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International Journal of Veterinary Science and Research

INTERNATIONAL JOURNAL OF Veterinary Science and Research OPEN ACCESS JOURNAL

ISSN: 2640-7604 DOI: https://dx.doi.org/10.17352/ijvsr

Research Article

Evaluation of Quality Characteristics of Eggs from Local and Improved Guinea Fowls Raised under Semi-intensive Management System

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Received: 03 February, 2025
Accepted: 17 February, 2025
Published: 18 February, 2025

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Keywords: Production systems; Local; Quality indices; Sudan savannah

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Abstract

This study was conducted to evaluate the quality characteristics of eggs using 160 eggs from local and improved guinea fowls raised under semi-intensive management systems in Wammako Local Government Area of Sokoto State, Nigeria. The two selected guinea fowl flocks were regarded as the treatments, represented as T1 and T2 respectively. Each treatment was replicated 10 times. The local and improved Guinea fowl were sourced from local Guinea fowl producers in Villages of Wammako Local Government Area of Sokoto, Sokoto State, Nigeria. External and internal egg quality parameters from the two flocks were evaluated. Data generated from the study was subjected to analysis. The results showed that there were significant differences ($p < 0.05$) between the treatments in all the external egg quality and internal quality of eggs measured except yolk colour ($p > 0.05$). The study concluded that improved guinea fowl possessed good egg quality characteristics compared to local guinea fowl. It is therefore recommended that consumers and food processing industries should utilize eggs from improved guinea fowl which is considered superior in terms of quality compared to local guinea fowl.

Introduction

Guinea fowl are regarded to have originated in Africa, its sometimes-called pearl hen. They are the domesticated form of the helmeted guinea fowl (*Numida meleagris*) and are related to other game birds (pheasants, turkeys, and partridges) [1]. Guinea fowl global production has increased rapidly. In underdeveloped countries, Guinea fowl can be successfully reared under semi-intensive conditions with less effort. Thus, Guinea fowl has been given importance as an alternative poultry [2].

Despite Guinea fowls are not as popular as chicken in the supply of poultry products, in some countries they are regarded as a major source of meat and egg after chicken among the small-scale producers [3]. Similarly, eggs from domestic fowl are normally preferred for consumption compared to eggs from guinea fowl due to availability and popularity among consumers. In Nigeria, guinea fowl eggs rank second to domestic fowl eggs in the supply [4]. According to Stadelman [5], egg quality is associated with those external and internal characteristics of an egg influencing consumers' acceptability. However, there is a paucity of information on the quality characteristic of eggs from local and improved guinea fowls raised under semi intensive management system in the semi-arid region of Sokoto.

Materials and methods

The study area

The study was conducted in the Animal Products and Handling Laboratory of the Faculty of Agriculture, Usmanu Danfodio University Sokoto, Sokoto State, Nigeria. The State is located in the extreme northwest of Nigeria, near the confluence of River Sokoto and Rima. It is between latitude 12°N and 13° 58°N and longitude 4°8E and 6°54'E and at an altitude of 350m above sea level. It is in the Semi-arid ecological zone,

Citation: Garba S, Nasiru MH, Muhammed NA, Taiwo KA. Evaluation of Quality Characteristics of Eggs from Local and Improved Guinea Fowls Raised under Semi-intensive Management System. Int J Vet Sci Res. 2025;11(1):001-004. Available from: https://dx.doi.org/10.17352/ijvsr.000151

surrounded by sandy savannah and isolated hills. The mean annual temperature is 28.3 °C, and the highest recorded temperature is 47.2 °C which is also the hottest temperature in Nigeria [6].

Ethical approval

Ethical approval was not sought from the ethics committee of Usmanu Danfodio University Sokoto, Nigeria for the present study because it involved only the collection of eggs from the Guinea fowl producers and therefore posed no risk to the subjects (animals). Thus, our study does not involve the experimental animals (Guinea fowl) directly.

Experimental design

Eggs from local strains of guinea fowls and eggs from improved strains of guinea fowls were regarded as Treatment 1 and Treatment 2 respectively. The performed evaluation comprised 80 eggs from each treatment (n = 160) laid out in a Complete Randomized Design (CRD). Guinea fowls that are in their first year of laying and also in a very healthy condition are identified and considered while any Guinea fowls that do not fall in this category are excluded.

Measurement of external egg quality parameters

The external quality parameters measured were briefly conducted as follows:

Egg weight (g): The eggs were weighed individually on a sensitive scale and each weight was inscribed on the eggshell.

Egg length and width (cm): The length of each egg was measured between the pointed and the broad ends. The width was measured from the widest point of each egg using the vernier caliper.

Shell weight (g): Shell weight was determined after emptying the egg contents. The shell interior was cleaned with tissue paper and allowed to dry thereafter; the weight was taken using the sensitive scale.

Shell thickness (mm): This was measured using a micrometer screw gauge with an anvil jaw calibrated in millimeters. Measurement was done after cleaning the internal part of the shell. This was measured by taking readings from the proximal, medial, and distal portion of the shell and the average was recorded as the shell thickness for each particular egg.

Egg shape index (%): This was determined based on measurements of the egg length and width using calipers, with 0.02 mm accuracy.

Measurement of internal egg quality parameters

Albumen weight (g): The egg was broken into an already-weighed yolk separator, and the yolk was removed. The albumen and the separator were weighed. The weight of the empty separator was deducted from the weight of the separator and albumen to obtain the albumen weight.

Albumen height (mm): This was measured by using a micrometer.

Albumen width (mm): This was measured by using a digital vernier caliper.

