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Effect of the Cresacin Feed Additive on the Digestibility of Nutrients, Productivity and Egg Quality in Egg Laying Quails

Djunaydi Gayirbegov and Gayaz Engurazov

N.P. Ogaryov National Research Mordovian State University, Saransk, Russia

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Corresponding Author:
Djunaydi Gayirbegov
N.P. Ogaryov National Research Mordovian State University, Saransk, Russia
Email: gajirbegov55@mail.ru

Abstract: The purpose of the article was to study the effect of the Cresacin feed additive on the digestibility and use of nutrients in the diet of egg laying quails, as well as their egg productivity and quality. The experiment was carried out on 600 heads of one-day-old quails of the Estonian breed, which were divided into four similar groups of 150 heads each. The optimization of this additive in the diets of the quails improved the digestibility of dry and organic substances compared to the birds from the control group by 2.25 and 2.16%, crude protein by 3.38%, crude fat by 2.67%, crude fiber by 2.76% and nitrogen free extractive substances by 1.16%. The optimization of the amount of this additive in the compound feed for egg laying quails in the second experimental group also increased the use coefficient of nitrogen, calcium, and phosphorus in their diet. It improved growth energy, egg productivity, and egg quality compared to the control group. To improve the quality of feeding quails, increase their productivity and normalize metabolic processes in the body, the authors recommend introducing Cresacin into their diet in the amount of 50 mg/100 g of compound feed.

Keywords: Egg Laying Quails, Additive, Digestibility, Live Weight, Egg Productivity

Introduction

An important factor in improving any breed of poultry and increasing their productivity is their feeding (Dei, 2021; Tallentire *et al*., 2016). Numerous studies (Gayirbegov *et al*., 2017; Smolovskaya *et al*., 2023) and practices show that the productivity, growth, and development of poultry, including quails, are largely determined by feeding conditions. When feeding quails, it is of great importance to enrich their diets with various feed additives of Russian and foreign production (Yurina *et al*., 2021; Arif *et al*., 2022). Thus, research (Gayirbegov *et al*., 2018; Bagno *et al*., 2019) has found that optimization of the composition of quail feed additives such as M-feed and *Calendula officinalis* extract improves metabolism and egg productivity. However, most of the feed additives used for quails are ineffective and expensive, which leads to an increase in the cost of production.

Therefore, in recent years, Russia has been constantly working on testing cheaper and more affordable feed additives that have specific properties and a positive effect on the birds' bodies (Gayirbegov *et al*., 2018; Bagno *et al*., 2019). One such additive is Cresacin, which was developed by the staff of the Moscow state research institute of chemistry and technology of organ element compounds and the Irkutsk institute of chemistry working under academician. According to Voronkov and Baryshok (2005), the preparation has low-toxic properties, is intended to increase the productivity and general resistance of poultry, and is presented in the form of a white crystalline powder with a cream or yellowish tinge and tablets of gray white with a yellowish tinge. The preparation is well soluble in water and alcohol.

According to IIC (2023), this preparation is a tonic and has a stimulating effect on the animal's body. Under its influence, the animals' reproductive functions are enhanced, and their livability increases, even with insufficient nutrition and deterioration of temperature parameters, as well as during oxygen deficit and pollution of the habitat. It does not accumulate in the body and is harmless to humans and animals. Cresacin is similar in its properties to silicon containing physiologically active substances, silatranes, as the triethanolammonium cation of Cresacin has a protatran structure (Voronkov and Baryshok, 2005).

Despite a large number of studies on the metabolism in poultry and the great practical and theoretical interest of this issue, the digestibility of nutrients in the diet of egg laying quails with the action of feed additives and their effect

on the productive indicators of birds still needs to be explored. Therefore, the clarification of this problem is a relevant task of the zootechnical science of poultry feeding. In this regard, for the first time, we conducted research on the effect of different dosages of Cresacin as part of the feed for Estonian quail breeds on the digestibility and use of dietary nutrients, egg productivity, and egg quality.

The purpose was to study the effect of Cresacin on the digestibility and use of nutrients in the diet of egg laying quails and their egg productivity and quality.

Materials and Methods

All research methodology and materials were discussed and approved at a meeting of the department of animal science of the national research Mordovian state university named after N.P. Ogaryov (minutes No. 9 dated September 22, 2022).

The experiment was conducted at a private farm belonging to A.A. Kulagin in the Republic of Mordovia (Russia). The morphological indicators of egg quality were determined in the atemarskaya poultry farm JSC laboratory in Mordovia.

In the experiment, we used 600 heads of one-day-old quails of the Estonian breed, which were divided into four similar groups of 150 heads each.

