Assessment of the impact of new complex feed additives in the production of rabbit meat

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Abstract. Currently, there are a number of feed components that stimulate productivity, growth of animals and poultry. One of them is preparations of antioxidant action on the animal body, which have a positive effect on strengthening the immune system and increasing productivity. In this work, data are presented on the comparative effectiveness of feed additives of various nature: bioflavonoids, polysaccharides, organic acids and protein-carbohydrate complexes in the diets of young rabbits. In the animals of the experimental groups that received bioactive substances as part of the diets, positive dynamics was observed in terms of growth as well as immune status. The greatest effect on the formation of the productive qualities of young rabbits was exerted by the using of the additives Dihydroquercetin + Gimalask, the synergistic effect of which was manifested in the activation of metabolic processes in the body of growing animals.

1. Introduction

Currently, rabbit breeding is a promising direction in animal husbandry, it has several advantages, for example, rabbits have high meat productivity due to high early maturity, increased fertility and a high percentage of muscle tissue output. The rabbit carcass contains less bones and cartilage – 12-16% compared with this indicator in cattle – 20-25%, while the share of edible parts is 84-88%, while in cattle – 57 -62% [1, 2].

Rabbit breeding is an important livestock sector, contributing not only to the development of the food program, but also to providing the population with dietary products. Its relevance is increasing due to import substitution. The market for rabbit products in Russia is in the process of formation; Rabbits are engaged in large-scale industrial breeding and processing in the Urals, Novosibirsk, Tyumen, Murmansk regions, the Republic of Mari El, etc. Relatively recently, much attention has been paid to rabbit breeding in the southern regions of Russia, where it is replacing pig breeding in subsidiary and farms, after the outbreak African swine fever [3].

One of the ways to increase the efficiency and profitability of rabbit meat production is to use new feed additives, which allow to obtain a significant increase in live weight, reduce costs associated with premature culling and mortality of animals, without the use of labor-intensive methods and technological solutions [4, 5].

However, various feed additives with antibiotics are still widely used for feeding rabbits. It should be noted that at present, natural feed additives are used both in rabbit breeding and in other branches of animal husbandry, since many consumers are wary of consuming products obtained using antibiotics or synthetic feed additives. In recent years, scientists have found the use of antioxidants to be not only
promising, but also economically feasible. Natural antioxidants have a complex effect on the animal’s body – it is scientifically proven that they first clear the body of free radicals, and secondly – interact only with certain free radicals, while breaking the chain of oxidative reactions [6, 7]. The greatest danger for the cells of a living organism is the continuous oxidation of polyunsaturated fatty acids, which results in the formation of a large number of hydroperoxides that have a high reactivity and have a powerful damaging effect [8, 9, 10]. Thus, the introduction of antioxidants in feed contributes to reducing the level of oxidative processes in the body, provides high safety of young animals, increasing the live weight, overall resistance and productivity of animals.

In this work, we studied the growth and development of young rabbits using ecologically safe drugs with high antioxidant indices — dihydroquercetin and arabinogalactan — in their feeding. They are produced from the butt parts of Daurian larch (Lerix dahurica Turez). The high efficiency of these drugs was previously established in various animal species [4, 11]. Also, as part of the research, it was decided to evaluate the synergistic effect of dihydroquercetin together with food acids, as well as a protein-carbohydrate supplement from wheat germ.

2. Methods and materials

The objects of research were rabbits of 45-120-day-old age of the Californian breed. The studies were carried out on the basis of the rabbit-breeding industrial complex IP Farm Korneev N.E., approbation took place in the private farm A. Mosolova Volgograd region. During the zootechnical experience, farms were favorable for infectious and invasive diseases.

2.1. Statement of experience

To achieve this goal, groups were formed on the basis of analogues taking into account live weight, gender, age and state of health. The experiment was carried out according to the scheme presented in table 1.

| Group | Number of animals | Feeding conditions |
|-------|-------------------|--------------------|
| Control | 15 | The main diet (OR - PK3-93) |
| I     | 15 | OR + feed supplement (0.026% Glimalask, 5% Vitazar) |
| II    | 15 | OR + feed supplement (0.026% Glimalask, 0.1% Arabinogalactan) |
| III   | 15 | OR + feed supplement (0.026% Glimalask, 0.002% dihydroquercetin) |

Throughout the entire period of the experiment, up to 120 days of age, the rabbits were in the same room with the same conditions. Animals of the experimental groups in addition to the main diet received feed additives consisting of the ingredients:

– Glimalask powder additive, consists of a mixture of organic acids: aminoacetic acid - 80 g, ascorbic acid - 12 g, malic acid - 8 g (manufacturer of NEC New Biotechnologies LLC, Volgograd, Russia);
– powdered additives arabinogalactan and dihydroquercetin (manufacturer Ametist LLC, Russia);

2.2. Determination of growth and development of animals

The dynamics of live weight was determined by weighing when setting up for the experiment, after 1.5 months and when removing from the experiment at the age of 120 days, the absolute and relative growth rates were calculated according to generally accepted formulas.

