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**RESERVES FOR INCREASING THE EGG PRODUCTION OF LAYING HENS AND QUAILS**

**Abstract.** The article presents experimental data on the study of the effect of including benzoic acid in various dosages in the feed for laying hens and quails. The study investigated the impact of this factor on egg production indicators (total egg yield, number of eggs with cracks) and the survival rate of the experimental birds. The results of the experiment revealed a positive effect of dietary benzoic acid supplementation, manifested by an increase in total egg yield and a reduction in the number of cracked eggs in the test groups. A significant increase in bird survival rate was also observed in the test groups compared to the control. The obtained results demonstrate the greatest effect from the introduction of benzoic acid into the diet for laying hens at a dosage of 750 grams per ton of feed, and for laying quails at a dosage of 800 grams per ton of feed. These levels can be recommended as guidelines for poultry nutrition specialists.

**Key words.** Benzoic acid, laying hen, laying quail, production performance, egg quality.

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**ТАУЫҚ ЖӘНЕ БӨДЕНЕ ЖҰМЫРТҚАЛАРЫН ӨНДІРУДІ АРТТЫРУҒА  
АРНАЛҒАН РЕЗЕРВТЕР**

*Аңдатпа.* Мақалада тауық және бәліңкір несущкаларының азығына әртүрлі дозаларда бензой қышқылын қосу әсерін зерттеу бойынша тәжірибелік деректер келтірілген. Зерттеу барысында бұл фактордың жұмыртқа өнімділігі көрсеткіштеріне (жалпы жиын, жарығы бар жұмыртқа саны) және тәжірибелі құстардың сақталуына әсері зерттелді. Жүргізілген тәжірибе нәтижесінде азыққа бензой қышқылын қосуының оң әсері анықталды, бұл тәжірибелік топтарда жұмыртқаның жалпы жинау көрсеткішінің жоғарылауымен және жарығы бар жұмыртқа санының төмендеуімен көрінді. Сондай-ақ, тәжірибелік топтардағы құстардың сақталуының бақылау тобына қарағанда сенімді түрде артқаны байқалды. Алынған нәтижелер тауық несущкаларының рационына бензой қышқылын тонна азыққа 750 грамм дозада, ал бәліңкір несущкаларының рационына тонна азыққа 800 грамм дозада енгізудің ең жоғары тиімділігін көрсетті. Бұл деңгейлерді ауыл шаруашылық құстарын азықтандыру саласының мамандарына ұсыныс ретінде ұсынуға болады.

*Кілт сөздер.* Бензой қышқылы, жұмыртқалайтын тауық, бөдене, өндіріс өнімділігі, жұмыртқа сапасы.

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## РЕЗЕРВЫ ДЛЯ ПОВЫШЕНИЯ ПРОИЗВОДСТВА КУРИНОГО И ПЕРЕПЕЛИНОГО ЯЙЦА

**Аннотация.** В статье представлены экспериментальные данные по изучению влияния ввода бензойной кислоты в различных дозировках в корм для кур-несушек и перепелов. В ходе исследования было изучено воздействие данного фактора на показатели яичной продуктивности (валовой сбор, количество яиц с насечкой) и сохранности опытной птицы. В результате проведенного эксперимента отмечено положительное влияние ввода бензойной кислоты в корм, выраженное в повышении показателя валового сбора яиц и снижения количества яиц с насечкой в опытных группах. Также отмечается достоверное увеличение сохранности птицы в опытных группах по сравнению с контролем. Полученные результаты демонстрируют наибольший эффект от введения бензойной кислоты в рацион для кур-несушек в дозировке 750 граммов на тонну корма, в рацион для перепелов-несушек - в дозировке 800 граммов на тонну корма. Данные уровни можно предложить в качестве рекомендаций для специалистов по кормлению сельскохозяйственной птицы.

**Ключевые слова.** Бензойная кислота, курицы-несушки, перепела-несушки, продуктивность, качество яиц.

**Introduction.** In modern poultry farming, high-energy protein-rich compound feeds are widely used, which have pronounced acid-binding properties [1]. Due to this, the activation of pepsin in the stomach slows down which means that nutrients are digested worse and are not fully absorbed in the body. In this case, the feed expended is not paid for by the products [2, 3].

Formic, fumaric, sorbic, citric, lactic, and other organic acids are most often used as acidifiers. Inclusion of organic acids or their salts in feed minimizes the number of respiratory and digestive system diseases in animals and poultry and increases their productivity [4].

Benzoic acid is an organic acidifier, colorless crystalline solid, and the simplest aromatic carboxylic acid. Benzoic acid and its salts are common food preservatives and can also be used as feed supplements for some animals such as pigs. It has been reported that the addition of benzoic acid to the broiler diets could increase average daily weight gain and feed conversion efficiency of broiler chicken, although excess levels of benzoic acid can have a negative impact on performance [5].