All zoo hygienic parameters of the microclimate in the room where the study was conducted, the light regime, and feeding and drinking conditions corresponded to the recommended standards. The experimental quails were kept in six-tiered cages of the KMP-6-300 type (Russia).

The diet of quails of the control group up to the age of 28 days consisted of complete starter compound feeds, starter 1 and starter 2 (Purina, US). From 28 days to the end of the experiment, we used the final (finish) compound feed. The composition of the starter 1 and 2 compound feeds included: Wheat, soybean meal, corn meal, corn gluten, vegetable oil, sunflower meal, skimmed milk substitute, corn bard, table salt, limestone, and premix.

The diet of quails in the control group included compound feed without the addition of Cresacin. The compound feed of egg laying quails from the first experimental group was additionally enriched with this additive, at the rate of 25 mg/100 g of compound feed. The second and third groups received 50 and 75 mg/100 g of compound feed, respectively. The number of experimental groups and doses of the studied additive in this experiment were determined based on the results of our earlier predictive experiment.

On the 140^{th}-150^{th} days of the experiment, to study the effect of different levels of Cresacin on the digestibility of nutrients in the diet, against the background of the scientific and economic experiment, a physiological (balance) experiment was conducted. It consisted of a preliminary (5 days) and an accounting (5 days) period. For this experiment, three quails were selected from each group, to be kept in individual cages adapted for the accounting for the feed consumed and the excreted litter.

To identify the indicator of egg productivity from each group, 40 quails were taken under observation. Egg production was accounted for by daily collection from each group of quails starting from the age of 40 days for 259 days of egg laying. During the experiment to study the effect of this additive on the morphological indicators of egg quality, five eggs were taken from each group.

Biometric processing of the received digital material was carried out on a computer using the Statistica 10.0 software, version 2.6, according to the method proposed by Merkurieva (1970).

Results

The data obtained in our studies on the digestion of nutrients in the diet of egg laying quails of the Estonian breed show that it changes significantly under the influence of Cresacin (Table 1). Thus, this additive included in the amount of 50 mg/100 g of compound feed in the diets of quails contributes to better absorption and digestion of nutrients in the diet. Deviation from this amount to a greater or lesser extent leads to a decrease in these indicators. Dry and organic substances in the control egg-laying quails that did not receive Cresacin were digested by 2.25 and 2.16% less ($p<0.05$), crude protein by 3.38% less, crude fat by 2.67% ($p<0.001$) less, crude fiber by 2.76% ($p<0.05$) less and Nitrogen Free Extractive Substances (NFES) by 1.16% ($p<0.05$) less than in the birds from the second experimental group who received the optimal amount of Cresacin. On the contrary, with a high level of Cresacin in the diet of quails of the third group (75 mg/100 g of compound feed), the digestibility of all nutrients (dry and organic substances) decreased by 1.25 and 1.12% ($p<0.05$), crude protein by 1.35%, crude fat by 1.72%, crude fiber by 1.79% ($p<0.05$) and NFES by 0.265% ($p>0.05$).

With a low level of Cresacin in the diets of egg laying quails of the first experimental group, this decrease was more significant than with its optimal and high content in the compound feed. Compared with the second group, which received an additive in the amount of 50 mg/100 g of feed, this difference for dry and organic matter equaled 1.43 and 1.24% ($p<0.05$), for crude protein 2.60%, for crude fat 2.035% ($p<0.05$), for crude fiber 2.38% ($p<0.001$) and for nitrogen-free extractives 0.26% ($p>0.05$).

Optimization of the amount of Cresacin in the compound feed of egg laying quails of the second experimental group in the amount of 50 mg/100 g also increased the nitrogen absorption coefficient in their diet (Table 2).

Thus, in comparison with the control and the first experimental groups, the excess equaled 3.4 and 2.59% ($p<0.05$), and with the third group 1.38% ($p>0.05$). With the high content of this additive in the compound feed of

egg-laying quails from the third group, the coefficient of absorption of this element was also higher compared to the control group by 2% ($p<0.05$) and compared to the first group by 1.2% ($p>0.05$).

The study of the effect of various dosages of Cresacin on the use of calcium showed that quails from the second group, who received the optimal amount of this supplement, deposited 245 mg of calcium in the body per day (Table 3). As for the birds from the control group who did not receive the feed additive in question, 63 mg or 34.6% less calcium was retained in their body compared to the second experimental group ($p<0.05$).

As for the birds from the first and third experimental groups who received a reduced and increased amount of the studied supplement, the retention of this element in their body compared to the second experimental group was lower by 60 mg or 32.4% ($p>0.05$) and by 55 mg or 28.9% ($p<0.05$).

