The influence of morphological parameters of eggs on the results of incubation

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Abstract. The purpose of the research was a comparative analysis of the morphometric parameters of eggs, as well as their impact on the results of incubation and the quality of day-old chicks. Eggs in the amount of 160 pieces were placed in the incubator and incubated according to generally accepted conditions. A high level of fertilization (88.2%) and hatchability (84.9%) of eggs was revealed. 126 heads were received, chick hatching rate was 78.7%. Received 65 cockerels, 61 chickens. The average weight of the eggs from which the cockerels were obtained was 59.6 g, which is 1.4% more than the weight of the eggs from which the hens were obtained, with an unreliable difference. The weight of males was significantly higher than that of females by 1.3 g (3.3%). For such analyzed morphological parameters as egg volume, cross-sectional area, egg surface area, no significant difference was found between the groups (from 0.02% to 0.39%). The size of the longitudinal sectional area and the semimajor axis of the eggs from which the chickens were obtained was higher by 3.3% and 2.3%. The value of the parameter semi-minor axis of eggs (2.71 cm), from which the cockerels were obtained, was significantly higher by 5.1%. The eggs from which the hens were obtained have a more rounded shape of the sharp end, the angle was 102.2 degrees, which is significantly higher by 5.9% than that of the eggs from which the cockerels were obtained. The shape index of eggs from which males were obtained varied from 0.548 to 0.815, and from eggs from which hens were obtained from 0.546 to 0.749 units.

1 Introduction

Egg-bearing chicken breeds and crosses obtained on their basis are the most common agricultural poultry (more than 50% of the total population) and are widely used in industrial poultry farming and in private backyards. The main objective of egg poultry farming is to increase the productivity of poultry, improve their reproductive performance, the incubation qualities of eggs and the nutritional value of egg products. [1-3]

Increasing the productivity of chickens, the nutritional and incubatory qualities of eggs at the present stage is solved on the basis of intensifying technologies and selection

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processes in the poultry industry, including through the creation of new highly productive crosses that have high reproductive qualities and are adapted for use in industrial technology conditions [4] .

Intensive selection of egg-laying hens to obtain a high egg mass during the productive period occurs due to an increase in the egg production of the bird and an increase in the mass of eggs laid. At the same time, the high egg production of modern cross-breed chickens when they lay a large number of eggs and the long-term use of stabilizing selection for these traits have led to changes in the parameters of the external characteristics and contents of eggs [4-9].

Creation of new and improvement of currently existing highly productive agricultural breeds and crosses. poultry requires a comprehensive comparative analysis of their quality.

The morphological and physicochemical characteristics of eggs, by which they are assessed under the influence of various factors, are subject to significant variability, but the greatest variability is distinguished by morphological characteristics and, to a much lesser extent, physicochemical characteristics characterizing the contents of eggs, which ultimately determine their hatchability .

High incubation rates are possible with a systematic assessment of eggs and identification of the level of deviation of indicators that determine quality from optimal ones, which significantly affect both the results of incubation and the quality of hatched young animals, their further viability, safety and productivity.

Egg weight and the ratio of protein, yolk and shell are important both during incubation and in the production of commercial products and deep processing [10]. The most effective method of increasing egg mass is poultry selection. It is believed that egg weight is 55% determined by genetic factors and 45% depends on the feeding and living conditions of the bird. Each gram of increase in egg weight corresponds to an increase in the weight of the protein by approximately 0.65 g, the yolk by 0.25 g, and the shell by 0.10 g [11]. With an increase in the weight of hatching eggs, the weight of day-old young animals increases. However, high egg weight has an adverse effect on chick hatching. In this regard, improving the hatchability of eggs and the quality of hatched young animals is impossible without systematic control of the quality of eggs obtained from the birds of the parent flock [12]. Inclusion in breeding programs and selection of chickens from the ancestral and parent stock according to the morphological parameters of the egg can be an effective way to stabilize the reproduction of poultry and increase the profitability of production [9, 13-15].

A comprehensive study of egg quality is one of the main ways to increase the productivity and efficiency of the poultry industry. Increasing the hatchability of eggs and the quality of hatched young animals is a controlled process, subject to regular monitoring of the quality of eggs and embryonic development of agricultural products. birds [6, 16].

