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Egg Productivity in the Quails Fed on the Extract of Calendula Officinalis

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Abstract*: *In the last decades, in the majority of the developed countries of the world, one of the trends in obtaining food products, including those of animal origin, has been obtaining organic products that do not contain artificial ingredients: antibiotics, growth promoters, GMOs, or any other biologically active substances of other than the natural origin. Currently, phytobiotics, i.e., active components of various plants are successfully used as their substitutes for preserving the health of animals and poultry, and for improving their productivity. The authors have studied the effect of the extract of Calendula Officinalis obtained at the Agroecology scientific laboratory of the Kemerovo SAI using the method of water-ethanol extraction followed by low temperature drying on the egg productivity of Manchurian quails. It has been found that out of the three dosages of the preparation used in the experiment (800 mg, 1,600 mg and 2,400 mg per 1 kg of feed) the maximum positive effect on the studied parameters (egg production, morphological and chemical composition of eggs, feed used for the production of 10 eggs, poultry preservation rate) was observed for the dosage of Calendula Officinalis being equal to 800 mg/kg of feed.

Keywords*: *quails, extract of Calendula Officinalis, egg production.

I. INTRODUCTION

Currently, in Russia and abroad, the demand for organic food products produced without the use of feed antibiotics, hormonal growth promoters, and synthetic amino acids for rearing agricultural animals and poultry is growing. In this regard, the use of feed additives that improve the quality of the products of livestock breeding, poultry breeding and are not harmful to human health is of great practical interest for both agricultural producers and consumers.

Over many years, the main methods of monitoring the intestinal microbiota in animals and poultry have been fodder antibiotics and antibacterial preparations, which inhibit the microflora of the gastrointestinal tract, weaken the immune system, make pathogens mutate, and develop their resistance to certain antibiotics. With that, certain amounts of the preparations get accumulated in the food products, presenting a danger to humans. Such negative aspects of using chemical preparations have already caused the prohibition of the use of some of them in Western Europe.

In the search for alternatives to the traditional chemicals, including feed antibiotics, a new generation of preparation based on phytobiotic medicinal plants has been developed and successfully used [1].

This paper presents the results of determining the efficiency of using various dosages of the extract of Calendula Officinalis in feeding egg-producing quails.

Calendula officinalis or pot marigold (Caléndula officinális) has anti-inflammatory, antiseptic, and bile-expelling action. The phytoncidal properties are determined by the essential oil of the plant. Calendula flowers have antispasmodic properties. Considerable content of carotenoids, flavonoids, ascorbic acid, and organic acids in the flowers contributes to capillary-strengthening action, improves the metabolic functions of the liver, which in turn improves the composition of bile, decreases the concentration of bilirubin and cholesterol in it, and increases the secretory and excretory functions of the stomach and the intestines.

Rutin in pot marigold promotes rapid suppression of the inflammatory processes, activates the processes of tissues regeneration, and has an antioxidant effect. Chlorogenic acid in pot marigold has anti-oxidant, hypoglycemic, hypocholesterolemic, hepatoprotective action, which helps improve digestibility and absorption of feed nutrients and compensate for the lack of vitamins.

The issue of the effect of phytobiotics on the egg productivity of quails, in particular, and on the quality of their eggs is of particular interest. For instance, Japanese quails that received Aloe vera at the dosage of 100 ml per liter of water showed an increased egg productivity and increased diameter of egg white, compared to the poultry in the reference group [2].

In the experiment for determining the effect of the extract of marigold flowers (Tagetes erecta) as a feed additive on Japanese quail egg productivity and quality, it was found that the dosage of the extract equal to 15 g/ton of the feed increased the productivity, improved the quality of the eggs, reduced the level of cholesterol in the eggs, and increased the egg yolk color intensity [3].

