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# Effect of washing table egg with water and detergents in quality during refrigerator storage

**Ritaj Hassan Jassim, Rawaa Mothana Ibrahim and Shahrazad M.J. Al-Shadeedi***
Veterinary Public Health Dep., College of Veterinary Medicine, University of Baghdad, Iraq.
***Corresponding author:** shahrazad@mracpc.uobaghdad.edu.iq
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## Abstract

This study was carried out during the period from October 31st 2021 to December 5th 2022, to compared the effect of washing table egg with water and detergents in quality during refrigerator storage. A total of 105 fresh table eggs were collected from a retail stores in Baghdad. After egg collection 15 eggs were immediately weight and studied the internal quality, 90 eggs were distributed into three groups of treatments: T1: 30 eggs were washed with water and inserted in egg trays. T2: 30 eggs were washed with water + liquid soap (1%) and inserted in egg trays. T3: 30 eggs were washed with water + hypochlorite (1%) and inserted in egg trays. All eggs were refrigerator storage immediately after washing and dried with facial tissues. All washed eggs were refrigerator storage for 1, 2 and 4 weeks. Al each period 10 eggs from each treatment were randomly collected and individually weight and interior quality parameter were studied. Egg weights, shell weight, white weight, yolk weight, white height, yolk height and yolk diameter were recorded for each egg separately and for each treatment, and after each storage period. The results revealed that the overall average egg weight, shell weight, yolk weight, white weight, yolk height, white height, yolk diameter were around 36.62 g, 4.56 g, 8.47 g, 25.59 g, 16.88 mm, 6.96 mm, 37.71 mm respectively at the time of sampling. The second and third treatments (T2, T3) recorded the highest quality parameters compared with the first treatment (T1) in all egg interior quality after storage in the refrigerator for 1,2 and 4 weeks.

**Keywords: Table egg, Washing, Detergents, Quality, Refrigerator storage.**

## Introduction

Commercial chicken eggs or called table eggs are very familiar, economical and easy to prepare food, very nutritious, as they provide a well-balanced source of essential and important nutrients for all human ages. Moreover, their high biological value protein and low caloric value make eggs valuable in many fitness and therapeutic diets for adults (Burley and Vadehra, 1989; Bufano, 2000; Matt et al., 2009).

Table egg consists of three main parts, the shell, the egg white and the egg yolk. The shell consists of calcite crystals embedded in a matrix of proteins and polysaccharide complex. Inside the shell the viscous colorless liquid called the egg white accounts for about 58 percent of the total egg weight. The eggs contain high nutritional value, the digestible protein coefficient of yolk is about 100% while the digestible protein coefficient of albumin is 97% and usually percent of albumin to yolk is 2 : 1 .The gross thermal energy generated from whole egg are very high value because it is contain fat and protein on 155-180 calories/gm, and the ratio of crude protein in egg is about 12% also contain all kinds of vitamins except ascorbic acid and it is rich in mineral elements such as calcium, phosphorus, copper and zinc (Stadelman and Cotterill, 1995).

The common external and internal contaminants of eggs have been comprehensively reviewed by Board (1966) and Mayes and Takeballi (1983). The dominant contaminants on the shell tend to be Gram-positive cocci and bacillus such as *Micrococcus* and *Arthrobacter* respectively. While the Gram-positive organisms dominate the contaminants on the shell of eggs the internal contaminants are primarily Gram-negative organisms such as *Alcaligenes*, *Achromobacter*, *Pseudomonas*, and *Escherichia* (Stadelman and Cotterill, 1995).

Egg washing is currently not permitted within the European Union, with few exceptions. This is mainly because there are concerns that cuticle damage could occur during or after the washing process, as a result of a suboptimal operation. The egg washing process itself consists of four stages: wetting, washing, rinsing, and drying (Hutchison et al., 2003).

Eggs are the only animal product with a protective shell. But this shell is not sufficient to keep eggs fresh for a long time (EUROPEAN UNION, 1991; FAVIER et al., 2000a, 2000b). The quality traits of the egg start to deteriorate right after oviposition. For this reason, many countries have developed strict rules for maintaining egg quality. Eggs must be delivered to the consumer within 21 days of production and consumed within 28 days. It is further recommended that eggs are stored at room temperature until the 18$^{th}$ day after the production date and between 5–8 °C from the 18$^{th}$ day onwards (Stadelman and Cotterill, 1995).

