STUDY ON THE QUALITY OF TABLE EGGS OBTAINED IN A PROFILE UNIT

Carmen Daniela PETCU[1], Dana TĂPĂLOAGĂ[1], Oana Mărgărita GHIMPEȚEANU[1], Otilia Cristina MURARIU[2], Oana Diana MIHAI (OPREA)[1], Emilia CIOBOTARU-PÎRVU[1]

e-mail: ghimpe_marga@yahoo.com

Abstract

The egg has a great nutritional value and is called "complete food". The study was conducted in an egg production unit located in southeastern Romania. In the current context of products available on the consumer market, this paper aims to highlight the importance of quality and freshness of the egg, using methods that are easy to perform and interpret, such as: exterior appreciation by visual examination of the egg shell and colour, density test in tap water, egg organoleptic examination to determine the freshness degree, vitelline index determination, pH determination and determination of the egg yolk colour using *La Roche* method. 25 samples of different quality, weight and laying data eggs were analysed. In addition, samples were also examined microbiologically for the presence of *Salmonella spp.*, in shell or in content. Exterior examination revealed that the most common colour of the examined eggs shell was light brown (40%). Egg organoleptic examination indicated that all samples analysed had an appropriate odour and presented the white egg corresponding colour (white). Following the vitelline index and pH determination, it was concluded that 18 eggs (72%) were fresh and 7 eggs (28%) were within the upper limit of acceptability values. In conclusion, eggs produced on the farms of the study unit comply with the legal requirements for classification in category A and the corresponding weight categories. The study reconfirms that through nutritional values, the egg contributes to a balanced and healthy diet.

Key words: eggs, pH, quality, egg yolk

In human nutrition, the egg has a great nutritional value and is called "complete food", used both commonly and for dietary purposes (Banu C., 2008; Banu C., 2009).

The egg included in the daily diet brings an important vitamin, mineral and nutritional contribution, along with vegetables, fruits, dairy products and meat (Bertechini A.G., Mazzuco H., 2013; Lesnierowski G., Stangierski J., 2017).

In this time, the consumer becomes more and more aware of the importance of food and the need for information about the place of origin, growing conditions (in the case of laying hens), feeding conditions, and the nutritional values offered by each food.

Considering all the qualities of an egg, it must be helped to retain the properties it possesses, which is facilitated by proper sorting and packaging that by way of manufacture and material used, helps maintain the freshness and validity of all its components.

Egg is an accessible nutritive food, with a content of 18 vitamins and minerals and about 70% water content. It has an increased digestibility and bioavailability (Covașă A.M. and Galiș A.M., 2017a, c; Cepeda A. *et al*, 2015).

Following the study conducted by Ruxton C. et al in 2010, it turned out that the consumption of eggs ensures an increased level of energy and nutrients. For example, the consumption of 4 eggs per week for men and 3 eggs per week for women provides the daily requirement: 2% energy, 3% saturated fatty acids, 3% protein and 5% monounsaturated fatty acids (Bertechini A.G., Mazzuco H., 2013).

The egg consists of macronutrients (proteins, lipids, carbohydrates) and micronutrients (vitamins and minerals). Most of the nutrients are found in the yolk (Cioceanu M. *et al*, 2007). The ratio between lipids and proteins is 2:1 (Jianping W., 2014; Covașă A.M. and Galiș A.M., 2017b).

The aim of the paper is to highlight the particularities of the technological flow in a laying hen unit, as well as the monitoring of the sorting, marking and packaging operations of the eggs. It is also aimed at assessing the compliance with the legislative requirements in force by the study production unit. Another objective of the paper is

[1] University of Agronomic Sciences and Veterinary Medicine, Bucharest, Romania
[2] "Ion Ionescu de la Brad" University of Life Sciences, Iași, Romania

to monitor the traceability of the egg and the aspects necessary to obtain quality products that will be offered to the consumer.

MATERIAL AND METHOD

The study was conducted on a laying hen farm located in southeastern Romania. In addition to egg production, the unit also undertakes collection, sorting, marking and packaging activities.

The MOBA 2500 is used for sorting, marking and packaging operations.

An important thing to analyze is the variation of the nutritional values (*table 1*) of several categories of eggs, depending on the breeding system of laying birds, so the code marked on the eggshell, also following the nutritional values of table quail eggs present on the market.

