Effect of Storage Material and Time on the Internal and External Quality of Table Eggs

Abstract

The study was conducted with the objectives to evaluate the effect of storage time and material on the internal and external quality of table eggs and compare improved egg storage practice technologies with the local practices. It was done in four districts with three treatments (T1=oil coated eggs stored in plastic only, T2=eggs stored in plastic with straw and T3=eggs stored in Zenbil with straw). About 240 eggs from Bovans Brown lay after 4 hours was used. Sunflower oil was used to coat the shell of the eggs. Generally, eggs were stored for 16 days and 45 days. There were 10 eggs per treatment with the replication of 8. Therefore, at 45 days of storage oil coated eggs were heavier than non-coated eggs. Similarly, coated eggs and eggs stored in plastic recorded higherhaugh unit(HU)than eggs stored in Zenbil. Hence, eggs can be stored for 45 days at farmer management level in plastic containers with straw than local materials without affecting the internal and external quality.

Key words; Bovans Brown, Coating, Eggs, Haugh Unit,

1. Introduction

Freshness is a major contribution to the egg quality. The internal quality of eggs begins to deteriorate after they have been laid due to loss of moisture and carbon dioxide via egg shell pores [1]. The shell of the egg is porous to admit the passage of air in and out, but it is coated with a mucilaginous matter which prevents the entrance of bacteria unless it is very old, wet, softened by moisture, rubbed off or otherwise the keeping quality of the egg is much reduced. Therefore, eggs should not be washed, held in damp musty places or handled more than necessary.

Eggs are expensive sources of high quality protein and other nutrients. However, they are highly perishable and can rapidly lose their quality [2]. Egg shells are breathable material; therefore, they allow moisture and carbon dioxide to permeate through the shell. The permeation causes changes in albumen and yolk as well as weight loss. The pores on egg shell need to be sealed to reduce evaporation and escape of carbon dioxide [3]. Improved protection methods such as coating may have minimized losses [3, 4, and 5]. Oil coating of the shell has been documented as a method of preserving egg quality and is used in practice [6]. Similarly, according to [1], surface coating is an alternative method to preserve egg quality, although it is much less effective than refrigeration. [7] reported that oil coated eggs had longer shelf life than un-coated eggs. Similarly, [8] stated that mineral oil coatings minimized the weight loss by 0.5% and preserved the albumen and egg quality of stored eggs at least three weeks. [1] also found that edible oil (coconut, palm, rice bran and soybean) coating could preserve internal quality of eggs (maintained to grade A) four weeks longer than non-coated eggs.

Egg quality has a genetic basis and can also be affected by non-genetic factors such as age of birds, feeding, season, transportation, storage period and condition. According to [9], farm produced eggs have good quality but poor handling and storage conditions in the farm and in the channels (can lead to loses in quality). The most important in the internal or external egg quality during storage length or handling practices are due to weight loss by water evaporation [10, 11], power of hydrogen of albumen and yolk increases, and haugh unit

(HU)value reduced, while carbon acid dissociates [12]. These fluctuations are the consequences of water movement through the vitaline membrane [13, 14].

Some findings showed that the traditional storage practices of farmers like cartons, baskets, clay pots and teff grain of farmers can preserve eggs for a less than a week [15]. They are all characterized by high egg weight loss by allowing high aeration and hydrophilic (absorbing water from the albumin) nature like storage in teff grain. Therefore, this demonstration was done with the objective of comparing the egg storage practice technologies with the local practices and evaluates their weight loss and quality deterioration effects.

2. Materials and Methods

2.1.Study area: This study was conducted in four districts (Gulo-mekeda, Ganta-afeshum, Hawzen and Hintalo-wejerat), four retailers (chicken and egg), four chicken producers and one research center. About 240 eggs of Bovans Brown chickens laid within 4 hours were used. Each egg was cleaned for its debris, weighed and given an ID number for each treatment. Farmers and traders were also given a short brief on the objectives, methods of the demonstration and internal quality of eggs by breaking one egg.

