



Effect of Storage on the Antioxidant Activity of Yolk Lipid for Some Kinds of Eggs

Sara H.M. Shareef* & Aum-El Bashir H.J. Al-Moussawi

Department of Food Sciences and Biotechnology, College of Agriculture, University of Basrah, Basrah, Iraq

*Corresponding author: e-mail: sarahashem1979@gmail.com

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Abstract: The current study included estimating the antioxidant activity of yolk lipid for the quail egg, *Coturnix japonica* (quail), *Gallus gallus* L. (hen), *Anas Platyrhynchos* L. (duck) and *Gygnus cygnus* L.(goose). The yolk and the white of those were separated from each other and the yolk lipid was separated also. The antioxidant activity, reducing power, chelating of iron ions and scavenging of hydrogen peroxide of yolk lipid for fresh egg were studied. The effect of egg storage at laboratory temperature (25-30°C) and refrigerator temperature (4±1°C) on antioxidant activity of egg yolk lipid was studied. The results showed that there was a significant decrease (P<0.05) in all the antioxidant activity tests with duration of storage compared to yolk lipid of fresh egg. The decrease was more obvious when storing the egg at lab temperature (25-30°C) compared with the stored egg in refrigeration (4±1°C).

Keywords: Antioxidant activity, Egg yolk lipid, Duck, Goose, Hen, Quil.

Introduction

Egg is one of the most important sources of human nutrition and most receptive, as it provides the body with the needs of the main nutrients. The edible section consists of water (74%) and proteins (12%) and lipids (12%) and carbohydrates (1%), in addition to vitamins and minerals and many antioxidants (Anton *et al.*, 2007; Li-Chan & Kim, 2008).

Most egg lipids are found in yolk and 65% of yolk lipids are triglycerides, in fact there are 30% phospholipids and 4% cholesterol in addition to carotenoids (Hatta *et al.*, 2008).

Saturated fatty acids (SFA) form 30-35% of total fatty acids and 40-45% monounsaturated fatty acids (MUFA), while Polyunsaturated Fatty Acids (PUFA) are 20-25% (Nimalaratne & Wu, 2015; Anton *et al.*, 2007).

Yolk is a rich source of antioxidant, it contains many compounds such as carotenoids, tocopherol, free amino acids, phospholipids and aromatic amino acids. Carotenoids are the main contributors to the presence of antioxidant properties of egg yolk, carotenoids which include lutein,

zeaxanthin and aromatic amino acids such as tryptophan and tyrosine which have antioxidant activity. Phosvitin of egg yolk is a good source of antioxidant activity as being holder of metals such as iron. Selenium is also an important source of antioxidant activity (Nimalaratne *et al.*, 2015).

Antioxidants have been given a wide attention to nutritionists and researchers in the medical field because of their direct effects in reducing the risk of chronic diseases such as cancer, heart disease, and aging. In addition, it also reduces the oxidation and destruction of DNA in the human body and delays the onset of oxidative rancidity which produces compounds that responsible for the unwanted flavor in them or causes changes in the color and loss in nutritional value or formation toxic compounds that will effect on the human health. So it requires an addition of antioxidants to prevent oxidation of lipids or destruction of vitamins or prevent the formation of free radicals resulting from oxidation of lipids, such as the species of active oxygen as the radical of hydroxyl and single oxygen and hydrogen peroxide. Free radicals are unstable and very effective and able to break the biological molecules which include DNA, proteins, high lipid, and carbohydrates (Surai, 2006).

Materials and Methods:

Eggs of a quail *Coturnix japonica* was purchased from the animal field of the College of Agriculture, University of Basrah. The local hen egg (Iraqi origin), *Gallus gallus* and the local duck egg. *Anas platyrhynchos* L. and local goose egg *Cygnus cygnus* were purchased from local markets in Basrah.

The egg were washed well with water and after the drying was stored in plastic containers and stored at laboratory temperature (25-30°C) and then at refrigeration (4 ±1°C) in different storage periods (15, 30, 45 and 60-days). After that each egg was broken manually and the white was separated from the yolk, the yolk lipid was separated from the protein by solvent process and then was frozen in plastic containers during the above storage periods.

The percentage of lipid was estimated by the method of Pearson (1970) and mentioned in Al-Tai & Al-Moussawi, (1992).

