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ORIGINAL ARTICLE

Impact of Storage Period and Quality on Composition of Table Egg

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ABSTRACT

The effect of storage methods and period on the external and internal quality indicators of table eggs of laying hens in a hot dry climate was examined. The traits were: egg weight loss, shape index, yolk index, albumen height, Haugh unit, and shell thickness. In this experiment a total population of 108 eggs of Hi sex breed were used. The age of chickens is 68 weeks and started production at age of 20 weeks. The storage periods were 0,3, 6, 9,12 and 15 days while the methods were: room temperature (37^0C) and oiling, refrigeration (5^0C) storage. Temperature is measured periodically three times per day during storage period. Indicators of performance are: percent loss in weight, shape index, yolk index, whiteness (Albumin), Hough-unit, and crust thickness. The results obtained revealed that loss in weight is positively related to storage period. In contrast, whiteness (albumin) increase with storage period .Storage type showed a significant difference ($P < 0.05$) between eggs stored at room temperature with that stored in refrigerator. It evident form the study that most of eggs characteristic are effected by type and duration of storage with exception of shape index and crust thickness. Therefore, To preserve egg internal qualities it is recommended to keep them in refrigerators for maximum of 30 days. For storage at room temperature it is evident from the study not to store eggs for period not more than-15--days.

Key words: eggs, storage method, quality, time, hens, hot dry climate.

Introduction

Eggs are a non-expensive, but very nutritious food. It is one of the main sources of portion, irons phosphate, amino acids and fatty acids of eggs facilitate digestion specially in rural areas. Conventional production of family system supply about 10% market demand of table eggs in most developing countries in general and in Sudan in particular. The park yard system of egg production sustain the small families economics and generate sustainable income. One of constraints to increase production in these rural and arid areas of Sudan is to preserve the egg qualities by selecting the most proper storage system(storage type and duration). Several chemical-physical modifications occur inside an egg during the storage period. Easily observable physical changes include, thinning of the thick albumen, the changes related to the ageing of the albumen and the yolk, and flattening of the yolk [10].

Another well-known quality parameter is the yolk index obtained by dividing the height by the diameter of yolk. The albumen that surrounds the yolk, which is called the thick albumen, progressively liquefies and thins with time, transforming itself into thin albumen. This phenomenon is caused by the deterioration of the gelatinous structure of the albumen that is due to the changes in the complex lysozime-ovomucine caused by the increase of pH during the storage period [1,6]. Another obvious change that can be observed during egg ageing is the flattening of the yolk caused by the weakening of the vitelline membrane [3]. These changes are used for

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the determination of the quality indices of the eggs. The Haugh unit, which an index based on the thickness is adopted by the European community to select eggs.

Proper storage of eggs is essential to preserve quality and cooking characteristics. Poor storage conditions can reduce eggs grade eggs within a few days. The principle degrading factors are high storage temperature and dehydration. Improper storage is reported to produce some observed changes: a change of thick albumen to watery albumen, enlargement of yolk that breaks easily when the shell is broken, enlargement of the air cell, and absorption of off-odors and off-flavors if stored near pungent foods [12]. The knowledge of effect of temperature degree on the quality control of internal composition of eggs is essential to make comparison between eggs storage at Rome temperature and the refrigerator. Egg value is determined by standards based on interior and exterior characteristics of individual eggs to reflect both the quality and size of the eggs. High quality egg contents are indicated by firm, thick albumen and yolks. The air cell is very small (less than 4.7 mm in depth), and the albumen contains no blood or meat spots. Eggs with large blood spots are classified as loss eggs and are considered "inedible". The value of each egg is determined individually by the lowest exterior or interior quality factor. Most downgraded shell eggs are due to external shell factors, but have high quality egg contents. Hence, and from the review of current literature the feasible indicators to judge the edible value of table eggs need to include: egg weight loss, shape index, yolk index, albumen height, Haugh unit, and shell thickness.

