

## COMPARATIVE STUDY OF QUALITY CHARACTERISTICS OF EGG STORED IN DOMESTIC REFRIGERATORS

### ESTUDO COMPARATIVO DAS CARACTERÍSTICAS QUALITATIVAS DE OVOS ARMAZENADOS EM REFRIGERADORES DOMÉSTICOS

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#### SUMMARY

This work compares the quality of eggs for consumption that were stored in the door compartments and on shelves inside domestic refrigerators. The experiment was conducted at the Laboratory of Technology of Animal Products Technology Department FCAV / UNESP - Jaboticabal. Ninety-six commercial brown-shelled eggs were packed in cellulose pulp trays with 12 eggs each and stored in a domestic refrigerator at 10°C during 8 weeks. Half of the eggs were placed in the door compartments, and half on the internal shelves. They were distributed in a completely randomized design, 2 x 4 factorial (2 storage and 4 periods), with 12 repetitions. We evaluated the following characteristics: yolk and albumen pH, Haugh unit, yolk and albumen index, and yolk color (standard colorimetric scale range). Means were compared by Tukey test at 5% significance level. According to the results of this study, we concluded that storing the eggs on the internal shelves of refrigerators was more efficient, since their internal quality remained higher throughout the storing period. This procedure was able to minimize temperature variations that eggs are subject to with the daily "open and close" of domestic refrigerator doors.

**KEY-WORDS:** Eggs. Quality. Refrigerator. Storage.

#### RESUMO

Este trabalho foi proposto com o objetivo de comparar as características de qualidade de ovos de consumo armazenados nos compartimentos da porta e nas prateleiras internas de refrigeradores de uso doméstico. O experimento foi realizado no Laboratório de Tecnologia dos Produtos de Origem Animal do Departamento de Tecnologia da FCAV/Unesp – Jaboticabal. Foram coletados 96 ovos comerciais de casca vermelha e acondicionados em bandejas de polpa de celulose contendo 12 ovos cada, e armazenados em um refrigerador de uso doméstico a 10°C, durante 8 semanas. Metade dos ovos foram colocados nos compartimentos da porta, e a outra metade nas prateleiras internas superiores do refrigerador, e distribuídos em um delineamento inteiramente casualizado em esquema fatorial 2 x 4 (2 locais de armazenamento e 4 períodos de avaliação), com 12 repetições. Foram avaliadas as características de pH do albúmen e da gema, unidade Haugh, índice gema e coloração da gema (através de leque colorimétrico). As médias foram comparadas pelo teste de Tukey a 5% de significância. De acordo com os resultados mostrados neste estudo, observou-se a eficácia em manter os ovos armazenados nos compartimentos internos dos refrigeradores, visto que a qualidade interna dos mesmos foram superiores. Tal procedimento foi capaz de minimizar as oscilações de temperatura a que os ovos ficam sujeitos com o "abrir e fechar" diário de refrigeradores domésticos.

**PALAVRAS-CHAVE:** Armazenamento. Ovos. Qualidade. Refrigerador.

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## INTRODUCTION

Eggs are known to be one of the most complete foods, since they are a rich source of nutrients, and display a great balance of fat, carbohydrates, minerals, vitamins and particularly, proteins. Eggs are the second best source of protein for humans, the first being breast milk. However, the egg is an ideal medium for the development of pathogens and since it is a product of animal origin like meat and its derivatives, it is a highly perishable food that may lose its quality quickly (THERON et al., 2003).

The production of eggs for human consumption focus on supplying the consumer market with products that retain their original quality. In order to preserve egg quality and freshness, it is necessary, soon after deposition, to keep them refrigerated. Under storage, the process of loss of water and carbon dioxide begins and is proportional to the temperature and humidity under which they are stored (SOUZA et al., 1997).

The quality of the eggs on the consumer table depends mainly on its storage. Soon after the eggs are laid, they start to change, and this inevitable phenomenon reduces its quality and eventually cause its deterioration. These changes can be delayed, but can not be entirely avoided.