Antioxidant activity was estimated using linoleic acid according to the method of Osawa & Namiki (1981) that mentioned in Al-Hilfi (2016).

Equation of reducing power was estimated by Oyaizu (1986) method mentioned in Chen *et al.* (2009).

Chelating of iron ions was measured according to the method created by Decker & Welch (1990) mentioned in Al-Hilfi & Al-Moussawi (2011).

Scavenging of hydrogen peroxide measured by Ruch *et al.* (1989) method mentioned in Gulcin (2005).

The complete random design (C.R.D) was used by the ready statistical program (SPSS, 2009), these factors were tested by using the least significant difference (L.S.D) test at probability level of 0.05.

Result and Discussion

Effect of storage on the Antioxidant activity of yolk lipid

The fig. (1) shows the effect of storage on antioxidant activity of yolk lipid for quail, hen, duck and goose egg. There were significantly different ($P < 0.05$) in the antioxidant activity values of yolk lipid for the egg that stored at laboratory temperature (A) and stored at refrigeration (B), whereas the antioxidant activity of yolk lipid decreased continuously during the storage period and the reduction of activity was more in the egg that stored in the laboratory.

Fig. (1-A), the antioxidant activity of yolk lipid stored at laboratory temperature decreased from 60.04%, 62.18%, 61.66% and 65.33% of quail, hen, duck and goose eggs yolk respectively before storage to 47.36%, 49.72%, 48.93% and 50.71% for the above four types respectively after 45-days of storage.

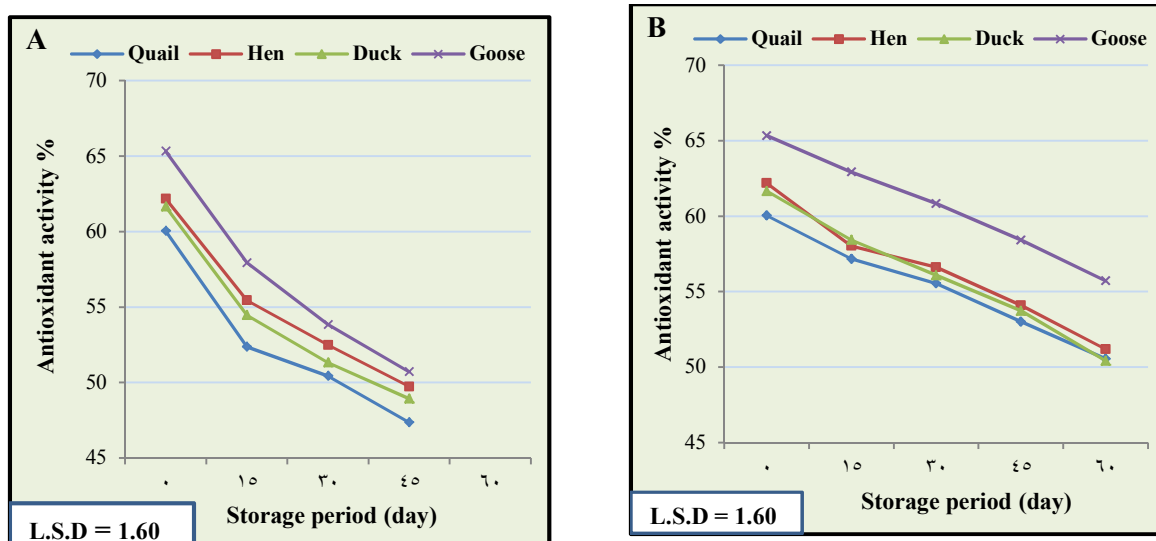


Fig. (1): Effect of storage on the antioxidant activity of yolk lipid, A: Laboratory temperature (25-30) °C, B: Refrigerator temperature (4±1) °C.

Fig. (1-B) Also shows the antioxidant activity values of eggs yolk lipid stored in refrigeration (4±1°C) for 60-days and there was reduction less than that was stored in the laboratory. The values of activity at end of the storage period (60-days) were 50.55%, 51.18%, 50.42% and 55.71% for egg types respectively. This was indicated by Akter *et al.* (2014) whereas their study was the effect of storage on the antioxidant activity of the hen egg, where they observed a significant increase in the oxidation of the yolk lipid of hen egg by increasing the storage period at a different temperatures. This agrees with Lakins *et al.* (2009), where they found that is egg storage for (30-90) days at (4±1°C) led to increase the value of Thiobarbituric acid, while storage at room temperature increased

the value of Thiobarbituric acid and the reason for that was explained that is the reduction of vitamin E content in stored egg.