After the ethanol extract from the leaves of Aspilia Africana had been introduced into the diet of Japanese quails, egg productivity, the weight of egg white and yolk, eggshell thickness significantly increased, and yolk color improved. To improve the characteristics of carcasses and the eggs, the authors recommend introducing into the diet up to 7.5 % of Aspilia Africana leaf extract [4].

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The research [5] showed that the extract of turmeric (Curcuma domestica, Val) in the dosage of 20 mg per one liter of drinking water had increased egg productivity and egg quality in quails.

Introduction of cinnamon oil into the diet of quails has a positive effect on egg productivity and shell quality [6].

Currently, available information resources provide no data about the use of preparations based on extracts of Calendula Officinalis obtained by water-ethanol extraction followed by low-temperature vacuum drying in poultry breeding.

The study was aimed at finding the effect of feeding various dosages of the extract of calendula Officinalis to quails on their egg productivity.

II. METHODS

A General description

The experimental studies were performed with Manchurian female quails at the age of 120 days. Using the method of analogous groups in accordance with the provisions of the "Methodology of Scientific and Industrial Research for Feeding Poultry. Recommendations", a reference and three experimental groups were formed, 20 quails in each [7]. Quails in all groups were kept in battery cages in identical conditions, in compliance with the zoohygienic norms.

B Algorithm

The reference and experimental quails received the same diet that was balanced in nutrients, vitamins, macro- and micronutrients. The daily feeding norm per one quail was 35 g; feeding was performed four times. With that, the vitamin-mineral premix (standard intake of 10 kg per 1 ton of feed) in the main diet contained additives of organic forms of selenium and iodine, containing selenomethionine, selenocystine, and iodinated casein at the dosages of 125 and 62.5 mg/kg of feed, respectively, as active ingredients. These doses had been proven to be the best in the previous studies [8]. The duration of the experiment was 127 days.

The quails in the experimental groups, together with the basic diet, additionally received the extract of Calendula Officinalis (Caléndula officinális) in the following dosages per one kg of the feed: the first — 800 mg, the second experimental — 1,600 mg, and the third experimental — 2,400 mg.

The extract of Calendula Officinalis obtained at the Agroecologia laboratory of the Kemerovo SAI using the method of water-ethanol extraction followed by low-temperature drying contains biologically active substances (coumarins, triterpenoids, flavonoids, chlorogenic acid, caffeic acid, carotenoids, ascorbic acid) in the amounts corresponding to requirements of normative documents [9, 10]. The dosages of the extract for feeding quails were calculated by the main biologically active substances in accordance with the recommendations of V. A. Tutelian et al. [11].

For studying egg productivity of the experimental quails, egg productivity of housed and average hens, the intensity of egg-laying, and the feed used per 10 eggs were considered according to the standard methods [5].

To characterize the quality of the eggs, their main morphological indicators were identified for five consecutive days.

The chemical composition of the eggs was studied at the Agroecologia laboratory of the FSBEI HE Kemerovo SAI according to GOST 30364.1-97 Egg products. Physical and chemical testing methods.

The quails' preservation rate was calculated in percent from the initial population.

The figures were processed biometrically in Microsoft Excel, and the veracity of the difference between the reference and the experimental groups was determined using the Student's t-test of statistical significance.

III. RESULTS

The data about productive qualities and preservation rate of egg-producing quails obtained during the experiment are shown in Table 1.

Table 1. Productive qualities and preservation rate of egg-producing quails

Characteristic	Group			
	Reference	First experimental	Second experimental	Third experimental
Egg productivity per housed hen, pcs	90.8	106.7	83.4	99.2
Egg productivity per average hen, pcs	91.2	106.7	86.5	99.7
Egg-laying intensity, %	71.8	84.0	68.1	78.5
Feed used per 10 eggs, g	350	297	380	320
Preservation rate, %	85.0	100.0	75.0	95.0

The results of the research showed that egg productivity per average hen in the first and the third experimental groups was higher than 17.0 % and 9.3 %, respectively, compared to the quails in the reference group. A decrease in egg productivity was observed in the quails in the second experimental group — by 5.1 %, compared to the reference. A similar trend was also found in the egg-laying intensity — by 12.2 %, 6.7 %, and 3.7 %, respectively.