Yolk weight (g): The egg was broken into an already-weighed yolk separator, and the albumen was removed. The yolk and the separator were weighed. The weight of the empty separator was deducted from the weight of the separator and yolk to obtain the yolk weight.

Yolk height (cm): Yolk height of the egg was measured using a Vernier caliper

Yolk colour: The colour of the yolk was scored visually with the aid of a Roche colour fan which is numbered from 1 to 15 and the colour intensity ranges from very light yellow to orange. The colour was placed near the yolk to determine the colour that matched the yolk. Albumen weight (g): This was obtained by subtracting both the yolk and the shell weights from the egg weight.

Haugh unit: The Haugh Unit was calculated using the procedure of Haugh [7].

$$HU=100 \text{ Log } [H +7.57 -1.7W^{0.37}]$$

Where H = height of the albumen (mm) and W = weight of the egg (g).

Data analysis

The results obtained in this study were analyzed using the Statistical Analysis System [8] package version 9.4 statistical package. The significant differences between local and improved guinea fowls regarding egg quality were verified by the Student's t - test. The p - value was established at $p \leq 0.05$.

Results

External quality

Results on the external quality characteristics of eggs from local and improved guinea fowls are presented in Table 1. The results showed a significant difference ($p < 0.05$) in all the external quality characteristics of eggs measured.

The improved guinea fowls recorded higher ($p < 0.05$) values of all the parameters (egg weight, egg length, egg width, egg

Table 1: External quality characteristics of eggs from local and improved guinea fowls.

Parameters	Treatments		SEM	p - value
	Local (T1)	Improved (T2)		
Egg weight (g)	37.04^{b}	45.18^{a}	0.56	0.035
Egg length (cm)	3.88^{b}	4.95^{a}	0.91	0.040
Egg width (cm)	2.81^{b}	3.82^{a}	0.75	0.024
Egg shape index (%)	77.14^{b}	84.19^{a}	1.27	0.042
Shell weight (g)	6.28^{b}	8.95^{a}	0.18	0.018
Shell thickness (mm)	0.34^{b}	0.47^{a}	0.02	0.032

ab = Means within the same row with different superscripts indicate significant differences ($p < 0.05$).
SEM: Standard Error of Mean.

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shape index, shell weight, and shell thickness) measured. It's essential to note that while genetic material plays a significant role in determining these external egg quality traits, other factors such as nutrition, and environmental conditions might affect the overall quality. External parameters of improved guinea fowl eggs are often considered better than those of local guinea fowl due to selective breeding practices. Improved breeds are usually developed for specific traits such as egg production, better disease resistance, and improved overall quality making them more desirable for commercial purposes [9,10].

Improved guinea fowls laid eggs of higher weight in comparison with the eggs of local guinea fowls. This was caused most probably by the selection for body weight carried out in these birds which resulted in the increase of the egg weight [11,12].

A positive relationship exists between egg weight and the weight of their albumens, yolks, and eggshells [11,13]. This could be responsible for a large difference in the weight of improved and local guinea fowl eggs. The greater eggshell weight of the improved guinea fowls could be attributed to its thickness as reported in the previous study conducted by Oke, et al. [14,15].

Internal quality

The results on the internal characteristics of eggs from local and improved guinea fowls are presented in Table 2. The results showed significant differences ($p < 0.05$) in all the internal quality characteristics of eggs (albumen weight, albumen height, yolk weight, yolk height, and Haugh unit) measured except yolk colour ($p < 0.05$).

Discussion

A direct positive relationship was observed between egg weight and other internal components (albumen and yolk) and external parameters of the eggshell. When an egg weight increases, the other parameters (albumen, yolk, and eggshell) also increase, and when an egg weight decreases, the albumen, yolk, and eggshell decrease. Thus, the egg weight of improved and local guinea fowls affects albumen, yolk, and eggshell and our findings corroborated with the work of Nowaczewski, et al. [11] and Idowu, et al. [16]. Similarly, Singh, et al. [9] reported that the internal egg quality of improved guinea fowl is often superior to that of local guinea fowl due to selective breeding for specific traits. The color of egg yolks is influenced by the diet of the laying hens [17,18]. Similar values recorded in the yolk colour might be related to the genetic makeup of the birds. Studies have shown that beyond diet, the hen's breed can influence egg yolk colour, with some breeds naturally producing darker yolks [19].

Table 2: Internal quality characteristics of eggs from local and improved guinea fowls.

	Treatments			*p* - value
Parameters	Local	Improved	SEM	
Albumen weight (g)	16.23^{b}	22.91^{a}	0.33	0.031
Albumen height (mm)	5.30^{b}	6.20^{a}	0.06	0.042
Yolk weight (g)	14.63^{b}	22.88^{a}	0.44	0.037
Yolk height (cm)	1.18^{b}	1.67^{a}	0.08	0.026
Yolk colour (scores)	6.00^{a}	6.20^{a}	0.65	0.064
Haugh unit	59.63^{b}	69.58^{a}	1.36	0.021

ab = Means within the same row with different superscripts indicate significant differences ($p < 0.05$).
SEM: Standard Error of Mean.

Conclusion

In conclusion, it may be stated that improved guinea fowl eggs compared to local Guinea fowl in terms of egg weight, egg length, egg width, egg shape index, shell weight, and shell thickness measured. Similarly, improved guinea fowl eggs recorded better (albumen weight, albumen height, yolk weight, yolk height, and Haugh unit except for yolk colour. In both guinea fowl varieties studied, yolk colour was similar. Thus, improved guinea fowl eggs have the overall quality compared with the local variety. It is therefore recommended to obtain eggs from improved Guinea fowl variety for consumers and the production of commercial eggs.

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