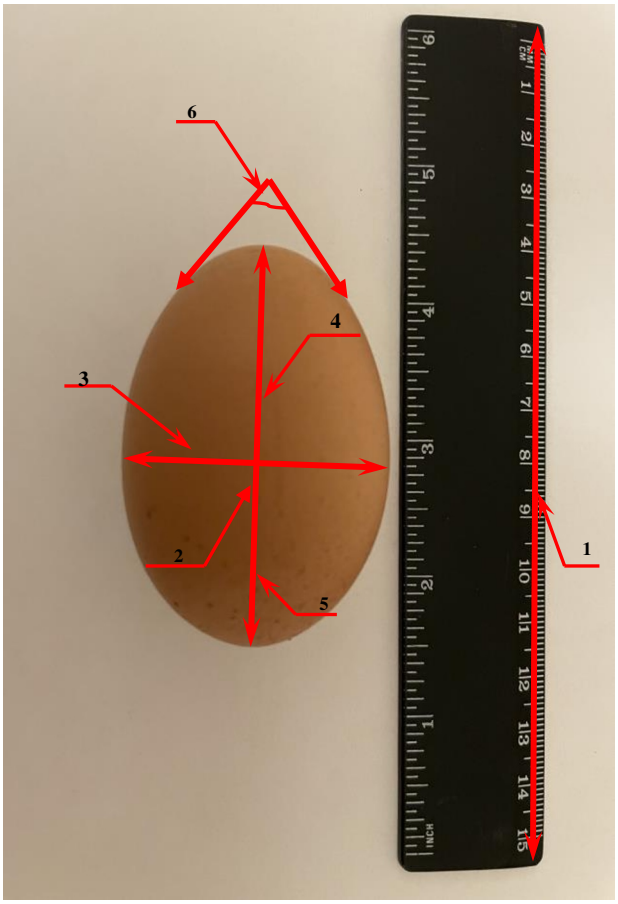
In this regard, the goal of our research was a comparative analysis of the morphometric parameters of eggs, as well as their impact on the results of incubation and the quality of day-old chicks.

2 Materials and methods

The experimental part of the work was carried out on the basis of LLC "Plemptitsesovkhoz "Uvinsky" of the Uvinsky district of the Udmurt Republic and in the educational and scientific laboratory of biotechnology of the Federal State Budgetary Educational Institution of Higher Education "Udmurt State Agrarian University". The material for the research was hatching eggs obtained from laying hens of the same age parental flock of the cross "Lohmann Brown Classic". The shelf life of eggs is 1-3 days. The volume of the poultry sample was 150 chickens. Keeping chickens in production buildings equipped with

3-tier cage batteries of 7-8 birds per cage with a sex ratio of 1:8-9. The microclimate parameters of the premises were maintained in accordance with the recommendations for work with the appropriate cross. To assess the quality of eggs, 30 eggs were evenly selected from different tiers of cages and areas of the poultry house directly from the cages at 7-8 months of the reproductive period.

At the first stage of the scientific experiment, eggs were selected for incubation by external examination, testing the fertilization of eggs using an ovoscope, and the weight was determined.



1 – prospectometer; 2 – large egg diameter; 3 – small egg diameter; 4 – semimajor axis of longitudinal section; 5 – semi-minor axis of longitudinal section; 6 – angle

Fig. 1. Determination of external egg parameters.

The mass of eggs was determined by weighing on an electronic scale with an accuracy of 0.1 g. The external parameters of eggs (morphological characteristics) were assessed according to the following characteristics: large diameter, small diameter, length of the large and small circles, longitudinal sectional area, cross-sectional area, surface area , volume of the egg, angle of the sharp end.

External characteristics of eggs were determined by their images obtained by photographing (Figure 1). The resulting images were processed in a graphics editor.

