

Original Research Article

Effect of Storage Methods on Egg Characteristics and Embryonic Development of Guinea Fowl (*Numida meleagris*) Eggs

ABSTRACT

Aims: This study was conducted to investigate the influence of different egg storage methods on egg characteristics and embryonic development of Guinea fowl (*Numida meleagris*) eggs.

Study design: A Complete randomized design (CRD) was used for the experiment.

Place and Duration of Study: The study was conducted at the Poultry Unit of the Department of Animal Science Education, University of Education, Winneba, Mampong campus.

Methodology: A total of one hundred and eighty (180) hatching eggs were used for the experiment. The various experimental coops were labelled in accordance with their experimental treatment as paper crates (T1), vegetable oil (T2) and saw-dust (T3). Each treatment (T) had three replications (20 eggs per replicate), which gave a total of nine replications. Data collected were analyzed using General Linear Model (GLM) procedure of SAS.

Results: Results showed that egg storage methods had significant ($P < .05$) effect on egg weight after storage, egg weight loss and embryonic development. The highest ($P < .05$) egg weight after storage was observed among eggs stored with vegetable oil and lower among eggs stored on paper crates. Eggs treated with vegetable oil produced very excellent ($P < .05$) results with lower weight loss while eggs stored with paper crates recorded the highest weight loss. Embryonic development was significantly ($P < .05$) higher among eggs treated with vegetable oil followed by saw-dust with paper crates being the least. Albumen weight and yolk weight was significantly ($P < .05$) higher among eggs treated with vegetable oil. Similar ($P < .05$) albumen weight was observed for both saw-dust and paper crates. The least yolk weight was observed among eggs stored on paper crates.

Conclusion: In conclusion, coating table eggs with vegetable oil could be effectively used to preserve egg quality and improve embryonic development.

Keywords: Vegetable oil, saw dust, paper crate, egg weight, egg quality

1. INTRODUCTION

Guinea fowl is a well known bird in West Africa and European countries, but in the rest of the world especially in developing countries it is yet to be well-established on a commercial basis [1]. The indigenous Guinea fowl (*Numida*

meleagris) is widely distributed in Africa where it has distinct popularity among smallholder farmers. In Ghana, indigenous Guinea fowls are mostly reared in small backyard units in small scale numbers. Guinea fowl plays an important role in the social life of many

tribes in Ghana. This is because the meat of Guinea fowl is highly accepted for food locally with no restriction or religious taboos [2].

Guinea fowl eggs are very popular in Ghana and are sold on the market during the months of May to July [3]. The eggs keep longer than domestic fowl eggs because of their unusually thick shell. The eggs consist of a protective egg shell, albumen (egg white) and vitellus (egg yolk) contained within various thin membranes. Egg shells act as hermetic seals that guard against bacteria invasion and the shell membranes function to retain the fluid of the albumen and also to resist bacterial invasion [4].

A young hen produces eggs with thicker shells and longer pores than older hens. The productivity of local Guinea fowls in Ghana can be improved through good management practices, egg collection, selection, storage and nutrition [5]. The major problems affecting Guinea fowl production are embryonic mortality, eggs storage length, egg size, nutrition and seasonal variation [6].

Guinea fowl egg quality and hatchability are significantly influenced by number of storage days, temperature and relative humidity. Romao et al. [7] recorded that egg-type quail eggs had 85 % hatchability when storage up to 10 days at 20 °C and 60 % of relative humidity. In other study Garip and Dere [8] reported that hatchability was 78.4 % for quail eggs stored for 5 days in 21 °C and hatchability declined to 35.4 % when the storage period extended to 15 days in the same storage temperature. According to [] who low temperature prevent embryonic development before incubation , and for this purpose the eggs room temperature must be 20 – 25 °C for 4-7 days. Awotwi [3] explained that hatchability is affected by many factors as fertility of eggs, handling of eggs and conditions during incubation.

Guinea fowls have limited shelf lives which vary depending on the storage methods and different environmental conditions. Eggs are very perishable food products. Careful preservation of edible eggs is extremely important as improperly handled eggs may contain elevated levels of Salmonella bacteria that can affect embryonic development. However, these parameters have not been fully examined in Guinea fowl [9]. The application of oiling on eggs, on the other hand, can be justified since they maintain the functional properties of food by decreasing moisture loss; gas transport (oxygen and carbon dioxide) reduces weight loss and maintains the internal measurement such as albumen and yolk quality [10]. The use of sawdust is very effective in slowing down reduction in albumen and yolk quality and improved embryonic development [11]. Moreover, little research work has been carried out to investigate into the effect of different egg storage methods on embryonic development to improve performance to achieve maximum hatchability in indigenous Guinea fowls.