Consequently, the specific objective of this study are two folds: First to quantify the effects of storage type (room Vs refrigerator) on the characteristic, internal quality, composition and edible values of table eggs as function of six evaluating indicators. Secondly, to identify the optimum duration (days) to store eggs at refrigerator and room temperatures.

Material and methods

The experiment was carried out at the Department of Animal Production Collage of Agricultural Studies in Shambat- Khartoum North-Sudan. A total sample of 108 eggs of Hi sex breed were randomly selected from the poultry population of year and a half of the department. The selected sample is divided into two equal groups. One group is stored at room temperature of 37 Co while the other is stored in a refrigerator at 5 Co.

Eggs were numbered and weight by the sensitive balance immediately after collection. Eggs in each group were distributed to six patches. Each patch contains three frequencies and each frequency contains three eggs. Measurements of egg composition and qualities were taken periodically at three days interval for a total duration of 15 days.

The indicators of composition and qualities of eggs includes: egg weights, highness of yolk and albumen, shell- thickness, eggs length and diameter.

The eggs were weighed before the storage by the sensitive balance immediately after their collection from the pen. The highness of the yolk was measured in the centre of the egg yolk. The thickness of albumin was measured near the chalaziferous area. After breading the eggs the shell was collected and part of it was taken after removing the membranes for measuring the shell thickness. The measurement was made in the three places: the picked edge, the wide edge and the egg centre. Then the average of the shell thickness was taken.

Measurement of eggs length and diameter was done by using a normal Vanier. From these measurements the following indicators were estimated:

The shape-evidence: The egg-length / The egg-diameter.

Hough-Unit: 100*Log (H+7.75-17*W-37)

Where: H=the egg highness and W=the egg weight

The yolk-evidence: Yolk-highness/yolk-diameter

The data obtained was analyzed by using the statistical program (SPAS), so as to compare the treatments and to made analysis of variance.

Results and discussions

Tables 1 and 2 show the number of the eggs tested each test day together with the average of their characteristic parameters including the Haugh unit (HU), the yolk index (YI), the air cell height (Air Cell), and the egg weight.

The impact of the type and duration storage on the loss of weight: The result obtained in table (1 and 2) shows that there is highly significant differences($p<0.05$) between the average percentage loss for eggs stored at the room temperature and the ones stored in refrigerator. It is seen that the average loss in weight is 4.76% for eggs stored at the room temperature and 1.54% for those stored in refrigerator. Result given in figure 1 revealed that the weight of x decrease due to the duration of storage and the percentage loss may be predicted for storage in refrigerator by the relation:

Y=0.920X-1.377 (R^2=0.846)

For room storage the relation:

Y-1.980X-2.172 (R^2=0.99)

Table 1: Mean values of evaluation indicators for eggs stored at room temperature for various storage periods.

Mean	After 15days	After 12days	After 9days	After 6days	After 3days	Control	State
59.66	59.26	60.23	58.04	60.32	60.38	59.74	Before Storage
46.88	53.29	55.96	54.52	58.13	59.35	0	After Storage
4.76	10.14	7.11	5.99	3.61	1.7	0	Weight Loss %
74.55	74.43	73.98	75.19	74.72	74.08	74.9	Shape Index
0.29	0.18	0.2	0.25	0.33	0.39	0.41	Yolk Index
6.99	5.68	5.81	6.77	6.79	8.19	8.7	Albumin Height
83.84	76.7	77.19	82.9	82.63	90.55	93.06	Haugh Unit
0.33	0.28	0.28	0.34	0.36	0.35	0.35	Shell Thickness

Table 2: Mean values of evaluation indicators for eggs stored at refrigerator for various storage periods.