The aim of this study was to compared between three washing detergent (water, liquid soap and hypochlorite) of commercial table egg during refrigerator storage, also compared between these washing detergent in some quality parameters of table egg after 1, 2 and 4 weeks of refrigerator storage.

## Materials and Methods

**Period of the study:** This study was carried out during the period from 31 / 10 / 2021 to 05 / 12 / 2022, to compared the effect of washing table egg with water and detergents in quality during refrigerator storage. Figure (2) shown the schematic diagram of the study.

**Egg collection:** A total of 105 fresh table eggs were collected from a retail stores in Baghdad.

**Washing treatments:** After egg collection 15 eggs were immediately weight and studied the internal quality, 90 eggs were distributed into three groups of treatments :

T1: 30 eggs were washed with water and inserted in egg trays.

T2: 30 eggs were washed with water + liquid soap (1%) and inserted in egg trays.

T3: 30 eggs were washed with water + hypochlorite (1%) and inserted in egg trays.

All eggs were refrigerator storage immediately after washing and dried with facial tissues.

**Storage periods:** All washed eggs were refrigerator storage for 1, 2 and 4 weeks. Al each period 10 eggs from each treatment were randomly collected and individually weight and interior quality parameter were studied.

**Internal quality characteristics of the egg:** All studied egg quality (internal) traits were measured for all collected eggs individually and according to the method indicated by Stadelman and Cotterill (1995) which included egg weight, white high, yolk high and yolk diameter.

**Egg Weight:** Egg weights were recorded for each egg separately and for each treatment, and after each storage period, a digital Sartorius balance scale was used for this purpose, measuring to two orders of grams before and after the start of packaging.

**White Height, Yolk Height and Yolk Diameter:** The white height was measured by using digital Vernier scale for the white of each egg, from the midpoint between the edge of the outer white and the yolk membrane, and the diameter and height of the yolk were also measured by using the digital Vernier scale (Figure 2 Some photos of the working study).

## Results and Discussion

**Egg weight:** Table (1) shows that the overall average egg weight was around 36.62 g at the time of sampling and after distributing eggs and treating them by washing with the three treatments. It was 34.66 g, which is the lowest value of egg weight for the second and third treatments (T2, T3), which are washing eggs with water and liquid soap and washing eggs with water and hypochlorite. The average weight of eggs in both of them reached 35.62 and 36.20 g, respectively, with a slight decrease compared to the weight of fresh eggs. When the storage period in the refrigerator is increased to two weeks, we find that the second and third treatments (T2, T3), washing eggs with water and liquid soap and washing eggs with water and hypochlorite, recorded an average egg weight of 35.29 and 36.12 g, respectively, superior to the first treatment (T1), which is the treatment of washing eggs with water only the one that recorded the lowest weight, and the average egg weight reached 33.44 g. The second and third treatments (T2, T3) continued to outperform the first treatment (T1) in the average egg weight after storage in the refrigerator for 4 weeks. The three treatments recorded an average egg weight of 30.60 and 34.53 and 35.14 g for the three treatments, respectively.

**Egg shell weight:** The data in table (2) revealed that the overall average egg shell weight was around 4.56 g at the time of sampling and after distributing the eggs and treating them by washing with the three treatments. It was 4.00 g, which is less than the shell weight for the second and third treatments (T2, T3), which are washing eggs with water and liquid soap and washing eggs with water and hypochlorite, as the average shell weight in them reached 4.22 and 4.30 g, respectively, with a slight decrease compared to the shell weight of fresh eggs. When increasing the storage period in the refrigerator to two weeks, we find that the second and third treatments (T2, T3), which are washing eggs with water and liquid

soap, and washing eggs with water and hypochlorite, recorded an average shell weight of 4.10 and 4.16 g, respectively, superior to the first treatment (T1), which is the treatment of washing eggs with water only the one that recorded the lowest weight, and the average shell weight was 3.91 g. The second and third treatments (T2, T3) continued to outperform the first treatment (T1) in the average shell weight after storage in the refrigerator for 4 weeks. The three treatments recorded an egg shell weight rate of 3.45, 3.52 and 3.55 g for the three treatments, respectively.

