CHANGES IN COMPOZITION OF EGG WHITE DURING STORAGE

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CHANGES IN COMPOZITION OF EGG WHITE DURING STORAGE

NINA MIJA, ADRIANA BIRCA, LIVIU GACEU

Abstract: *Hen eggs are an important source of nutrients, but their quality is highly affected by changes that may occur during storage. In this study are presented the results of the investigation of the change of the properties of eggs within 5 weeks of storage at room temperature and in the refrigerator. It can be observed an increased value of alkalinity of egg white and acidity of egg yolk. A migration of same components (phosphates, iron) occurs from yolk to white. The most optimal regime, which keeping quality of eggs during storage is maintenance in the refrigerator.*

Keywords: *freshness of eggs, alkalinity of egg white, acidity of egg yolk, content of phosphates and iron in egg white during maintenance*

Introduction

The modern poultry industry is not exactly satisfied with the traditional system assessment of quality of eggs, which are based mainly on visual inspection and ovoscoping [1,2]. Existence in practice of various batches of eggs impose a need to fast and objective estimation of the state of freshness, degree of bacterial infection, presence of livestock defects and states fatigue ore altered of them. Currently the main criteria used for grading of shell eggs accepted by the EU Legislation are freshness of eggs. Because of profound changes that may occur during egg storage, the state of freshness is a key component of its quality. Also, the consumers may perceive variability in freshness as lack of quality. The changes that occur in egg during storage are various and affect physiological state and structure of the components. The protective membranes dry, the cuticle under shell egg and viteline membrane that covering the yolk are damaged. The oxygen penetrates the pores formed, which catalyze various biochemical reactions on egg albumen level. According to some authors [5,7]., after yolk membrane damage processes of migration of compounds contained in the yolk to albumen are possible.

The aim of this experimental research was to estimate the dynamics of migration of phosphates and iron from egg yolk to egg white depending on the technological regime of storage eggs.

Materials and methods

Research has been conducted for food consumption hen eggs produced by hens cross *Leghornon* on poultry factory Valea Perjei, Taraclia. Measurements were performed at 0, 1, 2, 3, 4 and 5 weeks of storage of eggs. Comparative analysis was performed on eggs kept in a refrigerator (2 ± 4 °C) and eggs at room temperature (16 ± 18 °C). For each sample was used to determine average egg white/yolk obtained from 6 eggs with the same terms and conditions of storage. Alkalinity of the white, acidity of yolk was determined by titration [7]. Using spectroscopic methods was determined accumulation of phosphates in egg white [7] and iron in egg white [6]. Quantitative determination of phosphates was performed in reaction with molybdenum blue (phosphates concentration determined at λ= 670 nm), iron – with benzidine (concentration of Fe-benzidine complexone determined at λ= 440 nm).

Results

Changes of alkalinity of egg white. Alkaline qualities of the egg white are determined by the massive presence in the protein composition of basic amino acids (arginine, lysine) [7]. During storage alkalinity of egg white increased progressively (Tab.1). The phenomenon can be

explained primary, by increased proteolysis reactions and formation of degraded alkalinity products and secondary, by losses of CO_2 through the pores of the egg shell.

Table. 1. Effect of temperature and storage time on alkalinity of egg white

Storage time, weeks	Alcalinity degree of egg white, X (°)	
	Refrigerated eggs	Eggs at a room temperature
0	11,2 ± 0,31	11,2± 0,31
1	14,7± 0,34	13,9± 0,35
2	14,4± 0,33	14,2± 0,32
3	13,5± 0,29	16,7± 0,37
4	14,2± 0,36	16,5± 0,30
5	16,4± 0,37	17,4± 0,38

Changes the pH of egg yolk. Acid reaction of egg yolk is due to the presence of acidic substances (fatty acids, lecitinphosphaţes, glycophosphaţes) [4,7].. In fresh eggs acidity of eggs yolk was 5,1 to 6,5 degree of acidity, while after 5 weeks of storage, eggs stored in the refrigerator have 7,9 degrees of total acidity and 9,2 - at room temperature. Acidification of yolk by storage can be explained by enzymatic and non-enzymatic hydrolysis. ***Accumulation of phosphates in egg white***. In the composition of egg white phosphates are present in trace amounts, no more than 60-76 mg% . Unlike, significant sources of phosphates in egg yolk, about 400-550 mg%, are presented in simple and complex lipids (glicerinphosphaţes, lecitinphosphates) [1,4].