2.2. Experimental Treatments

There were three treatments. Treatment one (T1) -oil coated eggs placed in plastic container, T2-eggs placed in plastic container with straw and T3- eggs placed in local material made of sack called ‘zenbil’ with straw). Sunflower oil heated for 1-2 seconds was used to coat the shell of eggs and dried with soft clothes. There were 10 eggs per treatment with 8 replications.

Eggs were weighted at day one, 16 days and at 45 days later. However, egg weights were not taken for oil coated ones at 16 days. One egg per treatment was broken for the internal quality observation at each data collection time.

The most common indices used to evaluate egg freshness are Haugh unit (HU) and yolk index (YI) [16]. In addition, grading of eggs is mainly performed based on the egg weight and quality of egg shell, albumen, yolk and the air cell[17].

The HU was calculated as $HU=100\ \log(H-1.7W^{0.37}+7.57)$, the equation described by [18], where

H= height of thick albumen in mm

W= egg weight

$$\text{Egg weight loss} = \frac{(\text{final weight} - \text{initial weight}) * 100}{\text{Initial weight}}$$

Yolk index= (yolk height/yolk width)*100

Albumen index= (albumen height/albumen diameter)*100

Weights of each parameter were measured using electronic balance (Model HC-B 100001, Made in China), height of albumen and yolk were measured using ruler (Electroprime 50cm Clear Plastic Measuring Long Straight Centimeter Ruler G4p6)and egg length, egg width, yolk and albumen width were also measured using digital caliper (Venire caliper, model CD6” CSX, Mitutoyo, Japan).

Ethical approval: this research has no any animal or human ethical violation.

2.3.Data analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software version 20. One-way ANOVA was used to compare weight loss of eggs, HU and yolk index. The Tukey test at $p<0.05$ was used to compare the means as appropriate.

3. Results and Discussions

3.1.Egg and shell weight

The effect of storage material and time on egg and shell weight is presented in table 1. There was no difference ($p>0.05$) of egg weight at the demonstration time (initial egg weight) and 16 days storage. However, at 45 days of storage there was significant difference ($p<0.05$) of egg weight among treatments. Oil coated eggs weigh heavier than eggs stored in Zenbil, whereas, eggs stored in plastic with straw and Zenbil had similar weight. Eggs coated with oil lose less weight (0.6%) than eggs stored in Zenbil (6%) and plastic with straw (3%). Similarly, eggs stored in plastic with straw also lose less weight than eggs stored in Zenbil. Egg shell was also heavier in oil coated eggs than eggs stored in plastic with straw and Zenbil at 45 days. However, there was no difference ($p>0.05$) of egg shell weight stored in plastic and Zenbil. The shell weight percentage was not significantly different ($p>0.05$) among the storage materials at 45 days of storage. Similarly, [19] reported that coated eggs have less weight loss (0.34%) than non-coated eggs (5.46%) at the 6th week of storage, and [20] also reported that non-coated eggs lose more weight (7.87%) than coated eggs. Hence, lipid based coating materials are more resistant to moisture barriers because of their hydrophobic structure which lies in line with the present study. In addition, egg weight loss (6.43%)was observedwith the increasing storage period within 30 days of storage for control treatments and 2.6% during 8 days of storage, 4.59% lose stored in 28 days,respectively[18, 21, 22]. Moreover, [23] also reported that the weight loss of eggs increased over 5 weeks of storage period when stored at room temperature. However, the rate of loss in coated eggs was lower than non-coated eggs.