**Egg yolk weight:** Table (3) shows that the overall average egg yolk weight was around 8.47 g at the time of sampling and after distributing eggs and treating them by washing with the three treatments. It was 8.04 g, which is less than the yolk weight for the second and third treatments (T2, T3), which are washing eggs with water and liquid soap and washing eggs with water and hypochlorite. The average yolk weight in both of them reached 8.35 and 8.42 g, respectively, with a slight decrease compared to the yolk weight of fresh eggs. When the storage period in the refrigerator is increased to two weeks, we find that the second and third treatments (T2, T3), which are washing eggs with water and liquid soap, and washing eggs with water and hypochlorite, recorded an average yolk weight of 8.30 and 8.35 g, respectively, superior to the first treatment (T1), which is the treatment of washing eggs with water Only the one that recorded the lowest weight, and the average yolk weight reached 8.24 g. The second and third treatments (T2, T3) continued to outperform the first treatment (T1) in the average egg weight after storage in the refrigerator for 4 weeks. The three treatments recorded an yolk weight rate of 7.58, 7.67 and 7.98 g for the three treatments, respectively.

**Egg white weight:** Table (4) shows that the overall average egg white weight was about 25.59 g at the time of sampling and after distributing eggs and treating them by washing with the three treatments. It reached 22,655 g, which is less than the white weight for the second and third treatments (T2, T3), which are washing eggs with water and liquid soap and washing eggs with water and hypochlorite, as the average white weight in them reached 24.127 and 24,483 g, respectively, with a slight decrease compared to the white weight of fresh eggs. When the storage period in the refrigerator is increased to two weeks, we find that the second and third treatments (T2, T3), which are washing eggs with water and liquid soap and washing eggs with water and hypochlorite, recorded an average white weight of 22.35 and 22.70 g, respectively, superior to the first treatment (T1), which is the treatment of washing eggs with water only the one that recorded the lowest white weight, and the average white weight reached 21.64 g. The second and third treatments (T2, T3) continued to outperform the first treatment (T1) in the average white weight after storage in the refrigerator for 4 weeks. The three treatments recorded an average white weight of 20.10, 21.33 and 21.62 g for the three treatments, respectively.

**Table (1): Effect of different washing detergent on table egg weight (gm).**

| Washing Treatment | Storage | | | |
|---|---|---|---|---|
| | Zero time | 1 Week | 2 Weeks | 4 Weeks |
| T1 | 36.62 | 34.66 | 33.44 | 30.60 |
| T2 | 36.62 | 35.62 | 35.29 | 34.53 |
| T3 | 36.62 | 36.20 | 36.12 | 35.14 |

**T1: Washing egg with water,**
**T2: Washing egg with water and soap,**
**T3: Washing egg with water and hypochlorite.**

**Table (2): Effect of different washing detergent on table egg shell weight (g).**

| Washing Treatment | Storage | | | |
|---|---|---|---|---|
| | Zero time | 1 Week | 2 Weeks | 4 Weeks |
| T1 | 4.56 | 4.00 | 3.91 | 3.45 |
| T2 | 4.56 | 4.22 | 4.10 | 3.52 |
| T3 | 4.56 | 4.30 | 4.16 | 3.55 |

**T1: Washing egg with water,**
**T2: Washing egg with water and soap,**
**T3: Washing egg with water and hypochlorite.**

**Table (3): Effect of different washing detergent on table egg yolk weight (g).**

| Washing Treatment | Storage | | | |
|---|---|---|---|---|
| | Zero time | 1 Week | 2 Weeks | 4 Weeks |
| T1 | 8.47 | 8.04 | 8.24 | 7.58 |
| T2 | 8.47 | 8.35 | 8.30 | 7.67 |
| 3 | 8.47 | 8.42 | 8.35 | 7.98 |

**T1: Washing egg with water,**
**T2: Washing egg with water and soap,**
**T3: Washing egg with water and hypochlorite.**