The decreasing internal quality of the stored egg is linked mainly to the loss of water and carbon dioxide that happens during storage and is proportional to the rising temperature of the environment. The increasing temperature accelerates the physico-chemical reactions that lead to degradation of the protein structure present in the thick albumen, and the product of such reactions, the water linked to the large protein molecules is then transferred to the yolk by osmosis (LEANDRO et al., 2005). At room temperature, the physical characteristics of the shell, albumen, yolk and the internal quality of the whole egg are adversely affected (SOUZA et al., 2001).

Refrigeration is a common practice to preserve eggs. And according to Souza (2001), refrigerating the eggs prevents protein denaturation and physico-chemical changes that alter the quality of the product. Therefore, refrigerated eggs have higher quality, and supposedly when stored inside the refrigerator on the shelves, the eggs would be less subject to temperature changes during storage, which can extend shelf life.

Therefore, this work compares quality characteristics of eggs stored in the door compartments and on built-in shelves of household refrigerators.

## MATERIAL AND METHODS

The experiment was conducted at the Laboratório de Tecnologia dos Produtos de Origem Animal, in the Departamento de Tecnologia of Faculdade de Ciências Agrárias e Veterinárias, UNESP, Jaboticabal. Ninety-six brown-shelled eggs from laying hens of the Hy-line Brown lineage were used. The freshly laid eggs were

collected on posture day from approximately 35 week-old hens that were kept under the same management practices in the farm sheds.

The eggs were packed in cellulose trays containing 12 eggs each and stored in the laboratory inside a common refrigerator at 10° C, during 8 weeks to simulate household storage. The eggs were stored in two different places inside the fridge, half were placed in the door compartments and the other half on the fridge internal higher shelves.

At the end of the storage period (14, 28, 42 and 56 days) the eggs were broken on an appropriate glass table in order to determine their internal quality. The following characteristics were evaluated: Haugh unit, yolk index, yolk and albumen pH and yolk color (as described below).

**Albumen index:** was evaluated by Haugh unit as described by Card and Nesheim (1978). After weighing the eggs on a precision scale, they were broken onto a special glass table and a micrometer was used to measure the height of the thick albumen. The height (mm) correlated with the weight (g) determines the Haugh unit, or HU rating, as follows:  $UH = 100 \log (H + 7.57 - 1.7W^{0.37})$ , where: UH = Haugh unit; H = albumen height (mm); W = egg weight (g).

**Yolk index:** yolk height and diameter were measured using a micrometer. The ratio between the two parameters gives the yolk index as follows:  $YI = YH/YD$ , where: YI = yolk index, YH = yolk height (mm) and YD = yolk diameter (mm).

**Albumen and yolk pH:** was determined using a TEXTO digital pHmeter. The pH meter electrode was inserted directly in the beakers that contained egg yolk and albumen.

**Yolk color:** was measured using a standard colorimetric scale range, 1 to 15.

We used a completely randomized design (CRD) in a 2 x 4 factorial (2 storage sites and 4 storage periods), with 12 repetitions. The results were submitted to ANOVA and means were compared by Tukey at 5% significance level (SAS, 1999).

## RESULTS AND DISCUSSION

The results regarding the internal quality of the stored eggs are shown in Table 1. It is observed that storage place in the fridge affected Haugh unit, yolk index and color ( $P < 0.05$ ,  $P < 0.01$  and  $P < 0.05$ , respectively). There was interaction ( $P < 0.01$ ) between the place and period of storage of eggs, as shown in Table 2.

Yolk pH ( $P > 0.05$ ) remained unchanged. It was not affected by storage time and site, whether the egg was placed in the door compartment or on the inside shelves of the fridge. Thus, storing eggs at lower

**Table 1** - Mean values for Haugh unit (HU), yolk index (YI), yolk color (YC) and yolk and albumen pH of eggs stored in different places and periods.