Table 1: Effect of storage material and time on external egg quality (*M±SE*)

Storage material	IEW (g)	16EW(g)	45EW(g)	EWL (%)	Shell wt. (g)	Shell Wt%
Plastic container only (Oil coated egg)	52.34±0.46	-	52.17 ± 0.51^{a}	0.62 ± 0.11^{a}	8.57 ± 0.81^{a}	15.85±1.31
Plastic container with straw	52.96±0.46	51.95±0.45	51.21 ± 0.51^{ab}	3.01 ± 0.23^{b}	6.57 ± 0.37^{b}	13.18±0.65
Zenbil with straw	53.20±0.49	51.61±0.47	49.59 ± 0.49^{b}	6.02 ± 0.34^{c}	6.29 ± 0.18^{b}	12.82±0.53
p-value	*0.403*	*0.607*	*0.001*	*0.000*	*0.013*	*0.061*

^{abc}*means within a row not bearing a common superscript are significantly different (p<0.05)*

M= mean, IEW=initial egg weight, EW=egg weight, 16EW= egg weighed at 16 days, 45EW= egg weighed at 45 days, g=gram, Zenbil= locally made from sack and used to transport and store eggs, EWL= egg weight loss, SE= standard error of the mean

3.2.Internal quality of eggs

The effects of storage material and time on the internal quality are presented in table 2. There was no difference ($p>0.05$) of albumen and yolk weight including their indexes. However, oil coated eggs and those non-coated eggs stored in plastic with straw recorded higher HU than eggs stored in Zenbil with straw. [18] also reported that the HU of coated eggs ranges from 82.77-81.11 while, the non-coated eggs HU ranges from 74-57.57 in 30 days of storage, which is in line with the current study.While, [22] reported that the HU is reduced from 75.1 in coated eggs to 51.9 in non-coated eggs much lower than the current study and similarly,[20], said that,the lowest HU was recorded in non-coated eggs (39.41) while eggs coated with mineral oil recorded the highest 61.51value. Hence according to his study, as storage increased, the HU value decreased from 80.25 at 0 days to 59.14at 49 days when coated with mineral oil. In addition, [24] also reported that eggs coated with coconut oil and palm oil recorded 53.40 and 54.86 HU at 35 days of storage whereas; the non-coated eggs recorded 34.61 at 35 days of storage. This implied that different coating materials have different effect on the quality of eggs. The higher value of HU, the better the quality of eggs and the values range 0-130. The HU ranked as AA: 72HU, A: 71-60HU and B: 59-31 HU [25].

The yolk index of non-coated eggs (0.18)was lower than coated eggs (0.41) [24] at 35 days storage which is different from the current study. The present finding is lower than the report of [24]. Similarly, [22] also reported that eggs coated with coconut oil recorded 6.9% albumen index and 35.9% yolk index at 28 days of storage. The variation may be due to variation of coating materials.

Table 2: Effect of storage materials on internal quality of eggs at 45 days of storage

Storage material	**Yolk Wt. (g)**	**YI**	**Al Wt. (g)**	**AI**	**HU**
Plastic container only (Oil coated egg)	13.5±0.5	0.019±0.001	28.5±1.5	0.009	77.43 ± 0.72^{a}
Plastic container with straw	14±0.44	0.022±0.002	28.29±1.5	0.006±0.01	76.57 ± 0.48^{ab}
Zenbil with straw	13.83±0.48	0.021±0.004	28.33±0.56	0.206±0.20	75 ± 0.58^{b}
p-value	0.857	0.675	0.996	0.26	0.038

^{abc}*means within a row not bearing a common superscript are significantly different* ($p<0.05$)

4. Conclusion

Oil coated eggs and eggs placed in plastic container with straw had higher egg and shell weight and HU than eggs placed in Zenbil with straw at 45 days of storage.

5. Recommendations

It is better to store table eggs for 45 days in plastic container with straw without losing weight and internal quality (Especially in the rainy season), therefore, It is better to scale up these findings to the other beneficiaries (during rainy season). However, this demonstration should be repeated in the dry period (February to May) in the context of the region. Furthermore, An observation during the demonstration showed us good results in the utilization of oil coating of eggs stored in plastic with straw had grade A and better internal quality. Therefore, considering the cost of oil farmers can store eggs for 45 days.

Data availability statement: Data will be made available on request.

Consent: participants agreed to participate and share information during the research study

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