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Effects of storage period and temperature on egg quality traits of Kurdish hens

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Abstract

A total of 54 eggs were collected from local Kurdish hens in Villages around Sulaimani city in Iraq. Fresh eggs were collected and measured within same day of being laid. The eggs were weighed and stored under two storage systems (4°C and 18°C) for four weeks. Six eggs from both systems were broken for egg quality parameters at 0, 7, 14, 21 and 28 days at 4°C and 18°C. The traits were egg weight loss, yolk index, Shwan index1 and Shwan index 2. Results showed that overall mean eggs weight loss in refrigerated eggs was lower ($P<0.05$) compared to out of refrigerator. Yolk index, Shwan index1 and Shwan index 2 decreased significantly during storage in refrigerator and out of refrigerator without any significant difference in overall mean values. The results indicated that egg quality deteriorated with increasing storage, however, the lower temperature only preserved the egg weight with no effect on yolk and Shwan indices.

Keywords: Storage period; temperature; egg quality; Kurdish hens

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Introduction

Various egg quality attributes are lost with the increasing egg age. Egg is very perishable food product and its quality is vulnerable to deterioration during the period of storage and consumption. Egg quality is adversely affected by conditions such as temperature, humidity and storage period. Backyard egg production supplies almost 10% market needs of table eggs in most of the developing countries in the world (Colin et al., 2004; Tayeb, 2012). One of the most important predicaments to increase egg production in the rural and arid areas of Iraq is preservation of egg quality. Several chemical and physical modifications take place inside an egg during the storage period (Whitney et al., 1999).

Some of the easily observable physical changes include thinning of the albumen and yolk, as well as flattening of the yolk (Stadelman and Cotterill, 1995; Kirunda and McKee, 2000; Tayeb, 2012). The flattening of the yolk with the aging of the egg is probably caused by the weakening of the vitelline membrane (Fromm and Matrone, 1962; Kirunda and McKee, 2000).

Proper storage conditions of eggs are essential to preserve quality and cooking characteristics. Poor storage conditions lead to reduction of eggs grading in a short span of a few days. High storage temperature and dehydration are the principle degrading factors which deteriorate the egg quality (Hasan and Okur, 2009). Improper storage often causes alterations in thick albumen into watery albumen, enlargement of yolk that breaks easily when the shell is broken and the swelling of the air cell and absorption of unfavourable odours if stored near off-flavoured foods (Young, 1997).

Length of egg storage period in poultry species causes reduction in egg quality and increases embryonic mortality. Qualitatively egg worth is assessed on the standards based on external and internal characteristics of an egg. Good quality egg is characterized by firmness, thickness of albumen and

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yolk. The value of each egg is determined individually by the lowest exterior or interior quality factor. Some downgraded shell eggs have bad 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 variety factors like egg weight loss, shape index, yolk index, albumen height, Haugh unit, and shell thickness (Stadelman and Cotterill, 2005). In addition, in commercial egg production system, fertility and hatchability are determined by the age of the stored eggs. The main objectives of this study to evaluate the effects of storage type (refrigerator Vs. Out refrigerator) on the characteristic, internal quality, Shwan indexes1and 2 and the optimum duration (days) of local Kurdish eggs.

Materials and Methods

This study was carried out at the Department of Animal Production, Faculty of Agricultural Sciences, University of Sulaimani, Bakrago, Sulaimani, Iraq. In the current experiment, a total of 54 eggs were collected from local Kurdish hens in Village around Sulaimani city. Fresh eggs were collected and measured within same day of being laid. The eggs were weighed and divided into two storing methods. Six eggs were broken on fresh basis for egg quality parameters and 24 sampled eggs were stored in chambers in a refrigerator (4ºC) and equal number of eggs were stored out of refrigerator (18°C) for 7, 14, 21 and 28 days. Relative humidity was 60 to 65 % for all treatments.