Experimental, accumulation of phosphates in egg white during storage can be demonstrated by color reaction – appearance of blue color at addition of molybdenum blue is a clear evidence that egg whites gained a certain amount of phosphates. Quantitatively this phenomenon is studied with available calibration curve for the solution of 0,1M KH_2PO_4 maximum of absorption being at λ = 540 nm. Thus, was determined that level of phosphates in fresh egg white was 62,5 mg%. After 2 weeks of storage in a refrigerator as a results of migration of phosphates from the egg yolk increased to 72,3 mg% and after 5 week - 112.8 mg%. Consumption period of eggs as is shown in Hygienic rules is 3 weeks in refrigeration condition, during which the experimental egg white accumulated phosphates in an amount of 83,7 mg%. Keeping eggs at room temperature was observed an accelerated accumulation of phosphates in albumen, thus eggs of 5 weeks storage have slight signs of alteration, already containing 139,2 mg% of phosphates in albumen. (Fig.1).

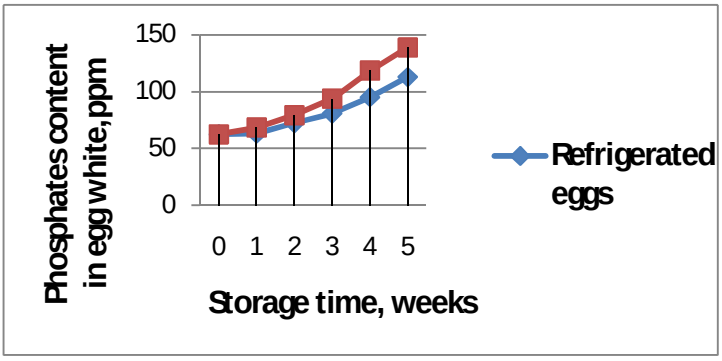

Fig. 1.*Dynamics of phosphate accumulation by storage*

Accumulation of iron in the egg white by storage_ Fresh egg white contains a minimum amount of iron – 0,78 mg%, instead fresh egg yolk is extremely rich in iron - 7 mg%. The main containing iron compound of yolk is phosvitin, a highly phosphorylated protein [1,3]. Thus it is possible iron transfer to egg albumen from yolk during storage due to the yolk membrane deterioration. The gradient of iron ions concentration between structural components of the egg is formed by the difference of the values: 0,0081 mg Fe/ 1g albumen and respectively 0,412 mg Fe/ 1g yolk.

To estimate the accumulation of iron in the egg white during storage was studied optical properties of Fe-benzidine complexone. Experimentally was studied absorption spectrum of Fe-benzidine complexone obtained by the treatment of egg white according to design proposed by the authors [6]. Absorption spectrum of the treated sample whites was recorded in the 200-650 nm range. From Fig.1 is easy to observe that spectrum has a band with a large absorption at λ= 300 nm, corresponding to hydrocarbon carbohydrate skeleton. Another band, with lower surface at λ = 440 nm, reflected the presence of Fe-benzidine complexone and is completely missing in fresh albumen samples, which almost contain minimum iron (Fig. 2). The appearance of this selective band than egg white treated samples being altered is a conformation of the fact that the yolk membrane deterioration causes a migration of iron ions from yolk to albumen, and a variation of it content in egg white.