To our knowledge, there have been no previous reports on the effect of benzoic acid on nutrient egg production and egg quality of laying hens and quails. This determined the relevance of our research.

**Aim of the study:** assessment of the effect of benzoic acid in the composition of compound feed on the collection of chickens' and quails' marketable eggs.

To achieve this goal, the following **tasks** were set:

- to study the effect of different doses of benzoic acid on the number of eggs with cracked shells;
- to identify the influence degree of benzoic acid on the livability and gross collection of eggs in experimental groups.

**Research materials and methods.** The studies were conducted in the Republic of Bashkortostan, Russia, at the experimental poultry house of the Bashkir State Agrarian University for keeping laying hens and an industrial quail farm, from February 2024 to

September 2025. The duration of the trial was 20 months. The objects of the study were laying hens of the Super Nick breed and laying quails of the Manchurian breed. For the experiments, 4 groups of 42 laying hens and 5 groups of 40 quails each were randomly selected. During the preparatory period (7 days before the start of feeding the experimental feed), all groups received the basic diet. Then, from the beginning of the accounting period until the end of the experiment, the control group in both trials continued to consume the basic compound feed, and benzoic acid was included in the diets of the experimental groups in the following doses:

- laying hens: Trial-1 – 500 g/t, Trial-2 – 750 g/t, Trial-3 – 1000 g/t;
- quails: Trial-1 – 400 g/t, Trial-2 – 600 g/t, Trial-3 – 800 g/t, Trial-4 – 1000 g/t.

All parameters of keeping and feeding the birds corresponded to the accepted industry recommendations. The records of livability and production performance were kept daily. The eggs were assessed for the presence of cracks by daily visual assessment during egg collection. The calculation of the gross collection and the output of marketable eggs was made upon completion of the trials. The obtained digital data was processed by the variation statistics method using Microsoft Office Excel. The reliability and degree of differences were assessed based on Student's criteria.

**Results and discussion.** The studies have revealed a positive effect of benzoic acid on the livability of poultry. In the first experiment, the livability rate of laying hens in Trial-2 (750 g benzoic acid per t of feed), Trial-3 (1000 g/t) was 92.9% and 95.2% respectively vs. 92.5% in the control. In the Trial-1 group, which used a benzoic acid dosage of 500 g/t of feed, no differences from the control were found. Perhaps this fact explains the insufficiency of a low dosage for significant changes in the intestinal microbiota that can affect the state and number of immune cells in the epithelium. With higher doses of the product, the architecture of the intestinal wall is presumably more favorable which contributes to the presence of a larger number of immune cells and, therefore, more effective production of immune bodies by them. It should also be noted that this experiment was conducted in the conditions of an experimental poultry house with a low concentration of birds in the house, with a minimum bacterial load. The livability rate at the level of 92.5-95.2% for experiments lasting 11 months is very high, not typical for industrial conditions.

The second experiment revealed an improvement in quail livability in all experimental groups from 80.0% to 85.0% vs. 75% in the control. The recorded mortality in the flock slightly exceeds the standard indicators which may be due to some omissions at rearing or in transferring period, but an important observation is that benzoic acid is able to control the mortality level, and this effect is dose dependent.

Gross egg collection is the main economic parameter of a poultry farm. The formation of this indicator is influenced by several factors, primarily the individual productivity of laying hens, the flock livability, the proportion of broken eggs, etc. At the same time, the number of broken eggs directly depends on the proportion of cracks. Eggs with cracks are included in the gross collection report, but identifying and accounting for this defect allows the producer to work on reducing the proportion of broken eggs and increasing the collection of marketable eggs.

