Use of probiotic complexes in feed diets to improve the quality of rabbit meat

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Abstract. We examined the efficiency of probiotic "Sporotermin" and "A2" for increasing the productivity and physiological status of the rabbits. The studies were conducted on a crossbreed population of rabbits (Soviet chinchilla and New Zealand red) at the age of 45 days, divided into control and experimental groups of 15 heads in each by the method of pairs-analogues in the vivarium of the faculty of veterinary medicine and animal husbandry technology of the Voronezh State University in 2017-2018. Rabbits of group 1 (control) received all-mash without additives, rabbits of group 2 and 3 additionally received probiotic preparation "Sporotermin" in a dosage of 1.0 g /kg of feed (rabbits of group 2) and "A2" in a dosage of 0.6 g/ kg of feed (rabbits of group 3). Upon reaching the age of 120 days, the live weight of all groups exceeded 3.0 kg, while rabbits of the 2nd group had an advantage over individuals of the 1st and 3rd groups by 295.0 g (9.10 %) and 115.0 g (3.36%). At the end of the experiment (120 days) in animals of the 2nd and 3rd groups there was a significant increase in the amount of total blood serum protein by 5.59 and 3.92% (P>0,95), respectively, compared with the control, as well as an increase in the amount of hemoglobin. In the experimental groups carcass yield made up 60.38 % and 56.88% (P>0,99), while in the control amounted to 55.56 % Thus, the preparation "Sporotermin" is a promising product from a number of probiotics used in animal nutrition and allows improving the productivity and meat quality of rabbits.

1. Introduction

Providing the population with high-quality livestock products is possible only with full feeding of animals, contributing to the intensity of animal growth, productivity and reduction of feed costs per unit of production. This requires manufacturers to abandon the use of feed antibiotics, which are able to accumulate in the body of animals. But in the conditions of industrial production of agricultural products, the exclusion of antibiotics can lead to mass diseases of animals. In this connection, there is a need to find alternative preparations to feed antibiotics that are able to maintain resistance to diseases of breeding objects [1, 2].

In the field of rabbit breeding today the issues of breeding, keeping and feeding of rabbits are better studied, and the influence of various probiotic and feed additives on the animal’s body is less studied, which is confirmed by a number of works of domestic and foreign scientists [3, 4]. To increase the meat productivity of animals are widely used various probiotic complexes that have a stimulating
effect on the animal body, as well as involved in the processes of normalization of intestinal microbiocenosis and increase resistance of the organism of farm animals.

The technology of livestock production is directly related to the problem of full feeding, keeping animals and obtaining high quality products, which necessitates the inclusion in the production cycle of probiotic additives that contribute to the restoration and maintenance of the microflora of the digestive tract, as well as the safety and productivity of animals [3]. Due to the reduction of agricultural production, the lack of full-fledged feed, poor veterinary and sanitary condition of livestock premises, the resistance of animals to various diseases is reduced, which entails the development of dysbiosis and immunodeficiency States, as well as an increase in the incidence of breeding objects, and as a consequence reduces productivity while increasing mortality. In this connection, it is important to include probiotic additives of different species composition in feed rations, which contribute to the maintenance of the physiological status of animals.

The object of the work: to substantiate the effectiveness of the use of probiotic complexes in the composition of feed rations with an assessment of their impact on the physiological status and quality of rabbit meat.

2. Materials and methods

The experiment on feeding rabbits with granulated all-mash was carried out on the basis of the faculty of veterinary medicine and animal husbandry technology of the Voronezh State Agrarian University in a closed room equipped with experimental cages for rabbits. The objects of research were crossbred rabbits obtained by industrial crossing of parental forms of breeds Soviet chinchilla and New Zealand red at the age of 45 days, divided into control and experimental groups of 15 heads in each group by pairs-analogues. Experimental groups were formed from clinically healthy animals. The maintenance and feeding of the rabbits conformed to the hygienic and zootechnical standards. All the rations of agricultural animals in research were balanced in accordance with the detailed rules of feeding.

We used all-mashes with the introduction of the probiotic preparations "Sporoterm" and "A2", and green mass of alfalfa and amaranth. Were all-mashes optimized using a software module "Optima feed " in terms of the LLC "Forage resource" (Voronezh). The production of complete granular feed with the introduction of probiotic complexes was carried out in the conditions of JSC "VEKZ" (Voronezh).