Determination of egg traits

Yolk weight (g): After removal of albumin, yolk was weighed by using sensitive electric balance (Mettler Toledo max=101g and e=0.1 mg).
Egg Shell weight (g): Shell weight was calculated by the following equation:
Egg shell weight = egg weight (g) – yolk and albumin weight (g)
Yolk height (cm): Yolk height was recorded by the Spherometer after pour yolk in the Petri dish.
Yolk diameter (cm): Yolk diameter was recorded by the same Vernier caliper after pouring yolk in the Petri-dish.
Yolk index: Yolk index was calculated depending on the yolk height and yolk diameter (mm) by using this equation:
Yolk index = Yolk height/Yolk width (Rose, 1997)
Shwan index 1: Shwan index 1 was calculated as described by (Ahmed and Aldabbeh, 1985).
Shwan index 1 = Yolk height/Yolk weight × 100
Shwan index 2: Shwan index 2 was calculated by the method as described by Ahmed and Aldabbeh (1985).
Shwan index 2 = 100 log [1.33 H – $W^{0.33}$]

Statistical analysis

Data collected were analyzed using XLSTAT 7.5.2 with storage periods and conditions as fixed factors. Significant means were separated by the Duncan's multiple range tests. The statistical model adopted was as follows:

$$Yijk = \mu + Ai + Bij + (AB)ij + eijk$$

Where
Yijkl = observation on the kth egg trait at an ith storage periods under a jth storage conditions.
μ = population mean
A i = effect of i Th storage periods
B ij = effect of the j Th storage conditions
(AB)ij = effect of interaction between of factor A with and factor B
eijkl = random error

Results and Discussion

Results of the effects of storage periods and condition on egg weight loss of local Kurdish hen are presented in Table 1. Egg weight loss significantly ($P<0.05$) increased with increasing storage periods and condition. During out of refrigerator (18°C), egg weight loss significantly ($P<0.05$) increased on day 28 of storage period. Refrigerated eggs had lower ($P<0.05$) egg weight loss, probably due to less moisture loss from the eggs. Temperature, relative humidity and flow of air or moisture are considered as the main factors in determining the technological conditions for storing eggs (Jones and Musgrove, 2005; Dudusola, 2009). With increase in the length of storage, egg weight declined as a result of increase in weight losses. The losses could be due to loss of carbon dioxide, ammonia, nitrogen, hydrogen sulphide gases and water from the eggs (Dudusola, 2009; Alsobayel and Albadry, 2011; Jin et al., 2011). Weight losses were not the same for all storage methods and storage conditions. Refrigerated eggs did not lose as much solvent as out of refrigerator (18°C). Thus, reduction in quality parameter was not so much high in refrigeration as compared to out of refrigerator.

The effect of storage condition and period on the yolk index was shown in Table 2. The results showed that the storage period and temperature conditions affected significantly the yolk index. Yolk index considerably decreased during storage at out of refrigerator. At out of refrigerator, the yolk index decreased in fresh egg on day 28 of storage. This result is in agreement with those of Siyar et al. (2007), Kirunda and McKee (2000) and Tebesi et al. (2012) who observed decreased yolk index. The lowest yolk index was recorded at day 28 is in agreement with Jin et al. (2011) who reported that the yolk and albumin

Table 1: Effects of storage periods and conditions on egg weight loss (g) of Kurdish hens

Storage period (day)	Refrigerator (4ºC)	Out of refrigerator (18ºC)	Overall mean
0 (Fresh eggs)	0.000	0.000	0.000
7	0.41± 0.16^{e}	0.60± 0.14^{d}	0.50± 0.11^{d}
14	0.55± 0.05^{e}	1.27± 0.13^{c}	0.913± 0.12^{c}
21	0.63± 0.14^{de}	1.88± 0.16^{b}	1.26± 0.21^{b}
28	0.96± 0.05^{cd}	2.74± 0.16^{a}	1.85± 0.28^{a}
*Overall mean storage condition	0.51± 0.07^{b}	1.30± 0.18^{a}	

$^{a-e}$Mean values with different letters in a column indicate significant differences (P<0.05); *Mean value within a row differ significantly (P<0.05).