2.3. The study of blood counts.

For analysis of blood parameters, three rabbits were selected from each treatment (at the end of the experiment (on day 120). Blood samples were collected (5 mL per animal) from the wing vein. The
biochemical blood composition was determined on a BiochemSa instrument (High Technology, inc., USA).

2.4. Statistical analysis
The statistical significance of the differences was determined by the unpaired t-test at \( P < 0.05 \).

Research materials were processed using graphical, trend, and statistical analysis methods, as well as using the Microsoft Office software package. The paper uses generally accepted standardized methods of analysis of the studied objects.

Ethical approval. The authors confirm that the Animal experiments complied with the principles of the European Convention for the Protection of Vertebrate Animals used for experiments or other scientific purposes.

3. Results and discussion

3.1 Determination of indicators of growth and development of animals
The use of new feed additives in the diet of rabbits allowed us to analyze the growth and development of animals, to determine the dynamics of live weight and their safety over the period of the experiment. The data obtained are presented in table 2.

| Indicators                        | Groups     |
|----------------------------------|------------|
|                                  | Control    | I           | II          | III         |
| Live weight, g:                  |            |             |             |             |
| 45 days (experience setting)     | 992±3.01   | 990±8.00    | 989±7.86    | 991±7.98    |
| 90 days                          | 2280±18.85 | 2340±16.20  | 2407±16.42  | 2498±17.27  |
| 120 days                         | 3080±21.09 | 3150±21.48  | 3260±22.17  | 3420±24.61  |
| Absolute increase, g             | 2088±16.20 | 2160±16.31  | 2271±17.08  | 2429±17.73  |
| Daily average growth, g          | 27.84±1.90 | 28.80±1.96  | 30.28±2.23  | 32.38±3.05  |
| % up to control group            | 100.00     | 13.45       | 108.76      | 116.31      |
| Safety, %                        | 98         | 100         | 100         | 100         |

The table shows that over the entire period of the research, the live weight of the rabbits of the experimental groups had a more pronounced growth dynamics compared to the control group rabbits. The safety of the livestock in the experimental groups was 100% versus 98% in the control. Analyzing the absolute increase in live weight, an increase in this indicator in the experimental groups should be noted, but the largest increase was in the III group and amounted to 2429 (\( P \leq 0.01 \)), which is 16.33% more than in the control group, by 12.45 and 6.96 % more than in groups I and II, respectively. The average daily gain of rabbits in the experimental groups exceeded the control indicator by 3.45, 8.76, 16.31% (\( P \leq 0.01 \)).

This trend can be explained by the presence of organic acids, arabinogalactan and dihydroquercetin in the complex feed additives, which contribute to the improvement of metabolic processes and optimization of the intestinal microflora of animals. It should be noted that rabbits of group III grew and developed more intensively than rabbits of the other groups. Thus, the use of a feed additive with dihydroquercetin from 45 days of age normalizes metabolism, which allowed animals to stably gain weight throughout the entire experimental period.

To determine the effect of new complex feed additives on the digestibility of nutrients in the diet, a physiological balance experiment was conducted. The daily count of feed eaten by rabbits, as well as analysis from the chemical composition, allowed us to determine the amount of nutrients consumed during this period. The data are presented in table 3. The difference between the nutrients received in the body of rabbits and excreted in the feces allowed us to calculate the digestibility coefficients presented in table 4.
Table 3. Average daily nutrient intake by rabbits for the period of physiological experience, g / goal (n = 3).

| Indicators     | Groups             |
|----------------|--------------------|
|                | Control            | I       | II       | III      |
| Dry substance  | 167.12±1.47        | 170.28±1.52 | 169.76±1.32 | 169.36±1.42 |
| Raw protein    | 32.81±0.29         | 33.84±0.26 | 33.08±0.24 | 33.21±0.25 |
| Raw fat        | 6.98±0.05          | 7.82±0.06  | 7.01±0.05  | 6.99±0.04  |
| Crude fiber    | 22.97±0.22         | 23.56±0.28 | 23.04±0.24 | 23.10±0.26 |
| BEV            | 87.72±0.56         | 88.63±0.62 | 88.12±0.58 | 87.93±0.6  |

Table 4. Digestibility ratios of feed nutrients, % (n = 3).

| Indicators     | Groups             |
|----------------|--------------------|
|                | Control            | I       | II       | III      |
| Dry substance  | 73.26±1.08         | 74.23±1.26 | 74.82±1.50 | 75.26±1.48 |
| Raw protein    | 68.97±0.62         | 70.54±0.47 | 70.84±0.58 | 72.12±0.60 |
| Raw fat        | 85.31±0.36         | 86.44±0.28 | 86.52±0.30 | 86.47±0.30 |
| Crude fiber    | 38.12±1.12         | 45.93±1.18 | 46.37±1.17 | 48.93±1.21 |
| BEV            | 85.02±0.61         | 85.09±0.52 | 85.20±0.50 | 85.86±0.60 |