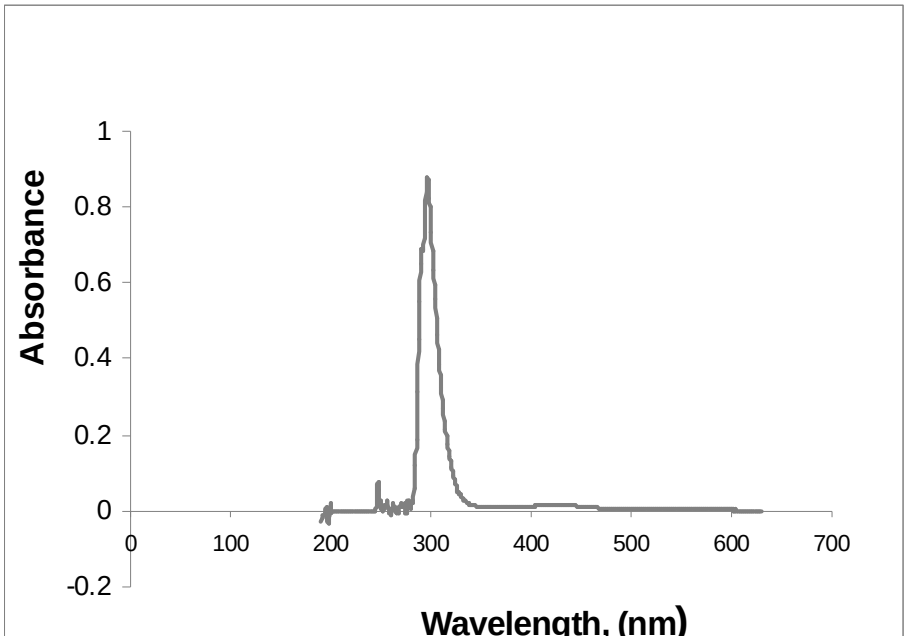

Fig.2 *Absorption spectrum of egg white sample, stored at room temperature for 5 weeks.*

Iron ions that have been migrated to the egg white in storage conditions are fixed by the protein fraction – ovotransferin. While iron was fixed in ovotransferin molecule in reaction with benzidine results an oxidized, chromogenic component and color intensity response is used as an index of the amount of iron concentration fixed by ovotransferin [6]. In this experiment is important, that egg white sample to be well treated with chloroform. In the interaction between benzidine and iron fixed by ovotransferin its necessary to produce a detectable absorbance at λ = 440 nm, even in the presence of low concentrations of iron, as is typical for the composition of native egg white.

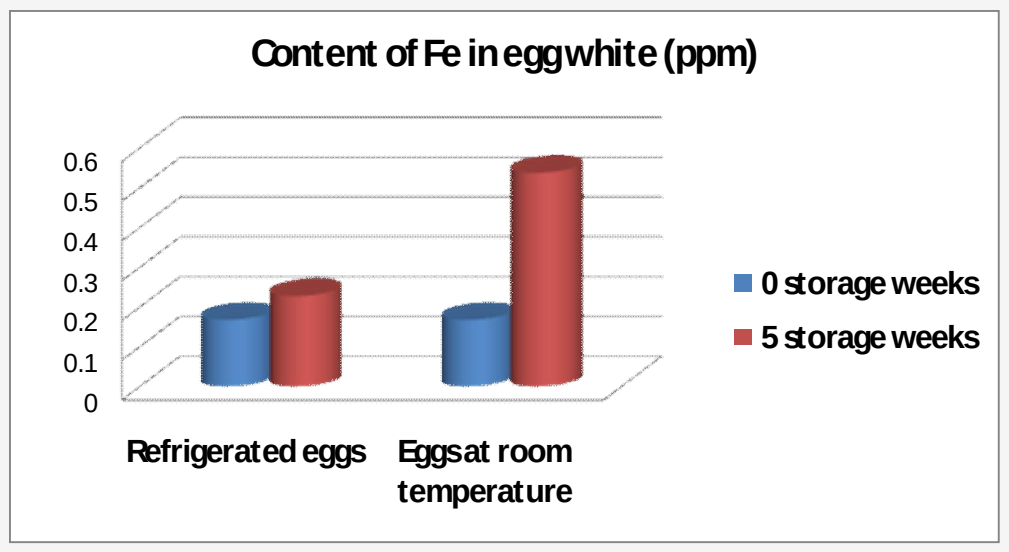

Fig.3. *The dynamics of iron accumulation in the egg white by storage*

Dynamics of accumulation of iron ions in storage egg whites is shown in Fig.3. It was established that after 3 weeks of storage were exceeded natural background in eggs stored at room temperature (0,32 mg% opposite 0,17 mg% in fresh white eggs), for eggs storage as refrigerator – was not exceeded. The positive dynamics of accumulation of iron in white eggs, stored at room temperature (up to 0,54 mg% after 5 weeks of storage), confirms the transfer of iron from egg yolk to egg white during storage.

Conclusion

Freshness of eggs is one of a main indicator for determining the quality of eggs. Profile of changes that occur in the egg white and yolk composition can be estimated by determining the value of the white alkalinity and acidity of yolk. Migration of egg yolk components to eggs white can now be estimate by determining the indices – the accumulation of phosphates and iron in the egg white. Regime of refrigeration is optimal to keep eggs, because ensure minimal changes in structure and composition of eggs.

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