Mean	After 15 days	After 12 days	After 9 days	After 6 days	After 3 days	Control	State
59.64	60.18	58.64	57.75	60.43	61.01	59.82	Before Storage
48.59	57.12	57.14	56.93	59.7	60.63	0	After Storage
1.85	5.24	2.58	1.41	1.22	0.63	0	Weight Loss %
73.87	74.52	73.49	73.2	73.72	73.35	74.97	Shape Index
0.4	0.33	0.4	0.39	0.41	0.42	0.42	Yolk Index
7.47	6.41	7.42	6.78	7.87	7.78	8.54	Albumin Height
83.34	79.41	68.83	82.94	88.69	87.91	92.26	Haugh Unit
0.33	0.29	0.35	0.32	0.34	0.35	0.34	Shell Thickness

Where: Y is percentage loss in weight and X is storage period. The correlation of loss of egg weight with storage period by linear relation is confirmed by.

These results agrees with the result reported by [9]. The loss in weight is attributed to loss of humidity from inside the egg due to evaporation effects. As given in figure 1 the average loss of weight in eggs stored at room is higher than that stored in a refrigerator [8,11].

Effect of the Storage Type and Duration on Shape Index:

The result of table(3) illustrate the non existence of the significant differences ($p > 0.05$) among the average of shape index for eggs stored in a room (74.53) or a refrigerator (73.87). The results also shows that there is no impact for the period of storage on the shape indices form the room or the refrigerator (Fig 2).

The Impact of the Duration and the Storage Type on Yolk Index:

The result given in table 1 and 2 prove the existence of significant deference ($p < 0.05$) among the average of the yolk indices. It is found that the yolk index for the eggs stored at the room is 0.29 and 0.39 for the eggs stored in the refrigerator. These shows that the yolk index is higher in the refrigerator compared to that obtained from room storage. It is also shown that the yolk index decreases according to the storage duration .As given in figure 3 the rate of reduction on yolk index is sharp with room storage and may be quantified with linear relation of the form: $Y=0.051X + 0.473$ ($R^2 = 0.969$) .For refrigerator storage rate of decrease in yolk index is milder and can be estimated by the polynomial relation:

$Y=-0.004X^2+0.016X+0.406$ ($R^2 = 0.829$).

It depends on the ratio of the yolk height to its diameter [7]. Flattening of the yolk is primarily due to the water content increase caused by osmotic migration from the albumen through the vitelline membrane [5].

The Impact of Storage on the Height of Eggs Albumen:

Table 1 and 2 indicate significant differences ($p < 0.05$) the increase of the averages height of albumen of the eggs for the eggs stored in a refrigerator (7.47 mm) and those which are stored at room temperature (7.00 mm). it is also seem that height of albumen decreases due to the duration of storage as seen in fig. 4. The rate of decrease in height of albumen for various storage types and periods can be estimated as given by the polynomial relations depicted in figure 4. It is also observed from figure 4 that there is a high albumen in the eggs stored at the room compared with that eggs stored in the refrigerator. [11] attributed to effect of rise of temperature in decreasing albumen height. This indicates that the temperature is one of the main factors influencing the egg quality during storage. The liquefaction of the thick white is largely influenced by the storage temperature. However, during storage the concentration of the free amino acid content in the egg white increases from 0.14 to 2.3 μ mol under various conditions of storage [2]. During storage, some well-known physical and chemical modifications taking place. These are the thinning of the thickness of albumen [5] and mainly the increase of albumen pH caused by the loss of carbon dioxide from the egg through the pores in the shell [4]. A rapid loss of CO_2 occurs particularly with the albumen, leading to a decrease in quality until the state of gas balance is reached between the inside and outside of the egg.