Rabbits of the control group were fed complete granulated all-mash PZK-92, the experimental group of rabbits received feed rations on the basis of feed PZK-92, with the addition of probiotic supplements: for the 2nd group of rabbits, the "Sporoterm" in a dosage of 1.0 g/kg of feed (2·10^9 KOE/g) and the 3rd group rabbits – «A2» in the dose of 1.0 g/kg of feed (4·10^9 KOE/g).

To determine biochemical parameters, blood was taken from the marginal ear vein in animals in the morning before feeding, in compliance with all the necessary rules of aseptic and antiseptic. Blood was tested for leukocytes, erythrocytes and hemoglobin. The number of leukocytes was determined by electronic particle counters, erythrocytes - by PEC (photo-electric calarimeter), hemoglobin-by Sali. The amount of total serum protein, albumins and globulins, alanine aminotransferase (ALT) and aspartate aminotransferase (AST) was determined from biochemical parameters. The total protein content was determined by refractometric method, protein fractions-by nephelometric method according to the degree of turbidity of solutions determined by a photoelectrocolorimeter [4].

Dynamics of live weight was taken into account by individual weighing. Meat productivity of rabbits was determined by weighing carcasses on scales after control slaughter at the age of 120 days and cutting carcasses according to the generally accepted method (N. I. Tinaev, 1988). Meat quality was evaluated using standard methods [5]. The development of internal organs was assessed visually, in accordance with the" Rules of veterinary examination of animals and veterinary and sanitary examination of meat and meat products " followed by weighing. On the basis of deboning carcasses we determined their morphological composition.
3. Results and discussion

Of great importance is the study of biochemical parameters of blood as a factor that reflects the peculiarity of the functioning of the body in the new conditions of feeding and keeping animals exposed to many stresses.

Blood plays a huge role in the life of the body. Blood composition is a system that reflects the redox and metabolic processes and characterizes the normal and pathological processes occurring in the animal body [6-8], provides the relationship between the parts and organs of the body, is involved in the delivery of nutrients and oxygen to the cells. Feeding, age, sex of the animal, breed, conditions, season, has a significant impact on the composition of the blood. The characteristic of the blood composition gives an assessment of the animal's condition and a general idea of fitness to environmental conditions, as well as allows controlling various changes occurring in the animal's body under the influence of feeding and maintenance [9-11].

In this connection, the study of the biochemical characteristics of blood gives the most complete picture of the course of metabolic processes at using probiotic feed additives of different species composition. This problem is actual and represents certain scientific interest for development and stabilization of resources of branch of rabbit breeding.

Probiotic preparations are widely used in animal husbandry, including as components of complete granular all-mash, which allows more accurate prediction the effect of the use in the diet of rabbits. In the work there were used probiotic preparation "Sporotermin", which is a complex of lyophilized microorganisms of the genus Bacillus subtilis and Bacillus licheniformis (not less than 3·10⁹ COE/g, as filler lactose) and feed probiotic «A2», obtained on the basis of biomass of live spore-forming bacteria Bacillus subtilis VKM IN-2711D – at least 2x10⁹ COE/g and Bacillus licheniformis VKM IN-2713D – at least 2x10⁹ COE/g and the filler (whey powder).

Received feed with the introduction of the probiotic complexes on organoleptic indicators meet the requirements of GOST 32897-2014 (table 1) [12].

| Table 1. Main indicators of quality of the developed all-mash |
|-------------------------------------------------------------|
| Indicator               | Recipe 1 (control) | Recipe 2 | Recipe 3 |
| Mass fraction of moisture, %                               | 14.0              | 13.9     | 13.8     |
| Diameter of granules, mm                                   | 4.7               | 4.6      | 4.6      |
| Granularity, %                                             | 7.6               | 7.5      | 7.5      |
| Passage through a sieve with 2 mm holes, %                  | 9.0               | 8.0      | 8.0      |

The effectiveness of the use of probiotic preparations "Sporotermin" and "A2" was evaluated in the feed rations of young growth of rabbits to assess the intensity of growth of young rabbits, which was determined by weighing of livestock in the control periods. Upon reaching the slaughter age (120 days), rabbits of the control group were characterized by a lower live weight, while in the experimental groups this indicator had a positive increase (table 2).

The highest live weight was observed in rabbits of the 2nd group (P>0.95), which received the probiotic preparation "Sporotermin" in the composition of the feed at a dosage of 1.0 g/kg of feed. In this group, upon reaching the age of 105 days, the live weight gain of rabbits significantly exceeded the value of the control group by 474.0 g or 17.21 %. Upon reaching the age of 120 days, the live weight of all groups exceeded 3.0 kg, while rabbits of the 2nd group had an advantage over individuals of the 1st and 3rd groups by 295.0 g (9.10 %) and 115.0 g (3.36%).

