Physicochemical parameters and morphological qualities of edible eggs depending on the period of the reproductive period of chickens

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Abstract. Changes in egg quality observed under intensive poultry farming conditions indicate the possibility of regulating these parameters without violating their inherent high nutritional benefits. Morphological characteristics, such as the weight and shape of the egg, the weight of the yolk, protein, shell, its strength and others are determined mainly by genetic factors and conditions of keeping and feeding. Egg mass is the most important physical indicator of nutritional and market value, which determines the productivity of poultry. At 26 weeks of age (beginning of laying) the egg weight averaged 57.7 ± 0.81 g, and at 80 weeks of age (end of laying) - 62.2 ± 1.86 g. The weight of eggs obtained from hens of the cross “Lohmann-white”, increased due to changes in the absolute mass of its constituent components. The mass of egg white during the reproductive period increased by 4.50 – 4.99%; yolk - by 6.8 – 14.9%; shells - by 4.4 – 18.8%, although this practically did not affect their ratio in percentage terms. The shell thickness increased from 365.0 ± 6.99 microns to 378.0 ± 7.09 microns. With an increase in the shell thickness, the density of eggs also increased from 1.070 ± 0.002 g / cm³ to 1.078 ± 0.002 g / cm³. The shape index of eggs ranged from 71.5 - 74.9%, while the increase in egg mass was accompanied by a decrease in the shape index. During the reproductive period, the Howe index was at the level of 82.5-84.4 conventional units. The protein index and Howe units decreased with age. All morphological and physicochemical parameters corresponded to the optimal values: protein index from 7.6 to 8.4%, yolk index from 39.0 to 42.0%, shape index from 74.9 to 75.3, Hau units from 82, 5 to 84.4 conventional units.

1. Introduction

Ensuring uninterrupted and sustainable supply of the population with high-quality food of animal origin, including eggs, is the main problem of maintaining the health of the nation and food security of any country [1-6]. Increasing the production of high-quality products is one of the most important tasks for the development of animal husbandry, including poultry farming, which is becoming more and more important due to the growth of the world’s population and the satisfaction of humanity’s need for nutritious food [7-13]. In this regard, the development of poultry farming is given great national economic importance [13-22]. An increase in productivity is inseparably associated with an increase in
breeding work [20-30]. All over the world, chickens of the egg breed of the Loman-white cross are widely used to obtain edible eggs. So that they have high productivity indicators, it is necessary that they be adapted to the conditions of industrial production. The problem of increasing the productivity of chickens and the quality of their chicken eggs will be solved on the basis of further intensification of the poultry industry, including through the use of new highly productive crosses adapted to specific climatic and production conditions. In this regard, a comprehensive study of the quality of chicken eggs is one of the main ways to improve the quality of eggs and the efficiency of the industry, and also allows you to control the technological conditions and quickly eliminate the causes that influenced the change in their properties [25-34]. The edible egg has a complex structure and is an unfertilized egg. Changes in egg quality observed under intensive poultry farming conditions indicate the possibility of regulating these parameters without violating their inherent high nutritional benefits. Morphological characteristics, such as the weight and shape of the egg, the weight of the yolk, protein, shell, its strength and others are determined mainly by genetic factors and conditions of keeping and feeding.

The purpose of the work is to study the physicochemical parameters and morphological qualities of edible eggs, depending on the period of the reproductive period of chickens

2. Materials and method

The experimental part of the work was carried out by an industrial poultry farm for the production of edible eggs. The objects of research were laying hens of the same age industrial herd of the Lohmann-White cross during oviposition, which were kept in the main production buildings equipped with cage batteries. Three experimental groups were formed according to the principle of balanced groups (n = 10). The first group consisted of laying hens at 26 weeks of age (beginning of reproductive period), the second at 52 weeks of age (peak of oviposition), and the third at 80 weeks of age (end of lay). In order to assess the quality of eggs, they were evenly selected from different tiers of 20 pieces directly from the cages at 26, 52 and 80 weeks of age. The indicators taken into account were determined using the following methods: the mass of the egg and its components by weighing on an electronic balance with an accuracy of 0.1 g; density of eggs - using saline solutions of various concentrations and a hydrometer at a temperature of 200C; shape index - using a caliper; 4) shell thickness - using the PUD-1 device; for protein and yolk, the height, large and small diameters of spreading were determined with an altimeter and calipers, and according to the data obtained, the following was calculated: the protein index by dividing its height by the average diameter and the yolk index by the ratio of its height to the average spreading diameter; the ratio of the mass of protein and yolk was obtained by dividing the mass of the protein by the mass of the yolk; Howe units according to the table, using the value of the mass of the egg (g) and the standing height of the outer dense protein (mm) when pouring the contents of the egg onto a flat glass.

