracked, and their occurrence was calculated as a percentage of the total number of eggs tested. The yolk index was determined according to the formula [yolk index = average height of yolk (mm) / average diameteter of yolk (mm).

The Haugh unit is measured according to the following equation:

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

Where H is the height of the thick egg albumen in millimeters, and W i

A Completely Randomized Design (CRD) was used as the experimental design. Data were analyzed using the General Linear Model (PROC GLM). Treatment means were separated using Duncan's multiple range tests with SAS 9.1 software (SAS Institute, 2009).

Result and Discussion

s the weight of the egg in grams.

3. Statistical Analysis

External and Internal Egg Quality Parameters

Chicken eggs are an important source of nutrients for humans (Nau et al., 2003). Due to their low production cost, they are an inexpensive source of protein and animal fat (Nys and Sauveur, 2004). The yolk-to-white ratio is the most important characteristic of egg composition and is related to the egg's dry matter content (Hartmann et al., 2003). Multiple genetic and environmental factors affect egg quality, including breed, age, diet, and ambient temperature (Kovacs et al., 2005).

1. External Egg Quality Parameters

Table (1) shows the external qualitative characteristics of eggs from two breeds of local and commercial chickens, collected in the morning and evening. The table includes egg weight, length, width, shape, Shell weight, shell thickness, and shell percentage.

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Significant ($p<0.05$) differences were observed based on the time of egg collection; the weight of morning eggs was significantly higher than that of evening eggs in local chickens. In commercial chickens, there were significant ($p<0.05$) differences in egg weight and shell weight between eggs collected in the morning and evening. No significant differences were found in the other characteristics between the times of egg collection. The dry matter efficiency of eggs, in terms of both quantity and quality, is of paramount importance (Suk and Park, 2001). In addition to this ratio, the eggshell's shock resistance is a key economic characteristic, as it determines the egg's ability to withstand transport from producers to consumers (Mertens et al., 2006). Significant losses, up to 10% of total egg production, can be attributed to fragile eggshells (Washburn, 1982). Furthermore, intact eggshells are also essential to prevent bacterial invasion and thus reduce the risk of food poisoning (Mertens et al., 2006). Egg composition is not a uniform characteristic, as it is influenced by numerous factors such as breed, age, size, and laying season (Coats et al., 2006).

Table (1): External egg quality parameters on chicken eggs collected in the morning and evening from two breeds of local and commercial chickens.

chickens' breeds	local chicken			commercial chicken		
Egg quality parameter	Morning	Evening	L.S	Morning	Evening	L.S
Egg weight (g)	61.55 ±1.572 a	56.16 ± 0.687 b	S	63.61 ± 0.985 b	69.25± 1.149 a	S
Egg length (cm)	57.23 ± 0.717	55.62 ± 0.560	NS	58.50 ± 1.126	59.95 ±1.280	NS
Egg width (cm)	45.27 ± 0.434	44.09 ± 1.862	NS	43.89 ± 0.362	46.01 ± 0.998	NS
Shape index (%)	79.18 ± 2.898	79.26 ± 3.176	NS	75.18 ± 1.419	76.788 ± 1.091	NS
Shell weight (g)	8.46 ± 0.190	8.18 ± 0.242	NS	8.97 ± 0.475 b	9.45 ± 0.270 a	S
Shell thickness (mm)	0.431 ± 0.009	0.43 ± 0.008	NS	0.35 ± 0.015	0.35 ± 0.009	NS
Shell ratio (%)	13.80 ± 0.507	14.56 ±0.355	NS	14.10 ± 0.692	13.65 ± 0.405	NS

standard error of mean, a, b: Values that do not share a common superscript in the same row are different ($P < 0.05$).

Table (2) shows the external qualitative characteristics of eggs from two breeds of local and commercial chickens. The table includes egg weight, length, width, shape, Shell weight, shell thickness, and shell percentage. Significant ($p<0.05$) differences were observed between local and commercial chickens in egg weight, egg length, shell weight, and shell thickness. This is consistent with the findings of (Lordelo et al. 2020) in their study in which eggs from a number of different small farms that raise indigenous chickens were characterized for their physical and chemical properties, such as weights, shape index (**SI**), HUs, yolk color, albumen protein content, yolk fatty acid content, and mineral content in the albumen and yolk and compared with eggs collected from a commercial poultry operation.

