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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

Quality, Chemical and Microbial Characteristics of Table Eggs at Retail Stores in Baghdad

Faris A. Al-Obaidi¹, Shahrazad M.J. Al-Shadeedi² and Rashed H. Al-Dalawi³

¹Iraq Natural History Research Center and Museum, University of Baghdad, Baghdad, Iraq

²Arab Scientific Heritage Revival Center, University of Baghdad, Baghdad, Iraq

³Technical Institute, Kirkuk, Iraq

Abstract: The objective of this study was to determine the shelf life of marketed table eggs in some retail stores of Baghdad city through determination some quality, chemical and microbial characteristics of the eggs. A total of 1680 chicken eggs (10 eggs were locally produced and 10 eggs were imported) were collected biweekly from retail stores in different seven popular regions of Baghdad city during the period from January 14th to July 15th of 2010. The data obtained revealed that locally produced eggs had lower egg weight, albumen weight and albumen height and higher albumen and yolk pH compared with imported, also *Psychrophilic*, Coliform, Staphylococci and Fungi counts were high in locally produced eggs compared with imported. No significant differences between locally and imported eggs chemical composition except moisture which was significantly ($p < 0.05$) higher in imported eggs. The total percentage of the incidence of Salmonella in table eggs at retail stores in Baghdad were 20.0% and 38.7% for locally and imported eggs respectively. This survey showed that marketed table eggs in retail stores of Baghdad city were of good quality and within the Iraq standard specification for eggs and where fit for consumption as shell eggs.

Key words: Table eggs, quality, chemical, microbial, retail stores, Baghdad

INTRODUCTION

Chicken eggs are familiar, versatile, nutritious economical and easy to prepare food, as they provide a well balanced source of nutrients for man of all ages (Matt *et al.*, 2009). Moreover, their high quality protein, low caloric value and ease of digestibility make eggs valuable in many therapeutic diets for adults (Burley and Vadehra, 1989; Bufano, 2000).

Eggs like meat and milk are perishable food which need quick cooling and refrigerator treatments during storage for keeping good quality (Stadelman and Cotterill, 1995). Storage revealed significant effect on percent loss in egg weight, albumen and yolk pH (Bufano, 2000). Naturally occurring *Psychrophilic* bacteria, Coliforms, Staphylococci, Yeast and Moulds on the egg shell surface and in egg contents got markedly increased during storage, eggs remained fairly acceptable sensorial up to 10 days of storage at ambient conditions (Imai *et al.*, 1986; Jones, 2007).

Recent years table eggs in Baghdad city were marketed from many different destination of production, some are locally and the others were imported from Syria, Iran, Ukraine and Turkey (Talal *et al.*, 2011), which stored and transported for long time in different temperature degrees, some are delivered directly to retail outlets and others to warehouses and other intermediate distribution points before going to the retail store or food service facility where they reach the consumer (Olivier *et*

al., 2009). The aim of this study was to determine the shelf life of marketed chicken table eggs in some retail stores of Baghdad city through determination some quality, chemical and microbial characteristics of the eggs.

MATERIALS AND METHODS

Eggs collection: A total of 1680 chicken eggs (10 eggs of locally produced and 10 eggs of imported: Syrian, Iranian, Ukrainian and Turkish) were collected biweekly from retail stores in different seven popular regions of Baghdad city during the period from January 14th to July 15th of 2010.

Eggs quality: All eggs were weighed using Sartorius digital balance and broken onto a flat surface where the height of the inner thick albumen and the upper point of yolk were measured with a height gauge (Ames micrometer, USA), yolk diameter measured with a vernier caliper device according to the methods revealed by Stadelman and Cotterill (1995). Egg Haugh unit values were determined according to the formula:

$$HU = 100 \log (H + 7.57 - 1.7W^{0.37})$$

Whereby: HU = Haugh units; H = Thick egg white height (mm); W = Egg weight (g) (Haugh, 1937).

Yolk index values were determined by division yolk high values to yolk diameter values according to the formula revealed by Stadelman and Cotterill (1995) which 10 eggs were utilized per treatment biweekly.