The amount of use of calcium in the diets of egg-laying quails also varied. Thus, the greatest degree of retention of this macronutrient from the diets was observed in egg laying quails of the second experimental group and amounted to 55.55% of the amount taken with mixed feed.

Calcium excretion through the digestive tract amounted to 44.44-58.704% of the intake. The largest amount of it was excreted in the droppings of quails of the control (259 mg) and the first (0.256 mg) experimental groups.

The use of phosphorus in the diet by egg laying quails from the amount of phosphorus taken with mixed feed under the influence of the studied feed additive in birds of all groups occurs less significantly than the use of calcium. Stronger retention of this element, as well as calcium, was observed in quails of the second experimental group who received an additive of Cresacin in the amount of 50 mg/100 g of compound feed (Table 4). Thus, the phosphorus use rate in the second experimental group was 23.53% higher than the control group ($p<0.05$), 21.56% higher than in the first group, and 16.99% ($p<0.01$) higher than in the third experimental group ($p<0.01$).

Table 1: The effect of Cresacin on the digestibility of nutrients in the diet, %

	Groups			
Nutrients	Control	1st experimental	2nd experimental	3rd experimental
Dry	63.50±0.20	64.32±0.24	65.75±0.31	64.50±0.32
Organic	64.86±0.14	65.78±0.27	67.02±0.12	65.90±0.20
Crude protein	43.02±0.32	43.80±0.56	46.40±0.30	45.05±0.36
Crude fat	52.20±0.40	52.84±0.27	54.87±0.16	53.15±0.20
Crude fiber	18.10±0.17	18.48±0.21	20.86±0.09	19.07±0.15
NFES	81.64±0.18	82.54±0.20	82.80±0.33	81.92±0.43

Table 2: The effect of Cresacin on nitrogen absorption in the diet of egg-laying quails, g

	Groups			
Indicators	Control	1st experimental	2nd experimental	3rd experimental
Consumed by the quails	0.5440±0.0000	0.5440±0.0000	0.5440±0.0000	0.5440±0.0000
Excreted with droppings	0.3091±0.0200	0.3053±0.0300	0.2912±0.0200	0.2987±0.0100
Absorbed by the body	0.2343±0.0100	0.2387±0.0300	0.2528±0.0100	0.2453±0.0200
Absorption coefficient	43.0700±000.32	43.8800±000.56	46.4700±000.56	45.0900±000.36

Table 3: The effect of Cresacin on the use of calcium in the diet of egg-laying quails, g

	Groups			
Indicators	Control	1st experimental	2nd experimental	3rd experimental
Taken with food and water	0.441±0.00	0.441±0.00	0.441±0.00	0.441±0.00
Excreted with droppings	0.259±0.02	0.256±0.02	0.196±0.02	0.251±0.01
Retained in the body	0.182±0.01	0.185±0.02	0.245±0.01	0.190±0.01
Use coefficient	41.270±0.52	41.950±0.59	55.550±0.53	43.080±0.22

Table 4: The effect of Cresacin on the use of phosphorus in the diet of egg-laying quails, g

	Groups			
Indicators	Control	1st experimental	2nd experimental	3rd experimental
Taken with food and water	0.204±0.00	0.204±0.00	0.204±0.00	0.204±0.00
Excreted with droppings	0.153±0.01	0.148±0.04	0.105±0.04	0.139±0.02
Retained in the body	0.051±0.01	0.055±0.01	0.099±0.01	0.064±0.02
Use coefficient	25.160±0.65	27.120±2.28	48.690±1.99	31.700±1.14

Optimization of the amount of Cresacin in the compound feed of egg-laying quails of the second experimental group in the amount of 50 mg/100 g also increased egg productivity. The results of taking into account the egg productivity of egg-laying quails showed that Cresacin in the compound feed in the amount of 50/100 g had a significant effect on egg production, which in the control and third experimental groups began on the 43rd day of the quail's life and the first and second groups on the 41st and 40th days (Table 5).

Out of 259 days of observations, the age of reaching 50% egg production of quails in the control and third experimental groups was on the 46th to 47th day. The quails of the first (41st day) and second experimental groups (40th day) achieved 50% egg production earlier, which was 1 week earlier than the birds from the control group. During the 259 days, 9,393 eggs were obtained from egg-laying quails of the second experimental group, i.e., 540 eggs more than in the control group, 161 eggs more than in the first experimental group, and 498 eggs more than in the third experimental group.

Optimization of the amount of Cresacin in the compound feed also contributed to an increase in egg production compared to the control group and counted for the egg laying quail housed. In the second experimental group, 6.3% or 14 more eggs were obtained for the egg-laying quail housed compared to the control group, 1.7% or 4 more eggs compared to the birds from the first experimental group, and 5.8% or 13 eggs from the third experimental group. In all the observed groups, 100% of quails were livable.