Table 1

Results on the nutritional values of hen and quail eggs

Egg nutritional value / Code marked	Energetic value (kcal)	Lipid (g)	Saturated fatty acids (g)	Proteins (g)	Sodium (g)	Carbohydrates (g)	Sugars (g)	Dietary fiber (g)
Code 0 (organic eggs production)	140	10	3.1	12.5	0.12	0.27	0.21	0
Code 1 (free-range eggs)	128	8.75	2.42	12	0.14	0.27	<0.13	0
Code 2 (indoor housing eggs)	111.9	6.70	2.88	11.7	0.15	<0.1	<0.1	<0.1
Code 3 (cage farming eggs)	132	9.54	2.70	12.26	0.14	0.12	<0.03	<0.50
Quail eggs	158	11	-	13	-	0.79	-	-

In the current context of products available on the consumer market, the aim was to highlight the importance of the quality and freshness of the egg, using methods that are easy to perform and interpret, such as: exterior appreciation by visual examination of the egg shell and colour, density test in tap water, egg organoleptic examination to determine the freshness degree, vitelline index determination, pH determination using pH strips and determination of the egg yolk colour using *La Roche* method.

Egg external examination

Exterior appreciation is done by visual examination of the egg shell and colour (*figure 1*), in order to observe the anomalies and defects that cause the decrease in quality. Following the evaluation, the eggs fall into fresh eggs, old eggs and eggs with quality defects.

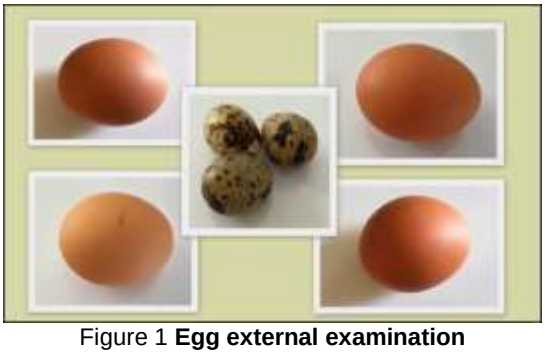

Figure 1 **Egg external examination**

Fresh eggs have the following characteristics: the shell has a rough appearance, the pores are visible, the colour is uniform, there are no spots, calcium deposits or other anomalies and defects.

Old eggs have a shiny appearance, possible spots, pores are not visible, and eggs with defects have cracks, fissures or anomalies (dirty eggs, stained white eggs, blood-stained eggs, white-striped eggs, eggs without shell, eggs covered with calcium, eggs with soft skin, eggs with calcium deposits) (Savu C., Petcu C.D., 2002).

Density test in tap water

As the egg ages, its density decreases. The density test is determined in tap water, the fresh egg having an average density of 1.080, and after 21 days it can reach 1.050. This method provides information about the egg freshness up to 30 days. The sample to be examined is placed in a glass container with water, following the angle formed by the egg with the lower part of the container (*figure 2*) (Savu C., Petcu C.D., 2002).

Figure 2 **Density test in tap water**

The Haugh unit determination

The method is used to assess the quality of the egg content. The test was introduced in 1937 by Raymond Haugh and has as its working principle the determination of the Haugh unit (HU) using the following formula:

$$HU = 100 * \log_{10}(h - 1.7w^{0,37} + 7.6)$$

h= egg white height

w= egg weight

Depending on the equation result, its quality and classification in a certain quality category is determined. The limits are between 0-130, and what is below 60 means a lower quality category and over 60 a higher quality category (Kluger J., 2010).

The working method consists in weighing the egg, breaking the egg on a flat surface and measuring the egg white height (*figure 3*).

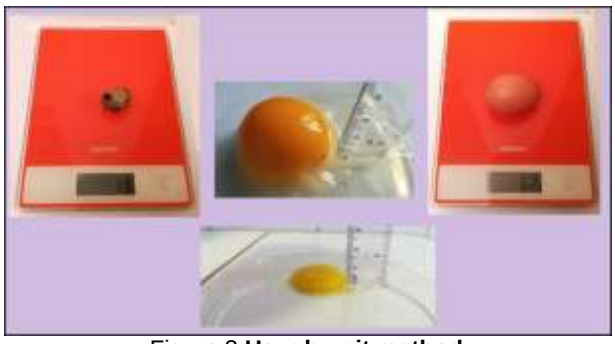

Figure 3 **Haugh unit method**

Egg organoleptic examination

For this method the egg must be broken (*figure 4*). As a method that determines the degree of freshness, the smell, colour, appearance and consistency are appreciated with the following interpretations: the fresh egg has a proper odour, the egg white colour is white, the egg yolk colour is in different yellow shades and the consistency is gelatinous for the egg white and specific to the yolk (Savu C., Petcu C.D., 2002).

