

# **Dynamika zmian jakości zachodzących w jajach konsumpcyjnych w różnych warunkach przechowywania**

Dynamics of quality changes occurring in table eggs under various storage conditions

## **Summary**

The quality of eggs and their stability during the storage must be analysed in the legislation adopted, which regulates both the quality parameters and the maximum period for table eggs trading. Importantly, it does not lay down specific storage conditions for this raw material, stipulating only that the refrigerated storage of eggs is exclusively reserved for the final consumer. However, in eggs, as in all food products, quality deteriorates with storage time. Therefore, it is necessary to provide appropriate methods to reduce the impact of time on the quality of raw egg material.

The aim of the thesis was to analyse the dynamics of changes in egg quality during storage in the context of their prediction and to develop methods to inhibit processes affecting the deterioration of table eggs. Research hypotheses were formulated that analysis of the daily variation of egg quality traits may contribute to the development of mathematical models to predict these changes as well as the time elapsed since laying, and that inhibition of the ageing process in table eggs is possible by modification of storage conditions and/or with the use of substances limiting shell pore permeability.

Three independent experiments were conducted. In the 1st one, evaluation of egg quality traits was performed daily during its extended storage up to 35 days, and the data thus obtained made it possible to create a multivariate mathematical model which, after further statistical processing, makes it possible to determine with high certainty (above 95%) the age of an egg based on its measurable traits, both non-destructive and destructive. Statistical methods based on linear regression equations (for traits characterised by linear variation) and polynomial regression equations for traits with non-linear dependence were used.

In 2nd experiment, the experimental factors were the type of eggs packaging (cardboard and plastic egg boxes) and the storage temperature (refrigerated and room temperature). Such an experimental arrangement made it possible to simulate changes in the quality of commercially traded eggs under similar conditions to those of consumers. An additional element was the determination of the type of egg box, which allows for longer preservation of egg quality during storage and trading. Apart from the evaluation of the

quality of the eggs, the study also analysed the variation in the yolk fatty acid profile and changes in their index values depending on experimental factors and storage time.

A second method to reduce the progress of negative quality changes of eggs during storage was to coat the shells with an aqueous solution of citric acid at different concentrations (3rd experiment). Due to the high amount of calcium in the egg shell, a weak organic acid causes a reaction that results in the formation of salts of this acid - citrates. As a consequence, they accumulate not only on the surface of the shell but also in the shell pores limiting their permeability, which leads to a limitation of gas exchange between the egg content and the external environment and thus contributes to a decrease in the intensity of negative quality changes. These observations were further confirmed by taking photographs of cross-sections and surfaces of shells treated with citric acid using the scanning electron microscopy (SEM) technique.

The research carried out allowed us to confirm the research hypotheses set out previously. It was shown, contrary to the available literature, that not all egg quality traits are characterised by linear changes during the storage time, so it is advisable to use polynomial regression. In addition, multiple regression analysis allows the determination of a predictive model allowing the inference of "egg age" based on measurements of selected traits. The packaging has an impact on limiting the rate of changes occurring, in eggs stored in plastic boxes, deterioration occurs more slowly than in eggs stored in cardboard ones. The intensity of these changes is similar to that observed under refrigerated conditions for cardboard boxes, so plastic boxes may be an alternative to refrigerated storage. These relationships were confirmed by reducing the intensity of changes in the fatty acid profile, especially in the context of polyunsaturated acids. The use of citric acid as a shell coating substance also allows inhibiting the processes leading to a deterioration of table eggs quality (reduction of weight loss, longer preservation of egg albumen structure, slowing down the increase of egg content pH) by changing the dynamics of these changes.

**Keywords:** hen eggs, egg storage, statistical models, quality changes, shell pore sealing