To evaluate the egg, first of all, the weight of the egg was taken into account, which in egg production is considered the main indicator affecting its market value and nutritional level (Réhault-Godbert *et al*., 2019). The results of the assessment of morphological indicators of egg quality are presented in Table 6.

Table 5: Egg productivity of egg-laying quails for 259 days of egg production

	Groups			
Indicators	Control	1st experimental	2nd experimental	3rd experimental
Number of heads taken under observation	40	40.0	40.0	40.0
Age of laying the first egg, days	43	41.0	40.0	43.0
Age of reaching 50% egg production, days	47	45.0	44.0	46.0
Total eggs received, pcs	8,853	9,232.0	9,393.0	8,895.0
Received eggs for the egg-laying quail housed, pcs	221	231.0	235.0	222.0
± Compared to the control group, pcs	-	+379.0	+540.0	+42.0
% Compared to the control group	100	104.3	106.0	100.5
Livability, %	100	100.0	100.0	100.0

Table 6: Morphological indicators of egg quality

	Groups			
Indicators	Control	1st experimental	2nd experimental	3rd experimental
Egg weight, g	11.200±00.280	11.70±00.230	12.89±00.320	11.37±00.170
Egg white weight, g	7.050±00.040	7.34±00.070	7.78±00.180	7.12±00.180
Yolk weight, g	3.290±00.110	3.47±00.040	3.96±00.030	3.47±00.080
Shell weight, g	0.860±00.200	0.89±00.210	1.15±00.220	0.78±00.190
Shell thickness, mm	0.168±0.0100	0.174±0.020	0.20±00.030	0.170±0.010
Egg density, g/cm^3	1.058±0.0010	1.061±0.001	1.062±0.001	1.058±0.001
Carotenoids, mcg/g	13.000±00.130	13.40±00.190	14.70±00.250	12.80±00.220

The conducted studies have shown that the weight of quail eggs of the experimental groups slightly exceeds the weight of control eggs. Thus, the difference in this indicator between the control and the first experimental groups was 0.5 g ($p>0.05$), the control and second experimental groups 1.69 g ($p<0.05$), and the control and third experimental groups 0.17 g ($p>0.05$). At the same time, the egg white weight in the first experimental group increased by 0.29 g ($p<0.05$) compared to the control group, in the second one by 0.73 g ($p<0.05$) and in the third experimental group only by 0.07 g ($p>0.05$). As for the other experimental groups, the egg white weight of quails from the first experimental group was also higher than that of the birds from the control group by 0.29 g and then from the third experimental group by 0.22 g. As the weight of the egg increases in the second experimental group due to the use of Cresacin, there is an increase in the weight of the yolk and shell. Thus, in comparison with the control eggs, the yolk weight was higher by 0.67 g ($p<0.05$) and the shell weight by 0.29 g ($p>0.05$), compared with the first group the difference equaled 0.47 g ($p<0.001$) and 0.26 g ($p>0.05$) and with the third experimental group, it amounted to 0.49 g ($p<0.05$) and 0.37 g ($p>0.05$), respectively.

In our studies, the egg density in all experimental groups was approximately the same **(**1.058-1.062 g/cm^3).

Discussion

In general, the obtained results showed that the addition of Cresacin to the feed composition in the optimal dosage (50 mg/100 g) has a significant effect.

The carotenoid content in the egg is also essential for the quality of the egg, as carotenoids play an important role in the metabolism of the developing embryo (Nabi *et al*., 2020; Kljak *et al*., 2021). The results of our studies showed that the content of carotenoids in the egg of control quails who did not receive Cresacin was 13.00 mcg/g, which is 3.0% less than in the eggs from the first experimental group ($p>0.05$), 11.6% ($p>0.01$) less than in the second group and 1.5% more than in the eggs of the third experimental group ($p>0.05$).

The positive effect of optimal amounts of feed additives on the digestibility of nutrients and the productivity of poultry is also confirmed by the studies of Santoso and Setiadi (2016); Setiadi *et al*. (2016); Santoso *et al*. (2017).

Conclusion

Based on the results obtained, it can be concluded that feeding quails with Cresacin in the amount of 50 mg/100 g of compound feed have a significant effect on the metabolism and productivity of egg laying quails of the Estonian breed.

Therefore, to normalize metabolic processes in the body of laying quails, we recommend introducing Cresacin into their diet in the amount of 50 mg/100 g of compound feed.

It is not recommended to use this additive in dosages below and above 50 mg/100 g of compound feed, as they do not significantly improve the metabolic processes in the body of quails and do not increase their productive performance.

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Author's Contributions

All authors equally contributed to this study.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues are involved.

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