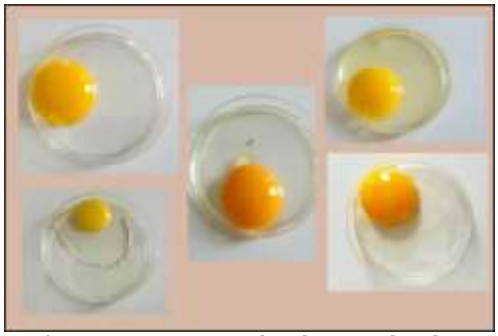

Figure 4 **Egg organoleptic examination**

Vitelline index determination

It is a method of the egg freshness examining, represented by the ratio between the diameter (d) and the height (h) of the egg yolk. This is done on a flat surface and the first step is to separate the egg white from the egg yolk, then measure the egg yolk diameter and height with a ruler (*figure 5*).

The fresh egg has a vitelline index of 1/2 (0.5), and the old egg of 1/3 (0.33) or even 1/4 (0.25) (Savu C., Petcu C.D., 2002).

Figure 5 **Vitelline index determination**

pH determination

The alkalinity of the egg white and the acidity of the egg yolk is measured using the pH strip to find out the freshness stage of the egg.

The egg white has an alkaline pH equal to 7.8-8.2 which increases as it ages and the egg yolk has an acidic pH around 6, which in the ageing process reaches 6.8-7 (*figure 6*) (Savu C. et al , 2002).

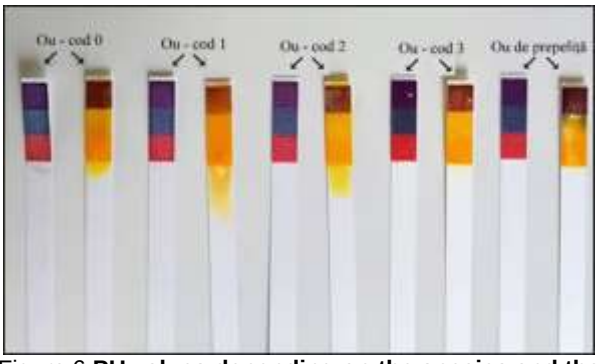

Figure 6 **PH values depending on the species and the code marked**

Determination of the egg yolk colour using *La Roche* method

La Roche method is a visual method that determines the colour of the egg yolk according to a reference scale (*figure 7*). The colour of the egg yolk is given by the carotenoids present in the feed administered to the hens, and depending on the quantity, the colours can be between 1-16 shades on *La Roche* scale (Míková K. et al, 2014).

Figure 7 **Determination of the egg yolk colour using La Roche method**

Criteria for marketing eggs in Romania and European Union

In Romania, the marking and classification of eggs is done accordingly with Commission

Regulation (EC) No 589/2008 of 23 June 2008 laying down detailed rules for implementing Council Regulation (EC) No 1234/2007 as regards marketing standards for eggs.

This regulation represents the minimum standards that must be met by the trader in order to be able to sell his product in the European Union.

Classification of eggs is carried out in two quality classes: A and B. Class A includes eggs which satisfy the following conditions:

- has an intact shell and cuticle, without defects and without dirt stains;
- after the ovoscopic test, the egg white and egg yolk are clear, without blood stains, with the egg yolk slightly mobile and the germ has an imperceptible development;
- has no foreign odours or foreign matter;
- the air space must not exceed 6 mm in height and, for eggs to be marketed as 'extra', it may not exceed 4 mm;
- are not washed, cleaned or treated for preservation.

Class B is represented by eggs that do not fall into class A, which have various defects: soft shell, calcium deposits, cracks or microcracks, etc. (Savu C., Petcu C.D., 2002).

Under Regulation (EC) no. 589/2008 are contained the ' time limit for grading, marking and packing eggs and marking packs', in which the following are presented: grading, marking and packaging shall take place within 10 days of laying, 'extra' or 'extra fresh' eggs are classified and marked within 4 days of laying and the minimum shelflife shall be from the moment of laying without exceeding 28 days.

RESULTS AND DISCUSSIONS

In the study unit, each stage of the technological flow is well individualized and supervised, ensuring the traceability of eggs, reducing the risk of their cracking and the risk of bacterial contamination.

Trained staff check the technological process throughout it. The flow is continuous and fast, respecting the flow chart prepared within the documentation of the food safety management system (Petcu C.D. *et al*, 2007), as well as the requirements of the legislation in force regarding the sorting, marking and packaging of eggs.

Results and discussions on eggs sorting and packaging

During the study the flow chart was followed and each technological stage was monitored, mainly the process of ovoscopy which is a critical control point (Goncearov M *et al*, 2004), sorting, marking and packaging.