**Table (4): Effect of different washing detergent on table egg white weight (g).**

| Washing Treatment | Storage | | | |
|---|---|---|---|---|
| | Zero time | 1 Week | 2 Weeks | 4 Weeks |
| T1 | 25.59 | 22.655 | 21.64 | 20.10 |
| T2 | 25.59 | 24.127 | 22.35 | 21.33 |
| T3 | 25.59 | 24.483 | 22.70 | 21.62 |

**T1: Washing egg with water,**
**T2: Washing egg with water and soap,**
**T3: Washing egg with water and hypochlorite.**

**Egg yolk height:** From table (5) the overall average egg yolk height was around 16.88 mm at the time of sampling and after distributing eggs and treating them by washing with the three treatments. It was 15.29 mm, which is less than the egg yolk height for the second and third treatments (T2, T3), which are washing eggs with water and liquid soap and washing eggs with water and hypochlorite. The average egg yolk height in both of them reached 15.38 and 15.88 mm, respectively, with a slight decrease compared to the egg yolk height of fresh eggs. When the storage period in the refrigerator is increased to two weeks, we find that the second and third treatments (T2, T3), which are washing eggs with water and liquid soap, and washing eggs with water and hypochlorite, recorded an average egg yolk height of 15.59 and 15.72 mm, respectively, that are superior to the first treatment (T1), which is the treatment of washing eggs with water only the one that recorded the lowest egg yolk height, and the average egg yolk height reached 14.68 g. The second and third treatments (T2, T3) continued to outperform the first treatment (T1) in the average egg yolk height after storage in the refrigerator for 4 weeks. The three treatments recorded an average egg yolk height of 13.93, 14.22 and 14.69 mm for the three treatments, respectively.

**Egg white height:** Table (6) shows that the overall average of egg white height was about 6.96 mm at the time of sampling and after distributing eggs and treating them by washing with the three treatments. It was 6.30 mm, which is less than the white height for the second and third treatments (T2, T3), namely washing eggs with water and liquid soap, and washing eggs with water and hypochlorite. The average white height of eggs in both of them reached 6.65 and 6.59 mm, respectively, with a slight decrease compared to the white height of fresh eggs. When the storage period in the refrigerator is increased to two weeks, we find that the second and third treatments (T2, T3), which are washing eggs with water and liquid soap, and washing eggs with water and hypochlorite, have recorded an average white height of 5.10 and 5.26 mm, respectively, that are superior to the first treatment (T1), which is the treatment of washing eggs with water only the one that recorded the lowest weight, and the average white height was 5.00 mm. The second and third treatments (T2, T3) continued to outperform the first treatment (T1) in the average white height after storage in the refrigerator for 4 weeks. The three treatments recorded an egg weight rate of 4.46, 4.84, and 4.87 mm for the three treatments, respectively. **Egg yolk diameter:** Table (7) shows that the overall average egg yolk diameter was around 37.71 mm at the time of sampling and after distributing the eggs and treating them by washing with the three treatments. It was 38.25 mm, which is the lowest value of yolk diameter for the second and third treatments (T2, T3) which are washing eggs with water and liquid soap and washing eggs with water and hypochlorite, as the average weight of eggs in both of them reached 38.64 and 38.94 mm, respectively, with a slight decrease compared to the weight of fresh eggs. When the storage period in the refrigerator is

increased to two weeks, we find that the second and third treatments (T2, T3), washing eggs with water and liquid soap and washing eggs with water and hypochlorite, recorded an average egg weight of 38.29 and 38.16 mm, respectively, superior to the first treatment (T1), which is the treatment of egg washing with water only, which recorded the highest diameter, and the average egg diameter was 39.90 mm. The second and third treatments (T2, T3) continued to outperform the first treatment (T1) in the average egg weight after storage in the refrigerator for 4 weeks. The three treatments recorded an average egg weight of 41.39 and 40.47 and 40.15 mm for the three treatments, respectively.