Characteristics	HU	YI	YC	pH Albumen	pH yolk
<i>Storing place (L)</i>					
<i>Fridge shelves</i>	65.39 A	0.431 A	7.03 B	9.02	6.32
<i>Fridge door</i>	63.05 B	0.420 B	7.29 A	9.03	6.49
MSD	2.12	0.008	0.249	0.023	0.20
Test F	4.84*	7.75**	4.21*	1.29 <sup>NS</sup>	3.14 <sup>NS</sup>
<i>Storing place (P)</i>					
<i>14 days</i>	67.46 A	0.424 B	6.50 C	9.07 B	6.33
<i>28 days</i>	69.84 A	0.439 A	6.96 BC	9.24 A	6.49
<i>42 days</i>	57.89 B	0.418 B	7.37 AB	9.21 A	6.42
<i>56 days</i>	61.71 B	0.420 A	7.82 A	8.56 C	6.39
MSD	3.95	0.014	0.46	0.043	0.36
Test F	25.87**	6.19**	20.19**	783.24**	0.47 <sup>NS</sup>
Test F <i>L x P</i>	1.62 <sup>NS</sup>	9.14**	3.34 <sup>NS</sup>	11.18**	1.74 <sup>NS</sup>
CV (%)	8.14	4.49	8.58	0.43	5.13

A,B: Means followed by different letters in the same column differ by Tukey at 5%. CV = Coefficient of Variance, MSD = Minimum significant difference. \* = P < 0.05; \*\* = P < 0.01.

**Table 2** - Interactions between storage period and local for albumen pH and yolk index .

pH albumen	Storage period (days)			
	14	28	42	56
<i>Fridge shelves</i>	9.07 b	9.25 a	9.24 a	8.50 Bc
<i>Fridge door</i>	9.06 a	9.25 a	9.18 a	8.62 Ac
IG	Storage period (days)			
	14	28	42	56
<i>Fridge shelves</i>	0.425	0.433	0.423	0.432 A
<i>Fridge door</i>	0.422 ab	0.436 a	0.413 b	0.398 Bb

A,B – Means followed by different uppercase letters in the same column are statistically different by Tukey at 5% a,b,c – Means followed by different lowercase letters in the same row are statistically different by Tukey at 5%.

temperatures (refrigerated) is efficient to maintain this characteristic during the studied period.

The best values of the Haugh unit were obtained for eggs that were stored up to 28 days. The storage of the eggs on the higher shelves inside the fridge also ensured eggs with better quality. These data are consistent with those reported by Alleoni & Antunes (2001), who compared Haugh unit values of eggs stored at 8° C, during 7, 14 and 21 days, and found 68.64±3.96, 62.53±3.03, 60.63±5.62, respectively.

Yolk color was higher for the eggs stored in the door compartments and longer than 42 days. During the deteriorating process, the egg promotes gas exchange between the environment and the egg itself and the yolk loses liquid into the albumen (as the egg ages the albumen becomes less dense) and therefore, the pigments of the yolk get more concentrated.

Santos et al. (2009) studied how temperature (room and refrigeration) and storage time (7, 14 and 21 days) affect egg quality. The authors reported that yolk color of eggs kept at room temperature, independent of storage time, was statistically lower ( $p < 0.05$ ) than the color of the eggs that were kept refrigerated at lower temperatures.

From the results shown in Table 2, it can be seen that albumen pH increased during storage; however, after 56 days of storage the values are close to those of a fresh laid egg. This result agrees with the ones reported by Xavier et al. (2008), who also evaluated quality of eggs under different storage conditions.

Yolk index values of eggs stored on the shelves inside the fridge remained stable compared to the eggs stored in the door compartments. And especially on the last day of storage (56 days), the superiority of storage inside the fridge is evident. Regardless of where they were stored, the results are within the standard range for yolk index, which varies from 0.30 to 0.50 for freshly laid eggs (ROMANOFF & ROMANOFF, 1949).

Garcia et al. (2010) when studying egg quality from brown-type laying hens stored at different temperatures and periods, concluded that longer storage periods affect egg quality of either young or old brown-type laying hens, regardless of the storage system. However, as observed in the present study, the deleterious effect of storage is minimized when eggs are stored at lower temperatures.

## CONCLUSION

The results showed that it is more effective to store the eggs on the shelves inside the fridge, since internal quality of those eggs was higher. The storage inside the fridge minimized temperature fluctuations, caused by opening and closing of the door, to which eggs stored in the door compartments are subject to.

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