The safety of rabbits in the experimental groups was 100 %, in the control group - 70.0 %, which is associated with increased overall resistance of the body, and probiotic compounds may have contributed to the normalization of digestion processes and as a consequence improve the conversion of feed.
Table 2. Dynamics of live weight of rabbits, g (X±S)

| Age, days | The 1st group (control) | The 2nd group (The 1st experimental group) | The 3rd group (The 2nd experimental group) |
|-----------|-------------------------|--------------------------------------------|--------------------------------------------|
| 1         | 45.00 ±0.15             | 46.50 ±0.16                                | 45.60 ±0.10                                |
| 45        | 885.0±10.14             | 882.0±13.59                                | 892.0±14.55                                |
| 60        | 1407.0 ±20.47           | 1536.0 ±22.10                              | 1508.0±21.20                               |
| 75        | 1756.0±32.15            | 1854.0±17.42                               | 1910.0±24.07                               |
| 90        | 2214.0±14.44            | 2874.0±19.48                               | 2559.0±17.20                               |
| 105       | 2754.0±20.18            | 3228.0±15.44*                              | 2986.0±14.36*                              |
| 120       | 3240.0±18.12            | 3535.0±26.00                               | 3420.0±27.10                               |
| % To control | 100.0                  | 109.10                                     | 105.55                                     |
| Safety, % | 70.00                   | 100.00                                     | 90.00                                      |

* P<0.95, ** P<0.99

The use of probiotics helps to optimize metabolic processes in the body, increase the absorption of nutrients and activate the body’s defenses. We have studied the biochemical parameters of blood (table 3), which confirm the positive effect of probiotic preparations on the functioning of the body as a whole.

Table 3. Biochemical parameters of blood of rabbits, (X±S)

| Indicator                      | Group                                      |
|-------------------------------|--------------------------------------------|
|                               | The 1st group (control) | The 2nd group (The 1st experimental group) | The 3rd group (The 2nd experimental group) |
| Protein composition of blood serum, g/l | At the beginning of the experiment (45 days) | At the end of the experiment (120 days) | At the end of the experiment (120 days) |
| Total protein, g/l            | 68,41±0,14                               | 70,11±0,22*                               | 68,76±0,17**                             |
| Globulins, g/l                | 33,19±0,16                                | 34,70±0,12                                | 34,15±0,26                               |
| Albumins, g/l                 | 35,22±1,17                                | 35,40±1,16                                | 34,61±1,15                               |
|                               | At the beginning of the experiment (45 days) | | |
| Total protein, g/l            | 71,29±0,45                                | 75,28±0,41*                               | 73,59±0,37*                              |
| Globulins, g/l                | 34,08±0,46                                | 34,90±0,60*                               | 36,68±0,37*                              |
| Albumins, g/l                 | 37,21±0,81                                | 40,38±1,14*                               | 36,91±1,02*                              |

* P<0.95, ** P<0.99

At the end of the experiment (120 days) in animals of the 2nd and 3rd groups there was a significant increase in the amount of total serum protein by 5.59 and 3.92% (P<0.95), respectively, compared with the control.

There is a positive dynamics of increase in morphological parameters of blood, in particular, increase in the amount of hemoglobin, so in the second group the amount of hemoglobin significantly exceeded the values of the first group (control) by 6.97 g/l or 6.26 %, in the third – 4.90 g/l or 4.32 % (P<0.99).

There is an increase in the content of red blood cells in group 2, which indicates an improvement in the provision of oxygen and more intense metabolic processes in the body of rabbits (table 4).

The studies showed that there were differences in the blood on the content of leukocytes. Leukocytes contained less in the blood of experimental groups of rabbits treated with probiotic preparations "Sporoterm" and "A2" in dosages of 1.0 and 0.6 g/kg of feed, respectively, and more in the control group.
Table 4. Morphological parameters of blood, (X±s)

| Indicator                  | The 1st group (control) | The 2nd group (The 1st experimental group) | The 3rd group (The 2nd experimental group) |
|----------------------------|-------------------------|-------------------------------------------|-------------------------------------------|
|                            | At the beginning of the experiment (45 days) |                                           |                                           |
| Red blood cells, 10\(^{12}\)/l | 4.65±0.14               | 4.68±0.15                                 | 4.52±0.12                                 |
| Leukocytes, 10\(^9\)/l         | 6.71±0.16               | 6.88±0.19                                 | 6.78±0.20                                 |
| Hemoglobin, g/l               | 102.90±1.10             | 103.28±1.22                               | 103.12±1.24                               |
|                            | At the end of the experiment (120 days)      |                                           |                                           |
| Red blood cells, 10\(^{12}\)/l | 5.19±0.17               | 6.32±0.09\*                              | 6.12±0.10\*                              |
| Leukocytes, 10\(^9\)/l         | 6.67±0.11               | 6.29±0.17\*                              | 6.44±0.12\*                              |
| Hemoglobin, g/l               | 111.28±0.84             | 118.25±1.11\*                            | 113.35±1.20\*                            |

* P>0.95, ** P>0.99

At the end of the experiment a control slaughter was carried out with an assessment of the morphological composition according to the generally accepted method (table 5).