**Table (5): Effect of different washing detergent on table egg yolk height (mm).**

| Washing Treatment | Storage | | | |
|---|---|---|---|---|
| | Zero time | 1 Week | 2 Weeks | 4 Weeks |
| T1 | 16.88 | 15.29 | 14.68 | 13.93 |
| T2 | 16.88 | 15.38 | 15.59 | 14.22 |
| T3 | 16.88 | 15.88 | 15.72 | 14.69 |

**T1: Washing egg with water,**
**T2: Washing egg with water and soap,**
**T3: Washing egg with water and hypochlorite.**

**Table (6): Effect of different washing detergent on table egg white height (mm).**

| Washing Treatment | Storage | | | |
|---|---|---|---|---|
| | Zero time | 1 Week | 2 Weeks | 4 Weeks |
| T1 | 6.96 | 6.30 | 5.00 | 4.46 |
| T2 | 6.96 | 6.65 | 5.10 | 4.84 |
| T3 | 6.96 | 6.59 | 5.26 | 4.87 |

**T1: Washing egg with water,**
**T2: Washing egg with water and soap,**
**T3: Washing egg with water and hypochlorite.**

**Table (7): Effect of different washing detergent on table egg yolk diameter (mm).**

| Washing Treatment | Storage | | | |
|---|---|---|---|---|
| | Zero time | 1 Week | 2 Weeks | 4 Weeks |
| T1 | 37.71 | 38.25 | 39.90 | 41.39 |
| T2 | 37.71 | 38.64 | 38.29 | 40.47 |
| T3 | 37.71 | 38.94 | 38.16 | 40.15 |

**T1: Washing egg with water,**
**T2: Washing egg with water and soap,**
**T3: Washing egg with water and hypochlorite.**

Through the results of our study, we find that the egg weight rates had the lowest decrease for the second and third treatments compared to the first treatment, which indicates the importance of using disinfectants in the form of soap or hypochlorites to the water for washing table eggs. We find that the characteristics of white weight and yolk weight did not decrease much and the characteristics of white height or yolk height did not deteriorate and the increase in yolk diameter was less for the second and third treatments compared to the first and these results are in agreement with previous studies where the results of the researcher (Jones et al., 1995; Jones et al., 2018) as they studied the effect of egg handling and conditions during extended storage on egg quality. This is due to the role of disinfectants with water in reducing dirt and preparing the microorganisms that are present on the surface of the eggshell (Stadelman and Cotterill, 1995; Henzler et al., 1998).

Table eggs are of the best internal, chemical, microbial and functional quality when they are fresh (Humphrey et al., 1989). Washing eggs would increase the deterioration of the internal contents of the eggs by removing the cuticle layer that covers the stomata in the eggshell, and this in turn works to

provide an opportunity to increase gas exchange represented by the entry of oxygen $O_2$ and the exit of carbon dioxide $CO_2$, which is responsible for the acidity of the internal contents of the egg, especially the egg white, and this can happen in all egg-washing treatments in general (Stadelman and Cotterill, 1995; Hutchison et al., 2003).

Microorganisms can enter through the pores of the shell causing egg spoilage and any damage to the outer layer of the cuticle leads to an increase in microbial penetration into the eggs (HUMPHREY, 1994a, 1994b), at the same time, the two treatments of washing eggs with water with the presence of disinfectants (the second and third treatments) reduced Preparing microorganisms on the surface of the shell, and therefore the deterioration in the quality of eggs was not at the level of the first treatment. Then increasing the storage period to four weeks, we find that the diameter of the yolk recorded less deterioration for the second and third treatments compared to the first treatment, where we find that the diameter of the yolk is clearly less and higher, which indicates a better quality of the egg yolk of these two treatments. Our results agreed with Yamak et al., (2021) who found that keeping eggs refrigerated significantly reduced the pH increase of both yolk and albumen ($p<0.05$) and resulted in better quality traits than keeping them at room temperature, also agreed with USDA (1966) and USDA (2001).

## Conclusions

The use of disinfectants and sterilizers reduces the deterioration of the contents of the eggs during cold storage. Increasing the storage period of eggs reduces the quality of the qualitative characteristics of eggs under any storage conditions and washing eggs with sterilizers and disinfectants helps reduce contamination and loss of internal quality.

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