The feed used per 10 eggs decreased in the quails in the first and the third experimental groups — by 15.1 and 8.6 %, respectively, compared to the reference.

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The highest preservation rate of quails was observed in the first and the third experimental groups — 100 % and 95 %, which was higher than in the reference group by 15.0 and 10.0 %, respectively.

The results of studying the morphological composition of quail eggs upon feeding the extract of Calendula Officinalis to the quails are shown in Table 2.

Table 2. The morphological composition of quail eggs

Characteristic	Group			
	Reference	First experimental	Second experimental	Third experimental
Egg weight, g	12.17 ± 0.30	11.90 ± 0.50	11.81 ± 0.39	12.54 ± 0.24
Shape index, %	77.32 ± 0.47	79.38 ± 1.99	84.40 ± 4.53	83.61 ± 4.87
Egg white index, %	3.77 ± 0.54	5.76 ± 0.69*	5.27 ± 0.50	4.83 ± 0.43
Yolk index, %	42.80 ± 5.86	38.28 ± 2.52	38.70 ± 4.91	42.49 ± 1.06
Relative content, %: egg white	50.70 ± 1.06	50.12 ± 1.93	47.14 ± 1.64	54.57 ± 0.63*
yolk	34.74 ± 0.70	35.50 ± 2.30	34.27 ± 1.11	31.52 ± 0.66*
shell	14.48 ± 0.86	15.04 ± 0.94	16.71 ± 1.27	13.68 ± 0.41

Analysis of the morphological composition of eggs showed that the egg weight was the highest in the third experimental group, and exceeded the reference by 3.0 %.

An increased shape index of the eggs obtained from quails in the experimental group was noted. The highest values were noted in the second experimental group — 84.4 %, which was higher than in the reference by 7.1 %.

The index of white in the eggs of the quails from the first experimental group significantly increased by 6.3 % ($P < 0.05$) compared to the reference.

The yolk index decreased in all experimental groups. The minimum values were noted in the first experimental group — 38.28 %, which was by 4.5 % below the reference data.

In the eggs of the quails from the third experimental group, a significant increase in relative protein content (by 3.9 %) ($P < 0.05$) and a decrease in the content of yolk (by 3.2 %) ($P < 0.05$) were noted, compared to the reference quails.

The chemical composition of the eggs of the quails fed on the extract of Calendula Officinalis is shown in Figures 1 – 4.

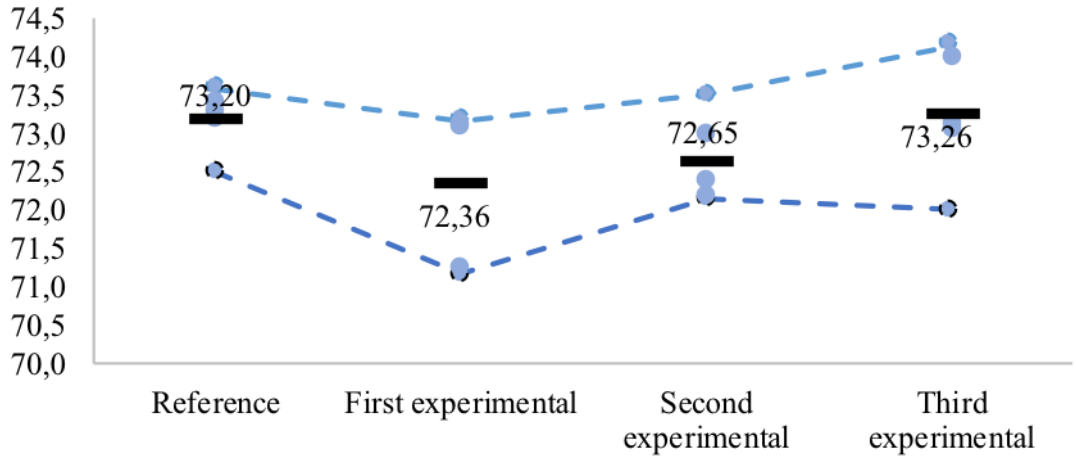

Fig. 1. Moisture content in the eggs of the egg-laying quails that received various dosages of the extract of Calendula Officinalis, %