Table (2): External egg quality parameters of local chickens and commercial chickens' breeds

Egg quality parameter	local chicken	commercial chicken	L.S
Egg weight (g)	58.86± 1.152 b	66.21 ± 1.083 a	S
Egg length (cm)	56.43 ± 0.497 b	59.17 ± 0.836 a	S
Egg width (cm)	44.68 ± 1.134	44.87 ± 0.565	NS
Shape index (%)	79.22 ± 2.049	75.92 ± 0.908	NS
Shell weight (g)	8.32 ± 0.153 b	9.19 ± 0.28 a	S
Shell thickness (mm)	0.43 ± 0.005 a	0.35 ± 0.008 b	S

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Shell ratio (%)	14.186 ± 0.316	13.89 ± 0.405	NS

standard error of mean, a, b: Values that do not share a common superscript in the same row are different (P < 0.05).

2. Internal Egg Quality Parameters

Table (3) shows the internal qualitative characteristics of eggs from two breeds of local and commercial chickens, collected in the morning and evening. The table includes albumen height, width, weight, percentage, index, and Haugh unit, as well as yolk height, width, color, index, weight, and percentage. The timing of egg collection significantly affected some of the studied characteristics. Eggs collected in the morning from local chickens showed a significant ($p<0.05$) advantage in albumen weight, albumin index, and yolk percentage compared to eggs collected in the evening. For commercial chickens, significant ($p<0.05$) differences were observed in a greater proportion of the characteristics based on the morning and evening collection times. Specifically, significant ($p<0.05$) differences were found in albumen height, albumen weight, percentage, index, Hue unit, yolk width, and yolk weight. No significant differences were observed between the remaining characteristics of eggs collected in the morning and evening from local and commercial chickens.

Table (3): Internal egg quality parameters on chicken eggs collected in the morning and evening from two breeds of local and commercial chickens.

Chickens' breeds	local chicken			Commercial chicken		
Egg quality parameter	Morning	Evening	L.S	Morning	Evening	L.S
Albumin height (mm)	7.86 ± 0.375	8.06 ± 0.215	NS	5.80 ± 0.674 b	7.13 ± 0.482 a	S
Albumin width (mm)	66.97 ±1.620	66.11 ± 0.683	NS	78.03 ± 2.11	75.85 ± 3.170	NS
Albumen weight	44.41 ± 1.719 a	39.98 ± 0.432 b	S	46.071 ± 0.949 b	52.46 ± 1.387 a	S
Albumen percentage	72.05 ± 0.909	71.21 ± 0.69	NS	72.41 ± 0.912 b	75.75 ± 1.466 a	S
Albumen Index	37.47 ± 1.277 a	32.91 ± 0.60 b	S	39.25± 0.795 b	43.66 ± 0.896 a	S
Haugh Unit (%)	63.02 ±1.531	61.87 ± 1.123	NS	72.61 ± 4.88 b	81.966 ± 3.255 a	S
Yolk height (mm)	16.96 ± 0.767	17.35 ± 0.183	NS	17.11 ± 0.361	17.78 ± 0.166	NS
Yolk width (mm)	38.84 ± 0.530	38.95 ± 0.325	NS	40.85 ± 0.476 b	42.90 ± 0.767 a	S
yolk color	8.66 ± 0.33	8.00 ± 0.516	NS	8.57 ± 0.202	7.33 ± 0.760	NS
Yolk index (%)	43.76 ±2.231	44.55 ± 0.621	NS	41.95 ± 1.187	41.55± 1.194	NS
yolk weight	13.58 ± 0.553	13.98 ± 0.33	NS	16.20 ± 0.420 b	17.65 ± 0.388 a	S
yolk percentage	22.16 ±1.136 b	24.93 ± 0.772 a	S	25.48 ± 0.624	25.48 ± 0.278	NS

standard error of mean, a, b: Values that do not share a common superscript in the same row are different (P < 0.05).

Table (4) shows the internal qualitative characteristics of eggs from two local and commercial chicken breeds. The table includes the albumen height, width, weight, percentage, and index, as well as the yolk height, width, color, index, weight, and percentage. Significant ($p<0.05$) differences were observed in all characteristics between the two breeds, except for yolk height, yolk color, and albumen percentage. This study is consistent with (Tehoua et al. 2025), which compared the physical, chemical, and mineral properties of chicken eggs from a local and an improved breed in the municipality. These findings align with those of Islam et al. (2017) in their study comparing rural farm eggs with commercial eggs produced under intensive farming conditions, focusing on egg quality characteristics. A significant difference was found between rural and commercial eggs in quality parameters. The highest egg weight (52.3 grams) and the

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highest albumen weight (33.71 grams) were recorded in commercially produced eggs. Similarly, the egg-to-albumen weight ratio (64.40 grams) was highest in commercial eggs. Notably, rural eggs were found to have a thicker shell (0.40 cm), a heavier yolk (15.47 g), and a higher egg-to-yolk ratio (33.96 g). Therefore, it can be concluded that eggs produced in rural farming systems have a higher nutritional value than commercially produced eggs.