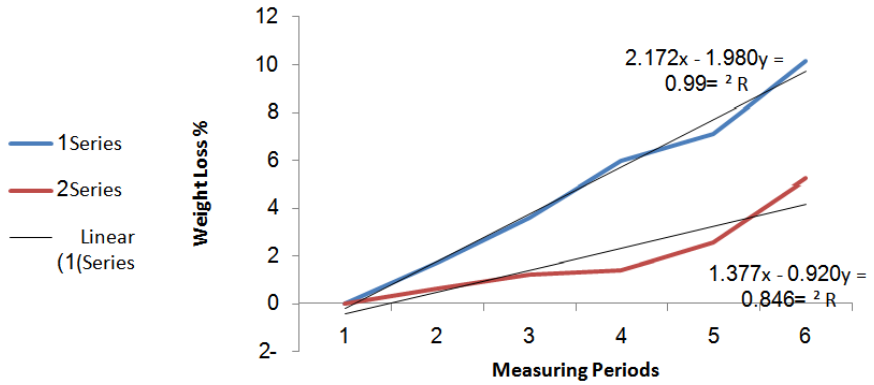

Fig. 1: Effect of different storage types and durations percentage weight loss of table eggs.

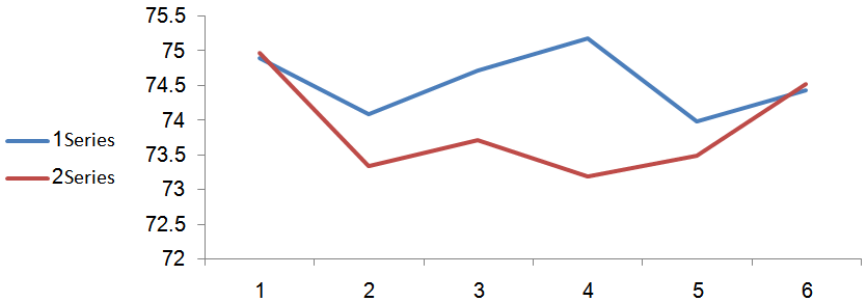

Fig. 2: Effect of different storage types and durations on Shape index of eggs.

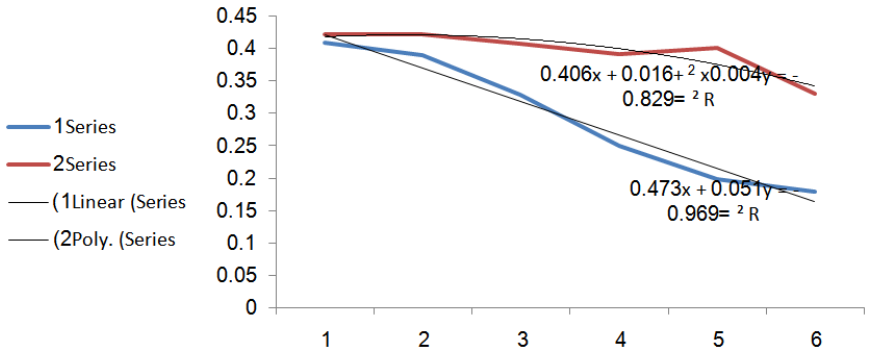

Fig. 3: Effect of Storage eggs in yolk index.

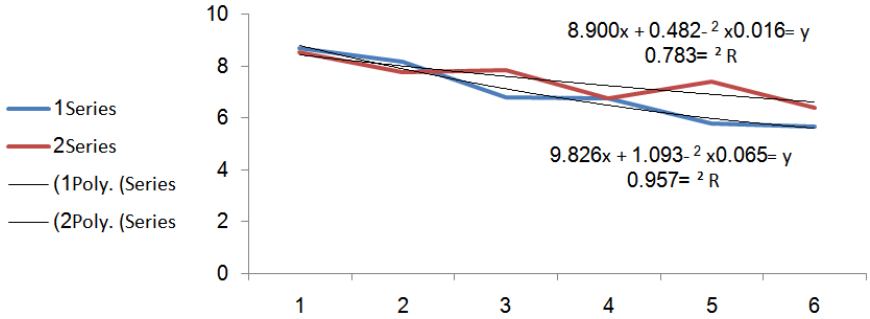

Fig. 4: Variation of height of albumen with storage types and periods.