The purpose of this experiment was to investigate the effect of different egg storage methods on embryonic development and egg characteristics of Guinea fowl eggs.

2. MATERIAL AND METHODS

2.1 STUDY AREA

The study was carried out at the Poultry Section of the Animal farm of the Department of Animal Science Education, University of Education, Winneba, Mampong-Ashanti campus, Ghana. Mampong-Ashanti lies in the transitional zone between the Guinea savanna zone of the north and the tropical rain forest of the south of Ghana along the Kumasi-Ejura road.

2.2 Egg Collection and Experimental Design

A total of one hundred and eighty (180) hatching eggs were obtained from the Guinea fowl unit of the University. Eggs were collected in the morning in containers which were cushioned to avoid breaking or shaking as recommended by [4, 12]. Each egg was weighed using an electronic weighing scale and marked with a permanent marker. Three different storage methods were applied to the eggs. That is using paper crates, vegetable oil and saw-dust. The eggs were stored for 14 days at room temperature (37.5-37.8 °C) and 75 % relative humidity. Candling was done on 14 days of storage to determine embryonic development. The various experimental coops were labelled in accordance with their experimental treatment as paper crates (T1), vegetable oil (T2) and saw-dust (T3). Every treatment had three replications (20 eggs per replicate) which gave a total of nine replications. A Complete randomized design (CRD) was used for the experiment.

2.3 Data Collection

Eggs were collected daily, identified and stored under a room temperature of 16 °C, for two weeks. This was to imitate the environmental conditions of local farmers. Eggs were cleaned, disinfected by fumigation. Eggs were incubated at 37.5-37.8 C and 60% relative humidity for 28 days. Candling was performed on day 14 of storage after which egg weight before storage, egg weight after storage, egg weight loss during storage, embryonic development, internal and external egg characteristics were recorded.

2.4 Parameters Measured

Parameters measured include egg weight before storage, egg weight after storage, egg weight loss during storage, embryonic development, internal and external egg characteristics.

The weight of fresh eggs laid in a day was obtained by weighing eggs from each

replicate using an electronic weighing scale. The eggs were stored under different storage conditions for 14 days. The egg weight after storage was obtained by weighing eggs from each replicate using an electronic weighing scale. Egg weight loss during storage was calculated as the difference between the initial egg weight and egg weight after storage using an electronic weighing scale. Candling was done on the 14th day to determine embryonic development respectively. Eggs that were developed were recorded according to their treatment respectively.

External and internal egg characteristics were considered. Two eggs from each replicate were collected for egg quality analysis. A total number of 18 eggs (2 from each replicate) were used to measure the internal and external egg characteristics. Parameters measured from the external egg characteristics were egg weight, shell weight and shell thickness. The weights of the eggs were determined with the aid of an electronic weighing scale. The shells were cleaned, washed and air-dried at room temperature until a constant weight was obtain using an electronic weighing scale. Shell thickness was determined from the broad end, narrow end and the middle of the shell using micrometer screw gauge and the average of the three measurements was taken as shell thickness in millimeters.

Internal egg characteristics measured were yolk weight, yolk colour, albumen weight and haugh unit. The above mentioned internal qualities were determined by cracking and breaking gently each egg into a clean petri dish and measurements were taken with the aid of a venier caliper sensitive to 0.01 mm. The yolk and albumen were carefully separated and weighed using the electronic weighing scale. Albumen weight was weighed using an electronic weighing scale. The colour of the yolk was measured using the roach colour fun and the higher the value the yellower the

yolk [13]. Haugh unit measures the quality of the egg and it was calculated using the following formula adopted from [14].

$$HU = 100 \log (H - 1.7W^{0.37} + 7.6)$$

Where,
 HU = Haugh Unit
 H = Albumen height (mm)
 W = Egg weight (g)

2.5 Statistical Analysis

The data collected was analyzed using General Linear Model (GLM) procedure of Statistical Analysis System (SAS for Windows, version 7). The means were separated by using the probability of difference (PDIFF) procedure of SAS [15].

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Effect of storage methods on egg weight and embryonic development

Result from the study table 1 shows the effect of different egg storage methods on egg weight and embryonic development. Egg storage methods had significant ($P < .05$) effect on egg weight after storage, egg weight loss and embryonic development. However, egg weight

before storage was found not significant ($P > .05$). The highest ($P < .05$) egg weight after storage was observed among eggs stored with vegetable oil and lowest among eggs stored on paper crates. Eggs treated with vegetable oil produced very excellent results with lower weight loss while eggs stored with paper crates recorded the highest weight loss.