The eggs are brought to the warehouse by means of a conveyor belt which collects the eggs from all production halls.

Manual sorting begins when the eggs enter the packing center on the conveyor belt and consists in removing the eggs with various defects or shell anomalies, which are not in accordance with the legislation in force, as well as with the consumer's preferences.

The purpose of the **ovoscopic examination** is to visualize the inside of the egg with a bright light source underneath, and eggs with cracks, microcracks, blood stains or defects in the egg white, egg yolk or air space integrity are not allowed in production.

Sorting is done in the following weight categories: S (53 grams), M (53-63 grams), L (63-73 grams) and XL (73 grams) (according to legislation in force), in order to form batches that will then go to packaging (*figure 8*).

Figure 8 **Sorting eggs**

Marking is done by printing on the eggshell a code and the validity date, with safety ink. The code contains the following notions: how the hens are grown, the country of origin, the county where the farm is located, the number assigned to the egg-producing farm by the County Agricultural Directorate and the validity date.

Packaging is performed automatically and collectively and is established gravimetrically (*figure 9*). The boxes used to pack eggs are made of simple, recyclable, reusable, rigid cardboard that does not change the physico-chemical properties of the packaged product (Petcu C.D., 2015).

Figure 9 **Packing in boxes of 30 eggs**

After packing the eggs in boxes, pallets are formed and then are stored at temperatures between 5-17°C and humidity of 66% (*figure 10*).

The delivery is made to the marketing establishments with authorized isothermal machines.

In addition to the aspects previously followed and presented in this paper, a study was conducted that aimed at the analysis of 25 egg samples, divided into 5 batches of 5 eggs of different quality, weight and laying period. The categories for hen's eggs are represented by the codes marked on the eggshell, namely code 0, code 1, code 2 and code 3, and quail eggs were examined just by different batches.

Figure 10 **The egg store**

Results and discussions regarding the external examination of the egg

After performing the external examination of the egg, the following have been concluded: 6 eggs had dark brown shell colour (24% of the samples), 10 eggs had a light brown shell colour (40% of the samples), 4 eggs had mottled brown shell colour (16% of samples) and 5 eggs (quail) showed mottled shell (20% of samples).

Results and discussions regarding density test in tap water

For the density test in tap water, the eggs were harvested in the first and second half of the shelf life, the results being as follows: 56% were within 7-15 days, 40% were within 15-21 days and 4% were within 30 days.

Results and discussions regarding the Haugh unit determination

Following the Haugh unit determination, it showed that 36% (9 eggs) had values below 60 and fell into a lower quality category, and 64% (16 eggs) had values above 60, thus falling in a superior quality category.

Results and discussions regarding the egg organoleptic examination

Egg organoleptic examination indicated that 100% of the 25 samples had an appropriate odour and presented a white egg corresponding colour (white).

Regarding the egg yolk colour, 4% of the samples had the yellow-orange yolk, 20% had the dark yellow yolk, 44% had the yellow yolk and 32% had the light yellow yolk.

Results and discussions regarding the vitelline index determination

Regarding the vitelline index, 72% of the samples (18 eggs) had a ratio between 0.45-0.53, of which 8% had a ratio equal to 0.5. The rest of the samples of 7 eggs (28%) had values between 0.27-0.37.

Results and discussions regarding pH determination

The pH value is between 6-7 for egg yolk and 7.5-9.5 for egg white. 72% are fresh eggs and 28% are eggs nearing the end of their shelf life.

Results and discussions regarding *La Roche* scale detrmination

The results of the *La Roche* method were between 4-14 on the colorimetric scale, as follows: 2 eggs had colour 4, 1 egg had colour 5, 4 eggs had colour 6, 3 eggs had colour 7, 5 eggs had colour 8, 4 eggs had colour 9, 4 eggs had colour 10, 1 egg had colour 11, 1 egg had colour 14.

All the samples evaluated had a correspondent on the *La Roche* colorimetric scale, and were considered compliant for human consumption. The most intense shades of colour were identified in eggs with codes 0 and 1.

Results and discussions on laboratory microbiological control of eggs

Microbiologically, the 25 eggs analysed had values in accordance with the legal admissibility limits. For all the analysed samples, negative results were obtained regarding the presence of *Salmonella* spp., both on the eggshell and in the content (egg white, egg yolk).

CONCLUSIONS

Eggs produced on the study unit farms comply with the legal requirements for classification in class A and the related weight categories.

The sorting and marking system complies with the European Union legislation in force, providing egg traceability, and packaging is done according to consumer requirements, using boxes of 6 and 10 (sizes M, L, XL), 20 or 30 eggs, made of recyclable cardboard, helping to preserve the egg nutritional values.