As a result of physiological experiment, it was found that the studied new complex additives positively influenced the digestibility of the main nutrient components. The highest digestibility of the protein was observed in group III and amounted to 72.12% (P≤0.01), which is higher compared to the control group by 3.15%, and compared to groups I and II by 1.58 and 1.28%, respectively. The rabbits of the experimental groups digested crude fiber significantly better – by 7.81, 8.25 and 10.81%, respectively, than the rabbits of the control group. The difference in the digestion of crude fat and nitrogen-free extractives between the rabbits of the analyzed groups was insignificant.

3.2 Blood characteristics

For an objective idea of the state of animal health, a study of the blood composition was carried out, which is an important indicator of the physiological state of the body associated with the functioning of vital organs and, ultimately, with the productive qualities of the animal. Hematological and biochemical blood parameters of rabbits are presented in table 5.

A comprehensive study of hematological blood parameters of rabbits allowed us to note that in the blood of group III rabbits, the concentration of RBC (red blood cells) and HGB (hemoglobin) was higher by 3.5 and 4.3% compared to the control group, and the level of animals in experimental groups I and II for these elements more by 0.9 and 1.2%; 2.1 and 2.9% compared with control, respectively.

The data obtained indicate an improvement in the supply of oxygen to the body and, as a result, increased activation of metabolic processes in the body of rabbits receiving complex feed additives. Moreover, more pronounced changes in these values were observed in rabbits of the II and III experimental groups treated with arabinogalactan and dihydroquercetin.

The number of WBC (leukocytes) in the blood, compared with the control, in the experimental groups decreased by 0.8, 1.2 and 2.0%, respectively, which suggests that rabbits from the experimental group III receiving a feed supplement with dihydroquercetin bioflavonoids have a higher level of natural resistance. The results of biochemical studies of blood serum showed that at the end of the experiment in the blood serum of rabbits of the experimental groups, the content of total protein was higher than that of peers from the experimental group by 2.1; 3.0 and 4.2%, respectively, calcium - by 3.1; 4.8 and 7.5%, phosphorus - by 3.5; 5.1 and 8.5%, respectively. As a result of the tests, it was found that all the analyzed parameters before setting up the experiment and at the end of the experiment were within the physiological norm, and their increase is the advantage of using a certain additive.
Table 5. Blood values of experimental rabbits.

| Indicators      | Control | Groups |       |       |       |
|-----------------|---------|--------|-------|-------|-------|
|                 | Before experience |       |       |       |       |
| RBC, 10^{12}/l  | 5.99    | 5.98   | 6.00  | 5.97  |       |
| WBC, 10^9/l     | 7.04    | 7.01   | 7.02  | 7.00  |       |
| HGB, g/l        | 105.20  | 109.40 | 109.80| 109.30|       |
| Total protein, g/l | 60.72  | 60.79  | 60.85 | 60.80 |       |
| Calcium, mmol/l | 2.13    | 2.204  | 2.251 | 2.237 |       |
| Phosphorus, mmol/l | 0.936  | 0.932  | 0.934 | 0.938 |       |
|                 | In the end of experiment |       |       |       |       |
| RBC, 10^{12}/l  | 6.29    | 6.35   | 6.42  | 6.51  |       |
| WBC, 10^9/l     | 8.36    | 8.29   | 8.26  | 8.19  |       |
| HGB, g/l        | 110.20  | 111.50 | 113.40| 114.9 |       |
| Total protein, g/l | 66.52  | 67.90  | 68.53 | 69.21 |       |
| Calcium, mmol/l | 2.240   | 2.309  | 2.340 | 2.408 |       |
| Phosphorus, mmol/l | 0.994  | 1.029  | 1.045 | 1.078 |       |

Conclusion

The results of the experiment show that the use of new complex feed additives in the feeding rations of rabbits helped to improve the morphological and biochemical properties of blood, accelerate the activation of mineral metabolism of the animal body. Thus, the III experimental group of rabbits had higher results in a number of indicators of growth and development. In our opinion, this is due to the advantage of a feed additive with dihydroquercetin, the mechanism of action of which is based on the strong redox ability of bioflavonoids, which is manifested in the property of hydroxyl groups of molecules to transform in reaction with free oxygen-radical metabolites into a resonance-stable radical-to bind transition metal ions, which in turn stimulate peroxide processes. In addition, dihydroquercetin with organic acids contained in the Supplement "Glimalask", had a synergistic effect by correlating the exchange status of the body of experimental rabbits, which allows us to conclude that the prospects and relevance of further research on the impact of these substances on the productivity and meat qualities of rabbits.

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