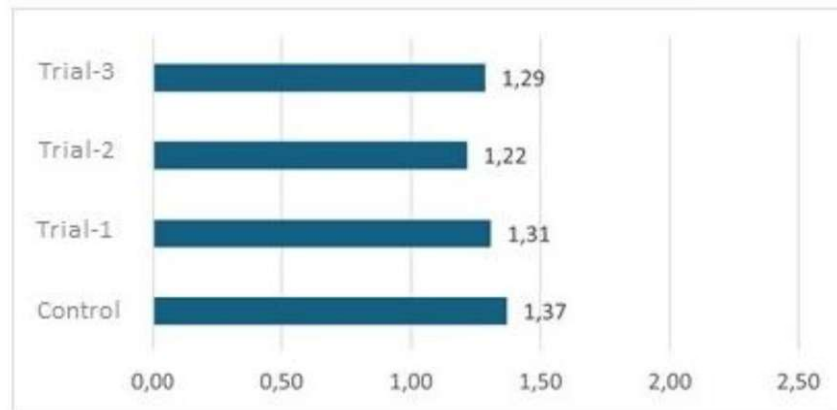


Figure 1 - The share of cracked laying hens' eggs in the total collection, %

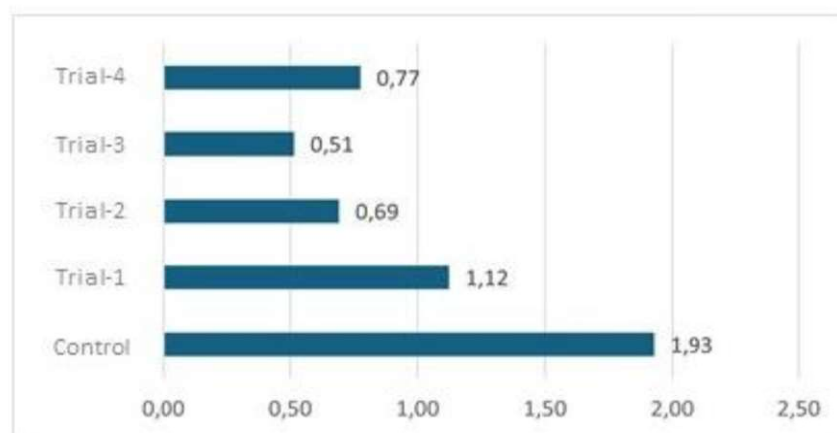


Figure 2 - The share of cracked quails' eggs in the total collection, %

In all groups with benzoic acid, positive dynamics were noted, and in the experiment on quails the effect was more pronounced than on chickens: in the best group, where quails received 750 g/t of benzoic acid with feed (Trial-3), the crack decreased by 3.7 times - 0.51% against 1.93% in control. It should be said that in general, the shell of quail eggs has a fairly low strength and thickness, looser in structure, which is an indicator of low shell calcification probably due to the species characteristics of quail. In the experiment on laying hens, dynamics for improvement are also noted, although not as pronounced as on quails. Thus, the introduction of benzoic acid into the diet of chickens contributed to a decrease in cracks from 1.37% (Control) to 1.22% (Trial-2). The higher quality of the chicken eggshell compared to quails can be explained by the greater selection work on the thickness and strength of the shell conducted for many years by producers of laying hens.

The data on the gross egg collection for the two experiments are shown in Figures 3 and 4.



Figure 3 - Gross collection of laying hens' eggs during the experimental period, pcs.

The experimental groups of laying hens yielded 340-532 more eggs, the best result was noted in the Trial-2 group (12570 eggs, which is 4.4% higher than the control,  $p < 0.01$ ), in the feeding of which benzoic acid was included in the diet in the amount of 750 g/t. The gross collection is a fairly subjective indicator since its calculation is affected by a number of factors including the livability. The dates of mortality are of significant importance - the earlier the bird dies, the lower the gross collection for the flock. And vice versa, even with the same level of mortality and production performance in two groups, the gross collection will be higher where the mortality occurred at the end of the accounting period. The marketable egg indicator is more economically meaningful, in the calculation of which, in addition to the above-mentioned indices, the percentage of egg breakage is also involved. Thus, in the experiment on hens in control group 12,028 commercial eggs were obtained, in the Trial-1 group by 2.85% more (12,371 pcs) ( $p < 0.01$ ), in Trial-2 - by 4.44% (12,562 pcs) ( $p < 0.01$ ), and Trial-3 - by 3.31% (12,426 pcs), ( $p < 0.01$ ). Thus, in the sum of the indicators, the use of benzoic acid in feeding laying hens at a dosage of 750 g/t gives the maximum effect. When exceeding this dosage, the additional benefit was not noted.



Figure 4 - Gross collection of quail eggs during the experimental period, pcs.

In the experiment on egg-laying quails, the highest egg collection was recorded in the Trial-3 group when using benzoic acid in the amount of 800 g/t, which is 23.47% more than the control ( $p < 0.01$ ). It should be noted that in Trial-1 with the minimum dosage of benzoic acid (400 g/t), the increase in the studied indicator was also significantly higher than the control (+13.13%,  $p < 0.01$ ). The collection of marketable eggs in the experimental groups exceeded the control indicator by 14.06-25.25% with the best index in Trial-3 (+1092 pcs or +25.25%,  $p < 0.01$ ).

**Conclusion.** As a result of the trials, a positive effect of using benzoic acid in feeding laying hens and laying quails on production performance and the collection of marketable eggs was established. Optimal levels of benzoic acid dosage for inclusion in the diet of laying hens are 750 g/t for hens and 800 g/t for quails.

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