For a more complete assessment of the parameters, the egg shape index was calculated using the formula developed by S.D. Batanov and I.A. Baranova:

$$I = \frac{S_2}{S_1} \cdot \sin\alpha \quad (1)$$

Where the cross-sectional area of the egg is defined as:

$$S_2 = \pi \cdot \left(\frac{d}{2}\right)^2 \quad (2)$$

The longitudinal cross-sectional area of an egg is determined similarly to the area of an ellipse:

$$S_1 = \left(D_1 \cdot \left(\frac{d}{2}\right) \cdot \pi + D_2 \cdot \left(\frac{d}{2}\right) \cdot \pi\right)/2 \quad (3)$$

Where D_1 is the semi-major axis of the longitudinal section, D_2 is the semi-minor axis of the longitudinal section.

All selected eggs were numbered with a marker and placed in hatching trays. Next, the eggs were placed in incubation cabinets.

The day before hatching (day 18 of incubation), the eggs were transferred to hatcher trays, which were divided into cells (cell size 8x9 cm) into which the eggs were laid.

At the second stage of the study, we analyzed the incubation results and determined the sex and quality of day-old chicks.

The experimental data were processed using the variation statistics method [17] using the MATLAB mathematical modeling program.

3 Results and Discussion

Eggs in the amount of 160 pieces, obtained from chickens after preliminary preparation, were placed in an incubator and incubated according to generally accepted conditions. To identify the main factors affecting incubation and chick quality, an analysis of the incubation results was carried out (Table 1).

Analysis of the results obtained indicates a fairly high level of fertilization (88.2%) and hatchability (84.9%) of eggs. As a result of incubation, 126 birds were obtained, while the percentage of chicks hatched was 78.7%. When dividing the chickens by sex, the result was 65 males and 61 females.

Egg weight is one of the significant physical indicators of nutritional and commercial value, which determines the productivity of poultry, and is also taken into account when incubating eggs. In order to obtain young animals that are uniform in mass, a form of egg selection before incubation is used, such as the formation of a batch of eggs with a homogeneous mass. A high correlation has been established between the masses of hatching eggs and hatched young animals [18]. The results of our research established that the average weight of the eggs from which the cockerels were obtained was 59.6 g, which is 1.4% more than the weight of the eggs from which the hens were obtained, with an unreliable difference. The weight of males was significantly ($P < 0.05$) higher than that of females by 1.3 g (3.3%).

The hatchability and viability of chickens depend on the quality of hatching eggs. In this regard, when preparing eggs for incubation, a morphometric assessment is carried out. Morphological characteristics characterizing the external parameters of eggs depending on the sex of day-old chicks are presented in Table 1.

Table 1. Morphometric indicators of hatching eggs.

Indicators	Gender of chickens					
	Cockerels			Chickens		
	$\bar{x} \pm \Delta x$	Cv, %	Lim (min-max)	$\bar{x} \pm \Delta x$	Cv, %	lim (min-max)
Egg mass, g	59.64±0.35	4.5	(56-66)	58.78±0.28	3.5	(56-65.50)
Chicken weight, g	41.19±0.31*	5.7	(35-46.5)	39.88±0.27	4.9	(36.50-46.50)
Point angle	96.81±0.55	4.4	(89-108)	102.19±0.60***	4.3	(92-111)
Large diameter, cm	6.21±0.03	4.1	(5.35-7.10)	6.18±0.03	3.1	(5.86-6.70)
Small diameter, cm	4.76±0.03	4.8	(3.90-5.30)	4.77±0.02	2.7	(4.50-5.10)
Length of the greater circumference, cm	17.41±0.09	3.9	(14.71-19.69)	17.44±0.06	2.5	(16.62-18.81)
Length of the smaller circle, cm	14.94±0.09	4.8	(12.25-16.64)	14.98±0.06	2.7	(14.13-16.01)
Major axis, cm	3.50±0.04	7.8	(2.90-4.30)	3.61±0.04	7.8	3.09-4.30)
Minor axis, cm	2.71±0.04*	9.9	(2.20-3.30)	2.58±0.03	7.8	(2.10-2.99)
Longitudinal section area, cm^2	26.17±0.33	9.7	(17.76-33.08)	27.03±0.31	8.5	(22.56-32.83)
Cross-sectional area, cm^2	17.81±0.22	9.4	(11.95-22.06)	17.88±0.13	5.4	(15.90-20.43)
Surface area, cm^2	86.12±0.91	8.1	(59.98-108.80)	86.12±0.54	4.6	(77.94-99.49)
Egg volume, cm^3	73.90±1.17	12.0	(42.61-104.43)	73.76±0.70	6.9	(63.60-91.25)
Egg Shape Index	0.676±0.01	8.4	(0.548-0.815)	0.648±0.01	8.3	(0.546-0.749)

