Alternative Egg Production: Duration of internal egg quality of laying hens created in cage-free system

Mariana Thimotheo[1], Guilherme Costa Venturini[2], Aline Giampietro-Ganeco[1], Luis Carlos Miguel Junior[1], Anaiara Langaro[3], Hirasilva Borba[1]

[1]FCAV - UNESP, Jaboticabal, SP, Brazil. E-mail: marianathimotheo@gmail.com
[2]FMVZ - UNESP, Botucatu, SP, Brazil.
[3]UDESC - CEO, Santa Catarina, RS, Brazil.

Abstract: The present study evaluated the duration of internal quality of cage-free eggs in the first few hours of storage under environment temperature. For this, 480 eggs of Isa Brown® laying hens, created on the cage-free system, with 60 weeks age were utilized. The eggs were distributed in an completely randomized design composed by eight periods: (fresh eggs and eggs with: 1, 2, 3, 4, 5, 6 and 7 hours of storage), with 60 repetitions each. The analyzed variables were: egg weight, shell percentages, albumen and yolk; Haugh unit and yolk index. The obtained results were submitted to variance analysis and the averages compared by the Tukey test on 5% significance. There were not significant differences ($P>0.05$) on the eggs' weight, on the shell, albumen and yolk's percentages and on the yolk index of the eggs on the hours of storage. There was, however, significant effect ($P<0.05$) of the hours of storage on the eggs' Haugh unit. The registered Haugh unit average values on the 3rd hour were bigger than the ones observed between the 5th and 7th hour, but kept similar to the fresh eggs and to the other evaluation periods. It was concluded that the duration of internal egg quality was kept similar during the first seven hours of storage.

Keywords: alternative system, commercial eggs, storage

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Introduction

The focus of the world stage based not only in relationship with the animal welfare but also quality and security of final product. Based on this, some poultry production methods and systems have evolved, differing mainly in poultry housing and management and feeding systems. Linked to the best rearing practices of laying hens, the cage-free system it could be an alternative to replace conventional cages.

In the cage-free system, laying hens are maintained loose, with floor covered by some bedding material, availability of perches and nests throughout the shed. This system has been proposed for providing greater possibility of interaction between animals and for giving them opportunities to express their natural behaviors, such as, laying eggs in nests, perching, scattering and dispersing heat through the opening of the wings, increasing their welfare (Rodenburg et al., 2005). Another characteristic of this system is related, for the most part, to diets, which use only vegetal ingredients, without the inclusion of antibiotics, anticoccidials or growth promoters. Thus, these conditions create an environment that harmonizes with the idea of natural food production, which has been established as essential for good nutrition.

An acceptable food by the consumer depends on its initial quality and durability. For eggs, quality can be defined as a set of characteristics responsible for their acceptability in the market and this may be related to the physical and sensorial traits (Barbosa et al., 2008). From the moment the egg posture occurs until its commercialization, the main objective is to preserve its original quality as much as possible until it reaches the consumer. It is known that during storage, changes in the physical and chemical characteristics of the eggs may occur, depending on the time, temperature and relative humidity (Alleoni; Antunes, 2001). Such changes lead to a reduction in the internal quality of the egg, mainly associated with losses of water and carbon dioxide through the egg shell pores to the environment. These losses may result in alterations in the flavor of the egg due to the increase in alkalinity, besides chemical reactions that occur inside the egg, providing an adequate environment for the development of microorganisms (Oliveira, 2006). These problems could be accentuated in the cage-free system, as it is a manual collection system, and so, to imply a greater time of egg collection and processing, that consequently, lead the greater exposure to environmental variations. These variations along with the egg storage form can shorten the shelf life of the final product to the consumer and may compromise the viability of this system of production.

Even so, cage-free eggs are increasingly present in the market and as consumer demand for these eggs rises, it is necessary to characterize this product. Some studies have described the effects of different housing systems on egg quality, but there is little research specifically related to egg quality produced by laying hens created in cage-free system. Data from studies of the effect of the initial storage hours on the quality of cage-free eggs were not found in the literature, making this study necessary. The aim of the present study was to evaluate the duration of internal quality of cage-free eggs in the first hours of storage under environment temperature.

Material and Methods

The experiment was conducted at FAI (Food Animal Initiative) in Brazil, located in the municipality of Jaboticabal-SP. Egg collection was performed in a single batch of birds in production created in the cage-free system. The experiment was carried out in the field, simulating the storage conditions of the eggs on the farm between the hours of posture/collection until transportation to the processing depot. We used 480 eggs of Isa Brown® laying hens with 60 weeks of age. The eggs were collected over five consecutive days of the week. The collections occurred at 8 o'clock in the morning and were randomly carried out throughout the extension of the shed at the exact moment when each hen carried out the laying. After collection, the eggs were individually weighed, identified, packed in cellulose pulp trays. The trays were stored in a room adjacent to the breeding shed, under ambient conditions without temperature control, and then separated into groups for evaluation at scheduled times. The experimental groups were represented by fresh eggs and eggs with up to seven hours of storage, at 1-hour intervals. A completely randomized design was used composed by eight periods: (fresh eggs and eggs with: 1, 2, 3, 4, 5, 6 and 7 hours of storage), with 60 repetitions each. The average air temperature and relative humidity inside the creative shed over the experimental period were 29.7°C and 59%, respectively.