Chemical analyses: The yolk was separated from the albumen and both were distributed into three replicates of glass beakers. Egg albumen and yolk pH values, moisture, ash, protein, lipid and carbohydrates contents in albumen and yolk were carried out according to AOAC (1980), all these measurements were done in triplicates biweekly, the pH of the albumen and the yolk were measured immediately with a pH meter (Electronic Instruments LTD, England) (Scott and Silver sides, 2001). Moisture determined by drying samples in conventional oven at 98°C for 24 h. Ash determined by ashing samples using muffle furnace oven at 600°C for 6 h. Lipid analysis was conducted on all samples using mixture of chloroform: methanol (1:1) and stirred for 20 min using magnetic stirrer for several rinsing times. Protein determined by the method of semi-microkjeldal determination of N% and the values obtained multiplied with 6.25 to calculate protein%. Carbohydrate was determined by subtracting moisture, ash, lipid and protein percentages from 100.

Microbial counts: At sampling, egg shell microbial load were eluted by rinse method in which two eggs (per replicate) were placed in sterile poly ethylene bags and carefully rinsed with 50 ml of sterile peptone water for 10 min, then several decimal dilutions were done using sterile peptone water in universal 10 ml screw capped bottles, *Psychrophilic*, Coliform, Staphylococci and Fungi (Mold and yeast) counts on egg shell were done by culturing 1 ml of each decimal dilutions on Nutrient agar, MacConkey agar, Staph. #110 agar and Saubroud agar plates respectively and the incidence of Salmonella were detected on Salmonella - Shigella agar and Triple Sugar Iron agar according to Yousef and Carlstrom (2003), all these measurements were done in triplicates biweekly.

Statistical analysis: Data were analyzed by using the General Linear Model Procedure of SAS (2001). Means were compared by the Duncan's Multiple Range test at 5% probability (Steel and Torrie, 1980).

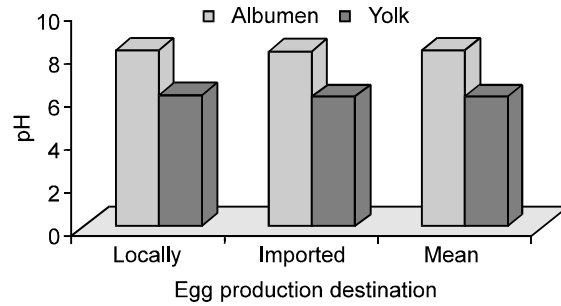


Fig. 1: Albumen and yolk pH of table eggs at retail stores in Baghdad

RESULTS

Table 1 shows the quality characteristics of table eggs at retail stores in Baghdad, imported eggs significantly ($p<0.05$) predominant locally eggs in egg weight, albumen high, Haugh unit, yolk high and yolk index, when as locally eggs had the highest value of yolk diameter compared with imported.

Figure 1 shows albumen and yolk pH of table eggs at retail stores in Baghdad at the time of collection, locally eggs were found to have the highest pH values comparable to imported eggs, albumen pH ranged of 8.16 to 8.25 and yolk pH ranged of 6.09 to 6.15 for both locally and imported eggs. The mean values of egg albumen and yolk pH were 8.21 and 6.09, respectively. Table 2 shows albumen and yolk chemical composition of table eggs at retail stores in Baghdad. For both, albumen and yolk statistical analysis revealed no significant differences between locally and imported eggs in ash, protein, lipid and carbohydrate percentages except moisture which was significantly ($p<0.05$) higher in imported eggs compared with locally produced.

Table 3 shows that locally eggs significantly ($p<0.05$) had the highest microbial count on the shell compared with imported eggs, *Psychrophilic*, Coliform, Staphylococci and Fungi counts on egg shell were 153×10^6 , 48×10^5 , 134×10^2 and 69×10^2 cfu/egg for locally eggs and 74×10^5 , 77×10^4 , 64×10^2 and 15×10^2 cfu/egg for imported eggs.

During the period from January to June 2011 the incidence of Salmonella in table eggs at retail stores in Baghdad city were high in imported eggs compared with locally produced eggs, also we observed that cold

Table 1: Quality characteristics of table eggs at retail stores in Baghdad

Parameters	Egg production destination		
	Locally	Imported	Mean
Egg weight (gm)	61.50±1.05 ^b	62.80±1.02 ^a	62.20±1.13 [*]
Albumen high (mm)	7.30±0.25 ^b	7.80±0.22 ^a	7.70±0.21 [*]
Haugh unit	85.50±1.84 ^b	89.70±1.73 ^a	88.90±1.83 [*]
Yolk high (mm)	16.20±0.41 ^b	16.80±0.47 ^a	16.50±0.44 [*]
Yolk diameter (mm)	36.70±0.93 ^a	36.20±0.98 ^b	36.50±0.96 [*]
Yolk index	0.44±0.06 ^b	0.46±0.03 ^a	0.45±0.03 [*]