Table 2: Effects of storage periods and conditions on yolk index of Kurdish hens

Storage period (day)	Refrigerator (4ºC)	Out of refrigerator (18 ºC)	Overall mean
0 (Fresh eggs)	0.44± 0.00^{a}	0.44± 0.00^{a}	0.44± 0.00^{a}
7	0.42± 0.00^{ab}	0.41± 0.00^{abc}	0.41± 0.00^{b}
14	0.41± 0.007^{b}	0.40± 0.02^{bc}	0.40± 0.01^{bc}
21	0.40± 0.018^{b}	0.38± 0.02^{bc}	0.39± 0.01^{bc}
28	0.38± 0.005^{c}	0.38± 0.00^{c}	0.38± 0.00^{c}
*Overall mean storage condition	0.41± 0.00^{a}	0.40± 0.00^{a}	

^{abc}Different letters indicate significant differences between the mean value (P<0.05); *Mean value within a row differ significantly (P<0.05).

Table 3: Effects of storage periods and conditions on Shwan index 1 of Kurdish hens

Storage period (day)	Refrigerator (4ºC)	Out refrigerator (18 ºC)	Overall mean
0 (Fresh eggs)	11.23± 0.27^{a}	11.23± 0.27^{a}	11.23 ± 0.18^{a}
7	9.75± 0.68^{b}	9.21± 0.29^{bc}	9.483± 0.36^{b}
14	9.08± 0.29^{bc}	9.21± 0.29^{bc}	9.150± 0.19^{b}
21	8.76± 0.22^{bc}	8.60± 0.68^{bc}	8.683± 0.34^{bc}
28	8.35± 0.22^{c}	8.19± 0.07^{c}	8.270± 0.15^{c}
*Overall mean storage condition	9.43± 0.24^{a}	9.29± 0.25^{a}	

^{abc}Different letters indicate significant differences between the mean values (P<0.05); *Mean value within a row differ significantly (P<0.05).

Table 4: Effects of storage periods and conditions on Shwan index 2

Storage period (day)	Refrigerator (4ºC)	Out refrigerator (18ºC)	Overall mean
0 (Fresh eggs)	88.48±1.28^{a}	88.480± 1.28^{a}	88.48± 0.86^{a}
7	87.02± 2.11^{ab}	85.038± 2.55^{abc}	86.033± 1.60^{a}
14	80.90± 1.80^{abc}	79.358± 3.33^{bc}	80.13± 1.82^{b}
21	79.83± 1.86^{bc}	77.178± 4.95^{c}	78.50± 2.55^{b}
28	79.06± 1.80^{c}	78.877± 1.08^{c}	78.91± 1.00^{b}
*Overall mean storage condition	83.06± 1.03^{a}	81.766± 1.47^{a}	

^{abc} Different letters indicate significant differences between the mean value (P<0.05); *Mean value within a row differ significantly (P<0.05).

indices and Haugh units were affected by storage periods and temperature.

The effect of storage period inside refrigeration and out of refrigeration of eggs on the Shwan indexes 1 was shown in Tables 3. The results showed that the storage period affected significantly (P<0.05) the Shwan index 1. The Shwan index 1 of fresh local Kurdish eggs was 11.23 at 0 day and then decreased significantly (P<0.05) during storage period on day 28 of storage period. The results of Shwan index 2 was presented in Table 4. The result showed that the storage period affected significantly Shwan index 2. In fresh egg, the value of Shwan index 2 was 88.48 at 0 day but it decreased significantly during storage periods to 78.77 out of refrigerator (18°C) at day 28. These results were in agreement with finding of Ahmed and Aldabbeh (1985) who reported significant decrease in Shwan indices for yolk quality in native Iraqi turkey during a storage period of 21 days.

Conclusions

The results indicated that egg quality deteriorated with increasing storage period, however, the lower temperature only preserved the egg weight with no effect on yolk and Shwan indices.

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