The analyzed variables were: egg weight; percentages of egg shell, albumen and yolk; Haugh unit and yolk index. The weights (g) of egg, shell and yolk were measured using precision balance (Marte, 0.001). The shell weight (g) was obtained after washing with water, followed by drying at environment temperature. The relative weights (%) of shell, albumen and yolk were calculated in relation to the weight of the eggs. The weight of the albumen (g) was calculated by the difference between whole egg weight and weight of the yolk + shell. For the determination of the Haugh unit, the height of the albumen and the yolk, with a digital micrometer, and the width of the yolk with a digital caliper rule, respectively were measured after the eggs were broken on a flat glass surface. The Haugh unit was calculated by the equation: $UH = 100 \log (h + 7.57 - 1.7 p^{0.37})$, in which UH: Haugh unit, h: height of albumen (mm) and p: weight of egg (g). The yolk index was calculated by dividing its height by width. The data were tested for the effects of

storage hours (HE, fresh eggs and eggs with: 1, 2, 3, 4, 5, 6 and 7 hours) using the experimental model: Y = μ + HE + e, in which: Y are the dependent variables (characteristics evaluated); μ is the general mean (constant inherent in all observations) and e is the standard erro. Data were analysed using the GLM procedure of the SAS (SAS 9.1; SAS Institute, Cary, NC, USA). The results were submitted to analysis of variance and the means were compared by Tukey test at 5% ($P<0.05$) significance.

Results and Discussion

Egg weight, percentages of shell, albumen and yolk, yolk index were not significantly altered ($P>0.05$) during the study period (Table 1). However, there was a significant effect ($P<0.05$) of the storage hours on the Haugh unit, where the registered Haugh unit average values on the 3rd hour were bigger than the ones observed between the 5th and 7th hour. For the other evaluation periods, there was no significant difference ($P>0.05$).

Table 1. Weights the egg, egg shell, albumen and yolk, Haugh unit and yolk index according to the hours of storage.

Variables	Fresh egg	Storage (hours)							*P-value*	CV(%)[1]
		1	2	3	4	5	6	7		
Egg (g)	66.57	65.58	65.60	66.55	64.98	65.69	65.00	66.11	0.4593	6.89
Egg shell (%)	9.43	9.50	9.25	9.40	9.31	9.51	9.53	9.29	0.2620	8.88
Albumen (%)	66.07	65.76	66.00	66.35	66.48	65.49	65.28	66.02	0.0852	3.41
Yolk (%)	24.48	24.63	24.75	24.30	24.21	24.97	25.08	24.67	0.1537	8.05
Haugh unit	95.21^{ab}	95.43^{ab}	96.07^{ab}	97.24^{a}	95.81^{ab}	93.37^{b}	93.25^{b}	93.29^{b}	0.0005	6.15
Yolk index	0.45	0.45	0.45	0.45	0.45	0.45	0.44	0.44	0.6644	5.25

[1]CV: coefficient of variation.
$^{a-b}$: means followed by distinct superscripts (lines) differ significantly *(P*≤0.05*)*.

Haugh unit is used to express the quality of the albumen, the higher its value, the better the quality of the egg. According to Coutts et al. (2007) the fresher the egg, the higher the Haugh unit value. In this study, the results obtained for the Haugh unit of the eggs presented three peaks of low values, the 5, 6 and 7 hours of storage, indicating a point drop in the Haugh unit of these eggs when compared to the eggs with 3 hours of storage. The possible explanation for these results can be attributed to the albumin fluidity, probably reflecting the longer exposure time of the eggs stored at ambient temperature of the poultry farm, which possibly potentiated the loss of albumin quality.

It was observed for the yolk index that it remained stable with the storage hours and presented mean values of 0.44 (6 and 7 hours) and 0.45 (other hours). According to Mertens et al. (2011), eggs of good quality have a yolk index around 0.45, which shows the good quality of all the eggs evaluated in this study during the 7 hours of storage. Therefore, the results obtained in this experiment demonstrated that the initial quality of cage-free eggs did not change during the first 7 hours of storage.

Therefore, the quality of the eggs from this system was assured, independent of the practices used for collection and storage.

Conclusions

Eggs produced in the cage-free system and stored up to 7 hours at environment temperature maintained their similar internal quality during the evaluation time.

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