The result of the Haugh unit determination showed that 64% of the samples fall into a higher quality category.

The colour of the egg yolk was the most different criterion in the organoleptic examination of the egg, with 4 types of results, starting from light yellow, yellow, dark yellow and ending with orange-yellow, colour found in eggs produced by hens grown in the ecological system.

Following the vitelline index and the pH determination, it was concluded that 18 eggs (72%) were fresh eggs and 7 eggs (28%) were within the upper limit of acceptability values, being the samples kept and analysed at the end of the validity period.

Following the application of *La Roche* method, 9 variations of the egg yolk colour were obtained and most often the colour 8 was found.

Because the products obtained in the study unit and used in our experiments showed compliance with the admissibility parameters, they are considered safe products for human consumption.

REFERENCES

Banu C., Bahrim G., Bărăscu E., Dan V., Danielevici C., Lungu C., Nicolau A.I., Nour V., Răsmeriță D., Stoica A., Verșescu V., Vizireanu C., 2008 - *Tratat de industrie alimentară. Probleme generale.* București, RO:Editura Asab.

Banu C., Ana A., Bârsan I.G., Bărăscu E., Bordel D., Bulancea M., Croitor N., Gyemant A., Hopulele T., Ionescu A., Jantea C., Nour V., Panțuru D., Păsat Gh., Răsmeriță D., Săhleanu V., Stoica A., Stoicescu A., Stroia A., Tofan I., 2009 - *Tratat de industrie alimentară. Tehnologii alimentare.* București, RO:Editura Asab.

Bertechini A.G., Mazzuco H., 2013 - *The table egg: a review.* Ciênc. agrotec., 37(2), 115-122.

Cepeda A., Lamas A., Franco C.M., Redondo-Valbuena C., Jose M.M., Jose A.R., Roca-Saavedra P., Xaquin A., 2015 - *Egg and Egg-Derived Foods: Effects on Human Health and Use as Functional Foods*. Nutrients, 7, 706-729.

Cioceanu M., Papuc C., Petcu C., Diaconescu C., 2007 - *Estimation of quail egg yolk plasma phospholipids after fragmentation by thin layer chromatography method*. Lucrari Stiintifice-Universitatea de Stiinte Agricole a Banatului Timisoara, Medicina Veterinara, 40:319-322.

Covașă A.M., Galiș A.M., 2017a - *Calitatea ouălor de consum prin aplicarea sistemului HACCP și marcarea acestora – aspecte legislative*, Revista Avicultorul, Editura Total Publishing, București, 3, 6-11**.**

Covașă A.M., Galiș A.M., 2017b - *Ouăle și sănătatea, Revista Avicultorul*, Editura Total Publishing, București, 4, 7-10.

Covașă A.M., Galiș A.M., 2017c - *Compoziția ouălor de consum în funcție de specia producătoare*, Revista Avicultorul, Editura Total Publishing, București, 2, 6-9.

Goncearov M, Petcu C, Antoniu S. *Hazard analysis critical control points - a modern concept regarding food quality and safety*. Scientifical Papers: Veterinary Medicine, Timişoara 2004, 37:868- 872.

Jianping W., 2014 - *Eggs and Egg Products Processing. Food Processing: Principles and Applications*, 2, 437-455.

Kluger J., 2010 - *Organic Eggs: More Expensive, but No Healthier*. Time magazine.

Lesnierowski G., Stangierski J., 2017 - *What's new in chicken egg research and technology for human health promotion? – A review.* Trends in Food Science & Technology, 71, 46–51.

Míková K., Bovšková H., Panovská Z., 2014 - *Evaluation of Egg Yolk Colour*. Czech J. Food Sci., 32(3): 213-217.

Petcu C.D., Savu C., Mitrănescu E., Chirilă S., 2007 - *The implementation of the integrated quality and food safety management system in the food industry units.* Lucrări Ştiințifice Medicină Veterinară, XL, 545-51.

Petcu C.D., 2015 - *Ambalaje utilizate în industria alimentară*, Editura Granada, București.

Ruxton C., Derbyshire E., Gibson, S., 2010 - *The nutritional properties and health benefits of eggs.* Nutrition & Food Science, 40(3), 263-279.

Savu C., Petcu C.D., 2002 - *Igiena și controlul produselor de origine animală*. București, RO:Editura Semne.

*** Regulamentul (CE) nr. 589/2008 al comisiei din 23 iunie 2008 de stabilire a normelor de aplicare a Regulamentului (CE) nr. 1234/2007 al Consiliului privind standardele de comercializare aplicabile ouălor.