In the experimental groups, the slaughter yield was 60.38 % and 56.88% (P>0.99), while in the control group it was 55.56 % (table 5).

Table 5. Results of control slaughter and morphological composition of rabbit carcasses, (X±s)

| Indicator                  | The 1st group (control) | The 2nd group (The 1st experimental group) | The 3rd group (The 2nd experimental group) |
|----------------------------|-------------------------|-------------------------------------------|-------------------------------------------|
| Pre-slaughter live weight, g | 3056.0±11.12            | 3138.0±17.60\*                           | 3170.0±9.57\*                            |
| Weight of hot carcass, g    | 1698.0±20.27\*          | 1895.0±16.12\*                           | 1803.0±23.56\*                           |
| Slaughter yield, %          | 55.56±0.42              | 60.38±0.54\*                             | 56.88±0.62\*                             |
| Weight of raw fat, g        | 110.0±4.33              | 132.0±2.17                               | 134.0±2.77                               |
| Pulp weight, g              | 1315.0±32.10            | 1511.0±35.30\*                          | 1409.0±40.12\*                          |
| Bone weight, g              | 273.0±3.44              | 252.0±4.10                               | 260.0±3.14                               |
| Index of meatines           | 4.82±0.18               | 5.99±0.35\*                              | 5.41±0.12\*                              |

* P>0.95, ** P>0.99

The evaluation of morphological structure showed that the muscular tissue mass in rabbits of experimental groups 196.0 g or 14.90 and 94.0 g or 7.14 %, respectively, more than individuals in the control group, which is reflected in the index of carcasses meatines of rabbits (P>0.95).

The analysis of the chemical composition of rabbit meat (table 6) shows that the meat rabbits of the experimental groups was characterized by a high content of protein 21.40 and 21.00 % respectively (P>0.99), while in the meat rabbits of the 2nd group (all-mash with the introduction of probiotic complex “Sporoterm” was used in a dosage of 1.0 g/kg feed), protein content was the highest.

Table 6. Chemical composition of rabbit meat, M±s

| Indicator                  | The 1st group (control) | The 2nd group (The 1st experimental group) | The 3rd group (The 2nd experimental group) |
|----------------------------|-------------------------|-------------------------------------------|-------------------------------------------|
| Mass fraction of moisture, % | 73.31±0.51              | 71.77±0.62\*                             | 71.84±0.20\*                             |
| Mass fraction of protein, %   | 19.40±0.22              | 21.40±0.30\*                             | 21.00±0.15\*                             |
| Mass fraction of fat, %       | 6.27±0.30               | 5.71±0.21\*                              | 6.06±0.54\*                              |
| Mass fraction of ash, %       | 1.02±0.04               | 1.12±0.02\*                              | 1.10±0.02\*                              |

* P>0.95, ** P>0.99.
Increased protein content in rabbit meat is apparently associated with a higher transformation of feed nutrients [13, 14] under the action of the probiotic complex "Sporotermin" when administered 1.0 g/kg of feed, respectively, in the protein component of muscle tissue. The use of the green mass of alfalfa and amaranth as a vitamin supplement in the feed [15, 16] also contributes to the improvement of the quality indicators of the resulting raw meat.

The presented organoleptic evaluation of the meat and broth of the rabbit control and test groups showed a positive effect of probiotic preparation "Sporotermin" on the formation of taste and aromatic profile, both boiled meat and broth. As a result of the tasting it was determined that the highest score was characterized by samples of boiled meat and broth obtained from the carcasses of group 2 (8.3 points and 8.1, respectively).

4. Conclusion
The study shows that the use of probiotic complex "Sporotermin" as part of all-mash is technologically justified, and also avoids a number of problems associated with a decrease in the safety and productivity of livestock, facing producers of quality raw meat.

The enrichment of all-mashes for feeding young rabbits with probiotic microorganisms has a positive effect on the intensification of livestock production, including meat productivity and safety.

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