Values (Mean±SE) with different superscripts in a row differ significantly ($p<0.05$)

Table 2: Albumen and yolk chemical composition of table eggs at retail stores in Baghdad

Parameters	Egg production destination		
	Locally	Imported	Mean
Albumen			
Moisture (%)	87.31±0.94 ^a	87.02±0.96 ^b	87.17±0.95*
Ash (%)	0.97±0.02	0.98±0.01	0.97±0.02
Protein (%)	11.43±0.58	11.49±0.55	11.46±0.54
Lipid (%)	0.02±0.01	0.02±0.01	0.02±0.01
Carbohydrate (%)	0.45±0.05	0.49±0.04	0.47±0.05
Yolk			
Moisture (%)	48.04±0.84 ^b	48.21±0.87 ^a	48.13±0.88*
Ash (%)	1.04±0.11	1.01±0.11	1.03±0.10
Protein (%)	16.59±0.42	16.48±0.43	16.55±0.42
Lipid (%)	33.72±0.81	33.70±0.86	33.71±0.84
Carbohydrate (%)	0.61±0.04	0.60±0.04	0.60±0.03

Values (Mean±SE) with different superscripts in a row differ significantly (p<0.05)*

Table 3: Microbial count of table eggs (cfu/egg) at retail stores in Baghdad

Parameters	Egg production destination		
	Locally	Imported	Mean
<i>Psychrophilic</i>	153 x 10 ⁶ ±37.2 ^a	74 x 10 ⁵ ±44.1 ^b	80 x 10 ⁵ ±32.6*
Coliform	048 x 10 ⁵ ±9.4 ^a	77 x 10 ⁴ ±11.6 ^b	28 x 10 ⁵ ±13.5*
Staphylococci	134 x 10 ² ±21.3 ^a	64 x 10 ² ±23.5 ^b	99 x 10 ² ±18.1*
Fungi	069 x 10 ² ±7.0 ^a	15 x 10 ² ±06.2 ^b	42 x 10 ² ±07.3*

Values (Mean±SE) with different superscripts in a row differ significantly (p<0.05)*

Table 4: Incidence of Salmonella in table eggs at retail stores in Baghdad

Months	Egg production destination	
	Locally	Imported
January	29.8 (25) ^b	54.8 (46) ^a
February	26.1 (22) ^b	65.5 (55) ^a
March	28.6 (24) ^b	34.5 (29) ^a
April	27.4 (23) ^b	44.0 (37) ^a
May	8.3 (7) ^b	28.6 (24) ^a
June	0.0 (0) ^b	4.8 (4) ^a
Mean/Total	20.0 (101) ^b	38.7 (195) ^a

Values with different superscripts in a row differ significantly (p<0.05)*

months (January, February and March) have the highest incidence of Salmonella in table eggs at retail stores compared with hot months (April, May and June). The total percentage (positive no. of total eggs) of the incidence of Salmonella in table eggs at retail stores in Baghdad were 20.0% (101 eggs/504 eggs) and 38.7% (195 eggs/504 eggs) for locally and imported eggs respectively (Table 4).

DISCUSSION

Eggs are sold by size, the weight for each size classification is based on weight per dozen rather than weight per egg. The greatest consumer demand is for Large and Extra Large eggs (egg weight more than 63 gm) (Stadelman and Cotterill, 1995).

Egg quality is a very important issue for future egg production in Baghdad. According to the USDA Grading Manual, eggs declared as AA quality must have at least 72 Haugh Units, eggs declared as A quality must have 60-72 Haugh Units, end eggs of B Quality must have more than 60 Haugh units. Eggs with lower Haugh units then 30 are not for consumption as a shell eggs and can be used only for processed eggs (USDA, 2000). Many of the eggs produced in Baghdad have low internal quality compared with imported eggs. Produced eggs in farms in Baghdad have very good quality (more than 75 Haugh Units) but because of poor handling and storage conditions in farms and in market they can lose in quality.