Egg Productivity in the Quails Fed on the Extract of Calendula Officinalis

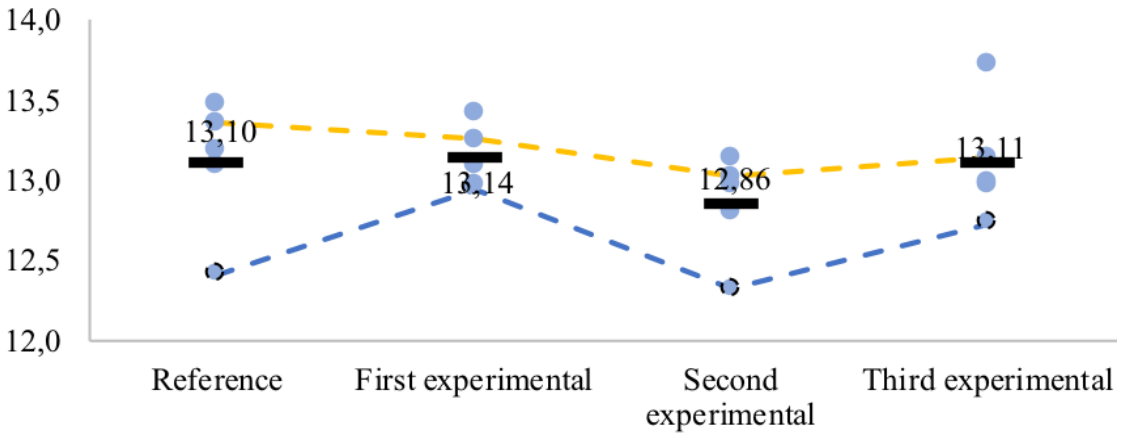

Fig. 2. Egg white content in the eggs of the egg-laying quails that received various dosages of the extract of Calendula Officinalis, %

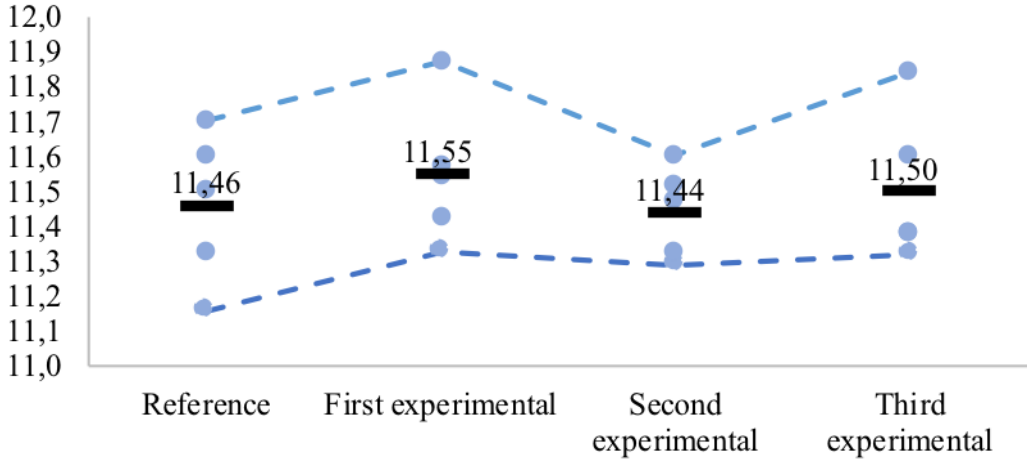

Fig. 3. Fat content in the eggs of the egg-laying quails that received various dosages of the extract of Calendula Officinalis,%