Effect of storage on the Reducing power of yolk lipid

The results in Fig. (2) refer to the effect of storage on the reducing power of the yolk lipid that was stored at laboratory temperature (A). The results showed there was significant differences ($P < 0.05$) for the values of reducing power between the egg types studied and there was significant effect for the storage ($P < 0.05$) on the reducing power values, when observed decreasing in reducing power with continuous of storage period. The values of quail, hen, duck and goose before storage were 1.352, 1.392, 1.497 and 1.403 respectively; however, the values of those have decreased to 1.132, 1.153, 1.342 and 1.302 respectively after 15-days, and continued the decreasing to the end of the storage period (45-days), as it reached 0.934, 0.902, 1.000 and 1.000, respectively. -

When the egg were stored in the refrigerator (4±1°C) (Fig. B), a decrease was also

observed in the values, but it was less than the effect of storage at laboratory temperature where the above values of fresh egg yolk lipid of quail, hen, duck and goose were decreased to 1.144, 1.113, 1.260 and 1.221 respectively, after 30-days of storage. Moreover, they were

continued to decline to the end of the storage period (60-days) whereas it reached to 0.955, 0.933, 1.072 and 0.967 for the above egg types respectively. This may be due to the effect of storage, especially at laboratory temperature, which led to reducing the concentration of active compounds in lipid,

including tocopherols and carotenoids and this is reflected on the mechanism of action of antioxidants.

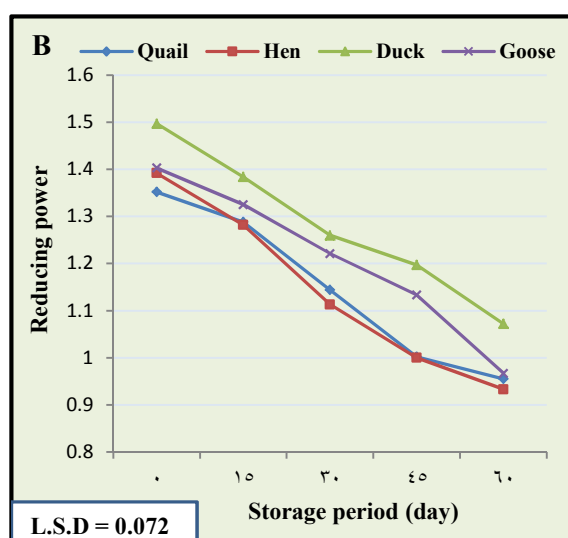
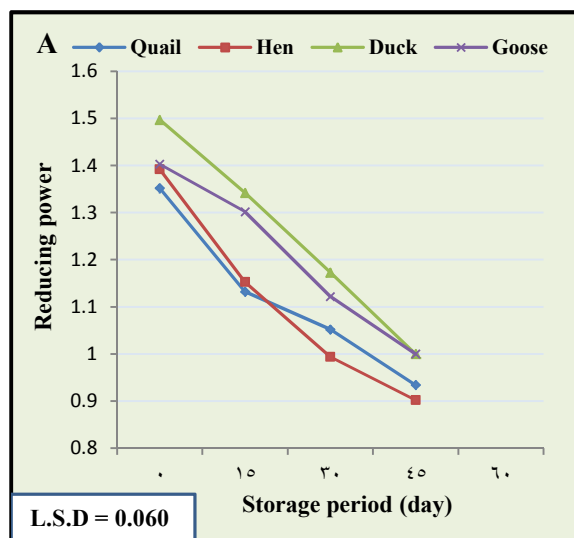


Fig. (2): Effect of storage on the reducing power of yolk lipid, A: Laboratory temperature (25-30) °C, B: Refrigerator temperature (4±1) °C.