Eggs in many stores are exposed to high temperature and low humidity, which will results with rapid decrease in egg quality. The yolk of a freshly laid egg is round and firm. As the yolk ages, it absorbs water from the albumen and increases in size. This weakens the vitelline membrane and gives the yolk a somewhat flattened shape on top and a general "out-of-round" shape. Ruptured yolks occasionally occur (Stadelman and Cotterill, 1995).

Properly refrigerated eggs stored in their carton in a home refrigerator will change from AA-grade to A-grade in about 1 week and from A-grade to B-grade in about 5 weeks. However, a properly handled and refrigerated intact egg will retain its nutritional value and wholesomeness for a considerably longer time (Zeidler *et al.*, 1999; USDA, 2007).

Several problems are encountered during the storage of eggs including weight loss and interior quality deterioration. The movement of CO₂ and moisture through the egg shell governs the changes in albumen, yolk and weight loss of eggs (Stadelman *et al.*, 1996). All imported eggs were oil coated, oiling of eggs is very effective in slowing down reduction in albumen and yolk quality, but does not replace the need for cool storage. The coating advantages by using edible films can be justified because they maintain the functional properties of foods by decreasing moisture loss and gas transportation (O₂ and CO₂), furthermore these edible films are delaying the volatilization of aromatic components (Kester and Fennema, 1986). The applications of coatings therefore reduce weight loss and also maintain the internal measurements of eggs such as Haugh units, yolk index and egg white pH. Wong *et al.* (1996) observed that chicken eggs coated with zein-based films had lower water loss and maintained their Haugh unit values during the storage period, when compared with eggs treated with solutions containing egg albumin, soybean protein isolate, wheat gluten and mineral oil. Coating also improved shell breaking strength to a certain extent, by generating a protective barrier. Li *et al.* (1985) packaged eggs with acrylonitrile and found no difference in Haugh units. Thus, they concluded that controlling the atmosphere is an efficient method of preserving shell egg quality at room temperature for a 7-week period.

Eggs contain protein and fat, but merely a trace of carbohydrate and no fiber. An egg is composed of about 11% proteins and 11.2% is fat. Most of the proteins are concentrated in the white part of the egg, known as albumen or egg white, the egg albumen mostly contains water and proteins. The yolk is surrounded by the albumen and contains about 80% of the calories and almost all fats present in the egg, also it contains vitamin A, D, E and K and minerals such as iron, calcium and phosphorus. The fat of an egg is found almost entirely in the yolk; there is less than 0.05% in the albumen. Several problems are encountered during the storage of eggs, the movement of CO₂ and moisture through the egg shell will change the chemical composition of the eggs, albumen and yolk pH increased and decreased moisture percentage of egg albumen. The yolk of a freshly laid egg is round and firm. As the yolk ages, it absorbs water from the albumen through vitelline membrane and increases in size and moisture percentage (Stadelman and Cotterill, 1995). With storage, the albumen weight of these eggs decreased because of moisture losses, moisture will evaporated through opened pores, causing a lower egg weight. This result agrees with those of many authors, most recently Ahn *et al.* (1997) and Ahn *et al.* (1999) who have found that shell weight does not change with storage. Yolk weight, which could be expected to

increase with a longer period of storage as amino acids and moisture move through the vitelline membrane from the albumen (Heath, 1977; Scott and Silver sides, 2001). Contamination of the egg shell can occur through contact with contaminated surfaces (nesting material, dust, feed, shipping and storage containers), handlers and animals (pets, rodents and insects), so refrigeration of shell eggs is required for retarding multiplication of microorganism during transportation and throughout storage (Olivier *et al.*, 2009). Some eggs are delivered directly to retail outlets and others to warehouses and other intermediate distribution points before going to the retail store or food service facility where they reach the consumer (Shenga *et al.*, 2010). All microbial counts of marketed table eggs in retail stores of Baghdad city were within the Iraq standard specification for shell eggs (COSQC, 2006), when as the incidence of Salmonella in table eggs at retail stores in Baghdad city were high in imported eggs which need to be routine sampled and monitored.

This survey conclude that marketed table eggs in retail stores of Baghdad city were of good quality (Haugh Units in more than 70% of the samples where above 80) and where fit for consumption as shell eggs and this is because of high demand for shell eggs. Recommendations, all imported eggs need to be routine sampled and analyzed for microbial quality prior to selling, locally produced eggs need to be coating by oil or using edible films to decrease moisture loss and gas transportation (O₂ and CO₂).

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