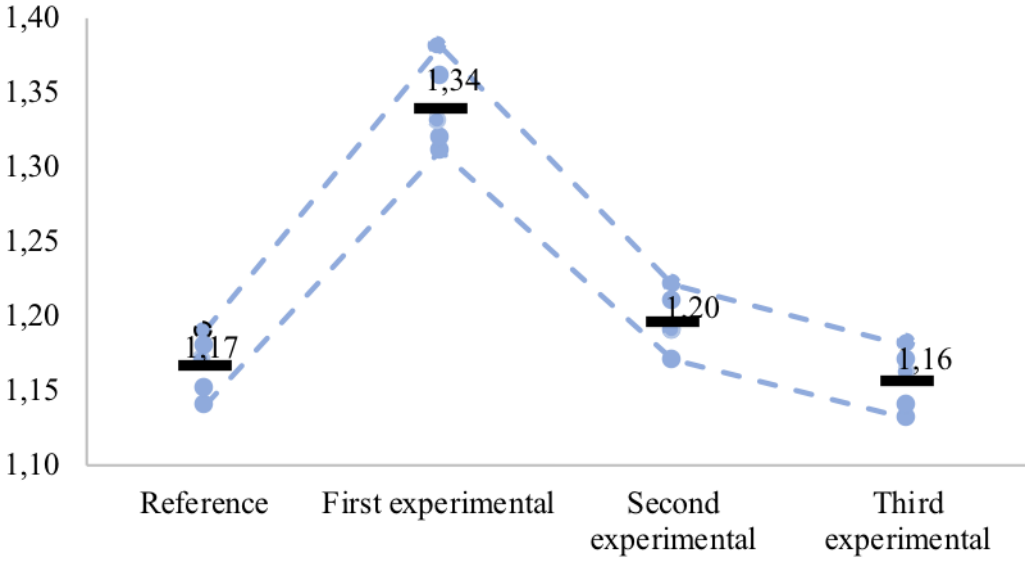

Fig. 4. Ash content in the eggs of the egg-laying quails that received various dosages of the extract of Calendula Officinalis,%

Chemical analysis of the eggs showed that by the amount of water and lipids in the quail eggs, no significant differences had been found between the experimental groups. High level of protein content was found in the eggs of the quails in the first experimental group, which was by 0.04 % higher than that in the reference. Ash content of the eggs of the quails in the first and the second experimental groups exceeded that in the reference group by 0.17 % ($P < 0.001$) and 0.03 %, respectively.

The obtained results are largely consistent with the results of the authors who studied the effect of introducing flour from the leaves of *Moringa oleifera* on the growth and the egg productivity of quails. They found that the efficiency of introducing *M. oleifera* into the diet of quails depended on concentration: moderate concentration (10 g/t) showed better results than the high concentration (20 g/t) [12].

IV. CONCLUSION

1. The results of the research have shown the increased, compared to the reference, egg productivity and preservation rate of the quails that received the composition of the extract of Calendula Officinalis along with the main diet at the dosages of 800 mg and 2,400 mg per kg of the feed. The egg productivity per average egg-laying quail in the first and the third experimental groups was higher by 17.0 and 9.3 %, the egg-laying intensity — higher by 12.2 – 6.7 %, and the preservation rate — higher by 15.0 – 10.0 %. The feed used for producing 10 eggs decreased by 8.6 – 15.1 %, compared to the reference group.

2. In the experiment, the introduction of the extract of Calendula Officinalis into the diet of egg-laying quails in the dosages of 800 mg per kg of the feed resulted in a significant increase in ash content — by 0.17 % ($P < 0.001$), compared to the reference group.

3. In feeding the egg-laying quails, it is advisable to use the extract of Calendula Officinalis obtained by water-ethanol extraction followed by low-temperature drying at the dosage of 800 mg per kg of the feed.

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