Effect of storage on the Chelating of iron ions of yolk lipid

The results in Fig. (3) showed the effect of storage at laboratory temperature (A) and refrigerator temperature (B) on chelating of iron ions of quail, hen, duck and goose yolk lipid. Results showed a significant decrease in chelating of iron ions with continuous of storage period, and the storage at the laboratory temperature had a clear effect in reducing the chelating of iron ions values compared to the refrigerated storage. In Fig. (A), the chelating of iron ions decreased from 57.37%, 55.17%, 53.75% and 52.53% for yolk lipid of quail, hen, duck and goose eggs before storage respectively to 48.23%,

47.38%, 46.76% and 45.34% after 15-days of storage and continued to decline, whereas it reached in the end of storage period (45-days) to 40.97%, 39.82%, 37.84% and 38.05% for the above egg types respectively.

Fig. (B) shows the effect of storage on chelating of iron ions of yolk lipid at refrigerator temperature (4±1°C), the results of the statistical analysis showed significant differences in chelating of iron ions during the storage period, the chelating of iron ions for yolk lipid of quail egg decreased from 57.37% before storage to 45.60% after 60-days of storage at refrigerated, and for hen from 55.17% to 44.16%, and for duck from

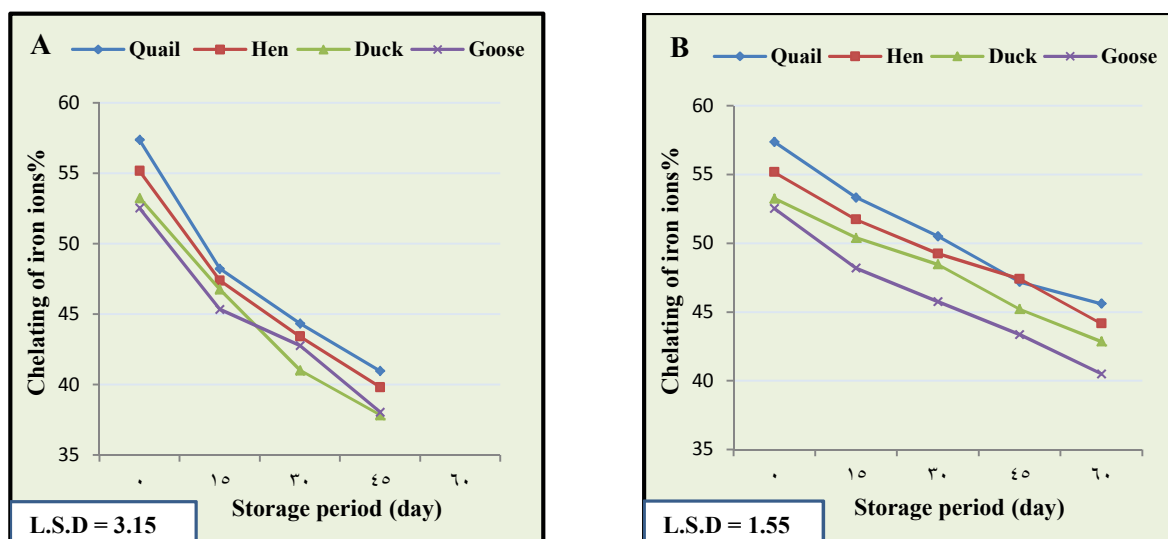


Fig. (3): Effect of storage on the chelating of iron ions of yolk lipid. A: Laboratory temperature (25-30) °C, B: Refrigerator temperature (4±1) °C.

53.25% to 42.86% and for goose from 52.53% to 40.49%. 53.25% to 42.86% and for goose from 52.53% to 40.49%. This difference of chelating of iron ions reduction for all extracts and lipid may be due to the difference in birds type as well as to the difference effect of storage periods at different temperatures on the specific and sensory characteristics of eggs, this is in line with what Abdul Mahdi (2009) have stated that the high quality of eggs begins to gradually deteriorate over time and the speed of degradation depends on the conditions of storage, circulation and marketing.

Effect of storage on the Scavenging of hydrogen peroxide of yolk lipid

The results in Fig. (4) showed the effect of storage on the scavenging of hydrogen peroxide of yolk lipid stored at laboratory temperature (A). The results showed significant differences ($P < 0.05$) for the values of scavenging among the studied egg types and there was a significant effect ($P < 0.05$) for storage on the scavenging of hydrogen peroxide, so there was reduction in scavenging with continuation of storage period, the values before storage were

50.42%, 52.14%, 50.47% and 56.71% for quail, hen, duck and goose respectively, the values decreased during storage after 15-days to 42.95%, 46.32%, 41.09% and 49.16% for the above types respectively and the reduction continued to the end of storage period (45-days), whereas it reached to 35.13%, 39.73%, 34.64% and 42.24% respectively.