3. Results

The edible egg has a complex structure and is an unfertilized egg. Changes in egg quality observed under intensive poultry farming conditions indicate the possibility of regulating these parameters without violating their inherent high nutritional benefits. Morphological characteristics, such as the weight and shape of the egg, the weight of the yolk, protein, shell, its strength and others are determined mainly by genetic factors and conditions of keeping and feeding. Egg mass is the most important physical indicator of nutritional and market value, which determines the productivity of poultry. Thus, at 26 weeks of age (beginning of egg-laying), egg weight averaged 57.7 ± 0.81 g, and at 80 weeks of age (end of egg-laying) - 62.2 ± 1.86 g, that is, over the period of research the weight of eggs increased by 5.5 g. The weight of eggs obtained from layers of the Lohmann-white cross increased due to changes in the absolute weight of its constituent components. The mass of egg white during the reproductive period increased by 4.50 - 4.99%; yolk - by 6.8-14.9%; shells - by 4.4 - 18.8%, although this practically did not affect their ratio in percentage terms, the first 2 cycles of the reproductive period (figure 1).
The ratio of egg components changed significantly in the third reproductive period (end of lay, 80 weeks) (figure 2).

An increase in egg mass during the reproductive period was accompanied by a change in the share of protein and yolk in its nutritional value. Against this background, both the absolute and the relative weight of the shell increased, which was reflected in its quality. The eggs of hens obtained from layers of the Lohmann-White cross at the end of the reproductive period (80 weeks of age) had a high indicator of shell thickness and its percentage in relation to eggs obtained from hens of layers at the beginning of laying (26 weeks of age) ($p \leq 0.05$). On average, during the reference period, the shell thickness increased from $365.0 \pm 6.99 \mu m$ to $378.0 \pm 7.09 \mu m$. With an increase in the shell thickness, the density of eggs also increased from $1.070 \pm 0.002 g/cm^3$ to $1.078 \pm 0.002 g/cm^3$. 

**Figure 1.** The ratio of the component parts of the eggs to the egg weight, %.

**Figure 2.** The ratio of the nutritional parts of the egg depending on the duration of the reproductive period.
The shape of the eggs is an important quality indicator. The shape index normally for uncalibrated eggs should be 74 - 78%. In our studies, the egg shape index ranged from 71.5 to 74.9%. At the same time, an increase in the egg mass was accompanied by a decrease in the shape index.

With the course of the reproductive period, the sizes of the constituent parts of the egg changed (figure 3).

![Figure 3. Altitudinal and latitudinal indicators of protein and yolk, mm.](image1)

The figure shows that linear and latitudinal measurements of protein and yolk changed with age, which affected the yolk and protein indices (figure 4).

![Figure 4. Egg white and yolk indices.](image2)

The yolk index of edible eggs of the Lohmann-White hens ranged from 39-42%. This value during the reproductive period remained practically unchanged, although it had a tendency to decrease somewhat. At the beginning of lay, the index was 42%, in the middle - 40%, and at the end - 39%.

One of the indicators of the quality of edible eggs is the protein index, which slightly decreases with age. This indicator was 8.4% at 26 and 52 weeks of age, and 7.6% at 80 weeks of age (p≤ 0.05), which corresponds to the standard indicators.
Of the indicators of protein quality, the Howe units have the highest connection with its index, since both of these indicators are determined based on the measurement of the height of the dense protein. Optimal values of Howe units for chicken eggs are 65-87. The analysis of the research results showed that during the reproductive period this indicator was at the level of 82.5-84.4 conventional units. The protein index and Howe units decreased with age.

4. Discussion
At 26 weeks of age (beginning of egg-laying), egg weight averaged 57.7 ± 0.81 g, and at 80 weeks (end of egg-laying) - 62.2 ± 1.86 g, that is, during the study period, the weight of eggs increased by 5.5 g. The mass of eggs obtained from layers of the Lohmann-White cross increased due to changes in the absolute mass of its constituent components. An increase in egg mass during the reproductive period was accompanied by a change in the share of protein and yolk in its nutritional value. The egg shape index ranged from 71.5 to 74.9%. Similar data were obtained in the research results of M P Rani, N N Ahmad, P E Prasad, C S Latha, N C Rath, N B Anthony, L Kannan, W E Huff, G R Huff, H D Chapman, G F Erf, P Wakenell.

5. Conclusion
Based on the foregoing, it follows that the assessment of the quality of edible eggs of the Lohmann-White hens during the reproductive period showed that all morphological and physicochemical parameters corresponded to the optimal values: protein index from 7.6 to 8.4%, yolk index from 39.0 to 42.0%, shape index from 74.9 to 75.3, Howe units from 82.5 to 84.4 conventional units. In general, the data obtained correspond to the established pattern.

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