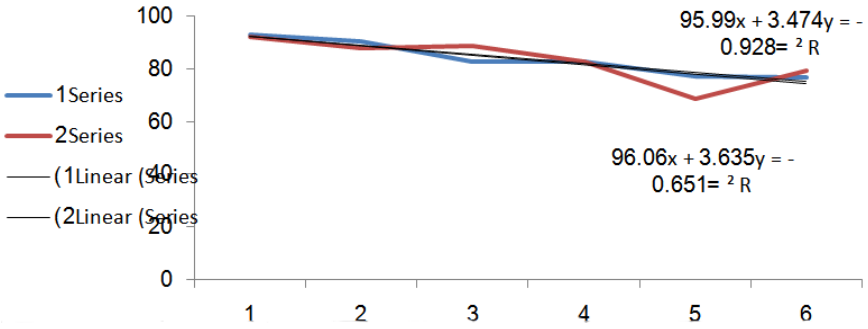

Fig. 5: Effects of storage types and periods on Hough-unit.

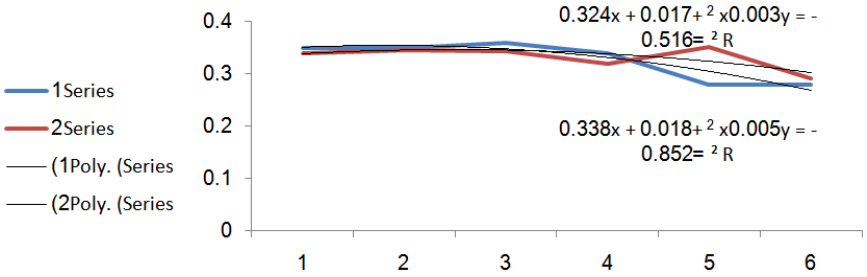

Fig. 6: Impacts of storage types and periods on shell thickness of eggs.

The Impact of Storage Types and Durations on Hough-unit:

As given in table 1 and 2 there is a significant differences ($p < 0.05$) between the average values of Hough -unit for the eggs stored in the refrigerator (86.34) and at room (83.70). Results have also shown the decrease in the hove-unit according to the increase on the storage duration. This is because of the weight decrease and the increase of whiteness [11]

The comparison of these two tables reveals that Haugh unit quickly decreases. However, the changes in the quality of eggs kept in the refrigerator (from 92.26 to 68.83 HU) were smaller than those of the eggs kept in the room (from 93.06 to 76.70 HU), As given in Figure 5 the rate of decrease can be estimated by linear relations for each type of storage such as:

for room storage: HU =Y= -3.474X+95.99 (R^2 = 0.928)

for refrigerator storage: HU =Y= -3.635X+96.06 (R^2 = 0.651)

Where: HU = Haugh unit and X = Storage duration.

The Impact of Storage on Egg Shell Thickness:

According to the results observed in table (1 and 2) there is no significant differences ($p > 0.05$) in the shell thickness between the averages of the eggs stored in the room and the eggs stored in the refrigerator. The results are illustrated that the shell thickness in the two storage types(room and refrigerator) decreases according to duration of storage as seen in figure 6. The polynomial relations for decrease in shell thickness for the various types and duration of storage periods is depicted in figure 6.

Conclusions and Recommendations:

From the study, it was observed that egg weight, albumen and yolk height, Haugh unit, albumen and yolk indices decreased with increase in storage time while shape index and shell thickness shows no significant differences. The regression relations given for the six evaluation parameters can be used for estimating optimum period for loss in egg qualities and for planning storage facilities. It can be concluded that the quality of an egg is affected by the method and length of storage. Eggs kept at high temperature 370C deteriorated in quality very fast and were not fit for consumption after two weeks. Refrigerated eggs were able to maintain their quality comparable to the fresh eggs. Were refrigeration facilities are not available and eggs must be stored and protected from direct sun light. It is more safe and advised in the hot dry climate, where ambient temperatures can reach 40^0C, eggs should not be stored at room temperature, for not more than one week before consumption.

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