When the egg stored in the refrigerator ($4 \pm 1^\circ\text{C}$) (B) was also observed a reduction in the values, but the reduction was less than the effect of storage at laboratory temperature, as the above values for fresh egg yolk lipid decreased to 43.84%, 45.63% and 44.56 and 50.39% for egg of quail, hen, duck and goose respectively, after 30-days of storage and continued to decline to the end of storage period (60-days) to 38.72%, 40.58%, 39.41% and 45.53% for the above eggs types respectively, this may be due to the effect of storage, especially at the temperature of the laboratory. Moreover, this led to reduce the concentration of active compounds in When the egg stored in the refrigerator ($4 \pm 1^\circ\text{C}$) (B) was also observed a reduction in the values, but the reduction was less than the effect of storage at laboratory temperature, as the above values for fresh egg yolk lipid

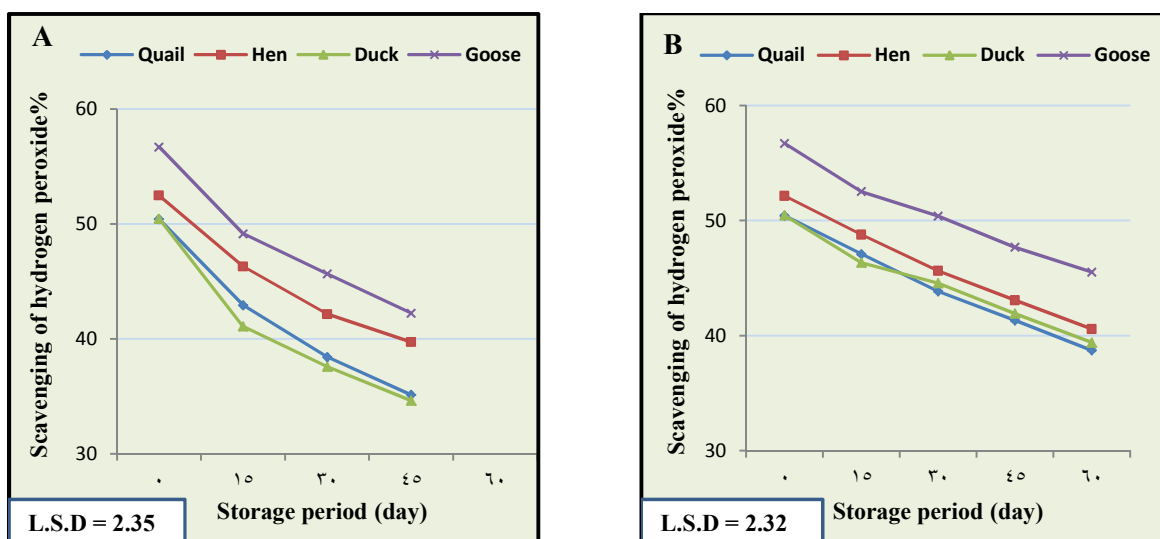


Fig. (4): Effect of storage on Scavenging of hydrogen peroxide of yolk lipid A: Laboratory temperature (25-30) °C, B: Refrigerator temperature (4±1) °C.

decreased to 43.84%, 45.63% and 44.56 and 50.39% for egg of quail, hen, duck and goose respectively, after 30-days of storage and continued to decline to the end of storage period (60-days) to 38.72%, 40.58%, 39.41% and 45.53% for the above eggs types respectively, this may be due to the effect of storage, especially at the temperature of the laboratory. Moreover, this led to reduce the concentration of active compounds in lipid which include tocopherols and carotenoids, and this is reflected on the mechanism of action of antioxidants.

1- The lipid of goose egg yolk gave the highest antioxidant activity compared to duck, hen and quail eggs yolk.

2- The antioxidant activity of yolk lipid for all egg types have been affected by storage and different storage conditions (room temperature and temperature of the refrigerator).

3- The decrease in the antioxidant activity of yolk lipid for all eggs types and all of the chemicals.

4- The decrease was more for yolk lipid of egg types in storage at room temperature compared to storage at refrigerator.

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