Embryonic development during the period of storage was significantly ($P < .05$) higher among eggs treated with vegetable oil followed by saw-dust with paper crates been the least.

3.1.2 Effect of storage methods on egg characteristics

Different egg storage methods had significant ($P < .05$) effect on albumen weight and yolk weight. Albumen weight and yolk weight was significantly ($P < .05$) higher among eggs treated with vegetable oil. The same ($P > .05$) albumen weight was observed for both saw-dust and paper crates. The least yolk weight was observed among eggs stored on paper crates. Vegetable oil has been widely used in egg preservation, and various degrees of efficiencies have been reported.

Table 1: Effect of storage methods on egg weight and embryonic development

Parameters	T1 (Paper crates)	T2 (Vegetable oil)	T3 (Saw-dust)	Standard Error	P-value
Egg weight before storage (g)	37.72	38.44	38.31	0.395	0.42
Egg weight after storage (g)	35.40 ^c	37.48 ^a	36.12 ^b	0.368	0.01
Egg weight loss (g)	2.320 ^a	0.960 ^c	2.190 ^b	0.234	0.04
Embryonic development	6.000 ^c	8.666 ^a	6.666 ^b	0.285	0.03

^{abc} Means bearing different superscripts in the same row are different at $p < 0.05$, p = probability of main effects,

Table 2: Effect of storage methods on egg characteristics

Egg characteristics	T1 (Paper crates)	T2 (Vegetable oil)	T3 (Saw-dust)	Standard Error	P-value
Albumen height (mm)	4.923	4.776	4.961	0.155	0.68

Albumen weight (g)	20.27 ^b	21.23 ^a	20.27 ^b	0.184	0.01
Haugh unit	77.12	77.86	81.45	1.885	0.27
Shell thickness (mm)	0.550	0.645	0.571	0.031	0.12
Shell weight (g)	4.968	5.507	5.452	0.151	0.06
Yolk colour	1.833	2.166	2.000	0.129	0.24
Yolk height (mm)	11.82	12.31	12.28	0.209	0.23
Yolk weight (g)	10.11 ^c	11.08 ^a	10.38 ^b	0.147	0.01

^{abcd} Means bearing different superscripts in the same row are different at $p < 0.05$, p = probability of main effects,

3.2 Discussion

3.2.1 Effect of storage methods on egg weight and embryonic development

The improved egg weight observed in this experiment could be as a result of the different egg storage methods. This can be further explained that, the efficacy of oils in preservation of eggs has been attributed to the ability of oil in blocking the air pores of the egg shells, thereby preventing the flow of air in and out of the eggs and degradation by the contaminants such as air may carry [16]. Similar findings were reported by [17].

The significant differences observed could be attributed to the level of vegetable used in this experiment. This finding is in support of the observation made by [16] who reported 1.7 (g) weight loss among chicken eggs.

The significant differences observed could be explained that coating of eggs with vegetable oils prevents microbial multiplication within the eggs thereby enhancing embryonic development. The findings in the present study compared favourably with the work of [18] who used groundnut, cotton seed and coconut oils.

3.2.2 Effect of storage methods on egg characteristics

The significant differences observed could be explained that the use of vegetable oil was effective in preventing deterioration, maintaining interior quality, the albumen weight and yolk weight as compared to

the other treatment groups. This result is in agreement with [17] who reported that coating eggs with vegetable oil prevents loss of moisture and carbon dioxide via the shell pores thereby maintaining interior quality of chicken eggs.

4. CONCLUSION

It can be concluded from the result of this study that coating eggs with vegetable oil improve egg weight with lower weight loss while eggs stored with paper crates recorded the lowest egg weight with the highest weight loss. This study further concludes that embryonic development during the period of storage was improved among eggs treated with vegetable oil. Egg quality was highest among Guinea fowl eggs treated with vegetable oil. This study recommends that vegetable oil should be used to store Guinea fowl eggs to improve egg quality and promote higher embryonic development.

ETHICAL APPROVAL

Experimental protocols used in this study strictly conformed with the internationally accepted standard ethical guidelines for laboratory animal use and care as described in the European Community guidelines; EEC Directive 86/609/EEC, of the 24th November 1986 (EEC, 1986).

DATA AVAILABILITY

The data used in this study are available from all authors.

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