Table (4): Internal egg quality parameters of local chickens and commercial chickens' breeds

Egg quality parameter	local chicken	Commercial chicken	L.S
Albumin height (mm)	7.96 ± 0.208 a	6.41 ± 0.451 b	S
Albumin width (mm)	66.54 ± 0.848 b	77.02 ± 1.79 a	S
Albumen weight	42.20 ± 1.077 b	49.02 ± 1.208 a	S
Albumen percentage	71.63 ± 0.559	73.95 ± 0.931	NS
Albumen Index	35.19 ± 0.961 b	41.28 ± 0.852 a	S
Haugh Unit (%)	62.44 ± 0.922 b	76.93 ± 3.204 a	S
Yolk height (mm)	17.15 ± 0.022	17.42 ± 0.231	NS
Yolk width (mm)	38.90 ± 0.297 b	41.80 ± 0.511 a	S
yolk color	8.33 ± 0.309	8.0 ± 0.392	NS
Yolk index (%)	44.16 ± 1.110 a	41.76 ± 0.810 b	S
yolk weight	42.20 ± 1.077 b	49.02 ± 1.208 a	S
yolk percentage	23.54 ± 0.777 b	25.48 ± 0.346 a	S

standard error of mean, a, b: Values that do not share a common superscript in the same row are different (P < 0.05).

Figure (1) illustrates the blood spots in chicken eggs collected in the morning and evening from two breeds of local and commercial chickens. A significant increase in blood spots was observed in evening eggs compared to morning eggs in both the local and commercial breeds. However, no significant difference in blood spots was found between the local and commercial breeds. Fayyad and Naji (2010) indicated that the appearance of blood and flesh spots in eggs reduces their quality because consumers do not prefer such eggs. The source of the blood spots is the rupture of a blood vessel in the follicle surrounding the egg during ovulation. The follicle may rupture, causing a drop of blood to fall from the ovary into the oviduct, and this drop is then observed on the yolk. Genetic factors largely control the percentage of blood and flesh spots in eggs. The heritability value for this trait is 0.5, meaning that 50% of the variation in this trait is due to genetic influence. Eggs laid in the evening contained blood spots in 0.05% of local hens and 0.07% of commercial hens, compared to eggs laid in the morning which did not contain blood spots. This may be due to the increased blood pressure caused by the hen's increased movement during ovulation, which dilates blood vessels, increasing the likelihood of a capillary rupture in the follicle wall.

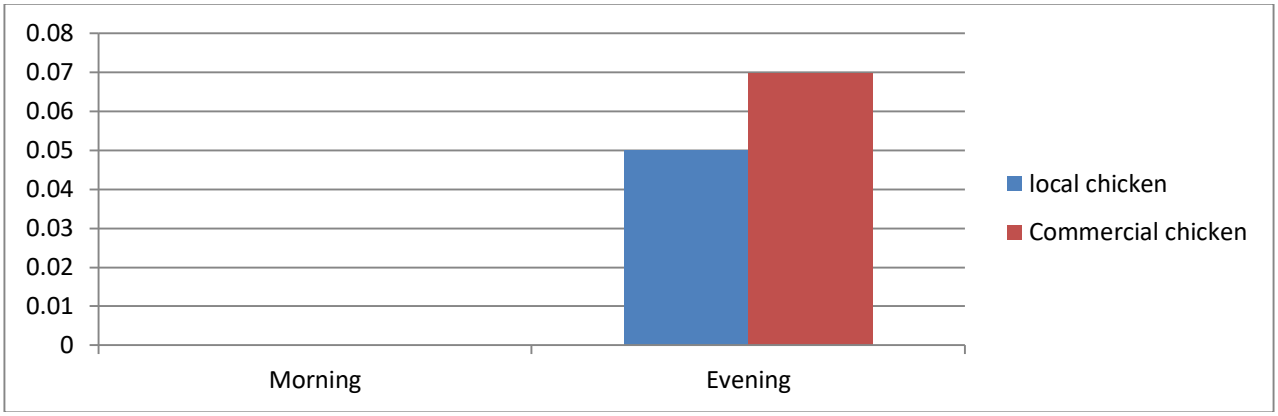


Figure (1): Blood spots in eggs were collected in the morning and evening of local chickens and commercial chickens' breeds

Conclusions

Therefore, it can be concluded that eggs laid in the morning have a higher nutritional value than those laid in the evening. Additionally, no blood spots appear in eggs laid in the morning.

Recommend

We recommend reducing the factors that negatively affect the quality characteristics of the producer's eggs in the evening.

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