*P < 0,05; **P < 0,01; P < ***0,001

The results obtained indicate that there were no significant differences between the groups in such analyzed morphological parameters as egg volume, cross-sectional area, large diameter, small diameter, egg surface area, length of the larger circumference, length of the smaller circumference. The difference varied from 0.02% to 0.39%. The value of the longitudinal sectional area and the semimajor axis of the eggs from which the chickens were obtained was higher by 3.3% and 2.3%, with an unreliable difference. Of particular interest is the value (2.71 cm) of the semiminor axis parameter of the eggs from which the cockerels were obtained, which is significantly (P <0.05) higher by 5.1%. It was revealed that the eggs from which the chickens were obtained have a more rounded shape with a sharp end. At the same time, the angle was 102.2 degrees, which was significantly higher by 5.9% (P <0.001) than in the eggs from which the cockerels were obtained.

The shape of eggs is an important indicator of quality. There are high demands on the shape of eggs. This is due to the fact that standard eggs are better preserved during transportation and standard hatching eggs produce chicks with optimal live weight. In our studies, the egg shape index was determined using the developed formula (1) and the analyzed indicator is characterized by the cross-sectional area, longitudinal section and angle of the sharp end of the eggs. The higher the egg shape index, the more pointed the tip of the egg is. The results obtained show that the shape index of eggs from which males were obtained varied from 0.548 to 0.815, and from eggs from which hens were obtained from 0.546 to 0.749 units, respectively.

The obtained correlations show that there is a close connection between the main physical and morphological parameters of eggs and the weight of chickens. Analysis of the magnitude of the correlation coefficient between the analyzed indicators indicates that a positive and in some cases quite strong relationship was identified between the weight of the egg and indicators characterizing external parameters, as well as the weight of the chickens, which varied from 0.02 (angle of the sharp end) to 0.57 (egg volume). In this case, it should be noted that there is a negative or close to zero relationship in the following quantities: “egg mass – angle of the sharp end” - 0.02; “egg mass – egg shape index” - 0.07. Of particular interest is the magnitude of the positive correlation between the mass of the

egg and the mass of the chick (0.78) and the value of the semiminor axis (0.22), as well as between the mass of the chick and the egg shape index (0.18).

The morphometric parameters of the eggs used to evaluate them, as well as the mass of eggs and chicks, are subject to a certain variability. The greatest variability differs in such morphological characteristics as egg volume (12.2% and 6.9%), cross-sectional area, longitudinal sectional area, semi-major axis, semi-minor axis and egg shape index (from 5.4% to 9.7%) . Indicators characterizing the volume of eggs, which ultimately determine the weight of day-old chicks, varied to a much lesser extent: the length of the larger circumference (2.5% and 3.9%) and the length of the smaller circumference (2.7% and 4.8%).

4 Conclusion

Thus, in preparation for incubation, it is necessary to evaluate eggs according to a number of morphological characteristics. The most important controlled indicators are the mass and shape of the egg. The quality of eggs and the degree of their compliance with the requirements is determined by a set of characteristics and a number of indicators. Assessing egg quality is the first necessary step for successful incubation. The physical dimensions and proportions of morphological characteristics, as well as their absolute and relative magnitude, are determined by heredity and are formed under the influence of a large number of factors. The revealed correlation gives reason to believe that the analyzed indicators of egg mass and the mass of day-old chicks are largely determined by the absolute value of the external parameters of the eggs. This will make it possible to develop an algorithm for determining the weight of chickens, their viability and predicting the sex of chickens at an early stage of embryonic development.

Acknowledgement

The reported study was funded by Russian Science Foundation according to the research project No. 23-26-00184.

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