Improving rabbit meat productivity: the effect of antioxidant feed additives on meat quality

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Abstract. The development of intensive forms of animal husbandry and the consistent improvement of their efficiency require solving both technical problems and issues of feeding and using full-fledged and cost-effective feed for all types of bred animals. This article presents data on the use of feed additives containing natural antioxidants in the aspect of influence on the quality indicators of the resulting meat. The assessment was carried out after a control slaughter at the age of 120 days in the amount of 3 heads from each group. The results of physical and chemical tests of rabbit meat of experimental groups are presented, and the positive effect of natural additives "Vitazar" and "Ecostimul" on the quality indicators of raw meat is determined.

1. Introduction

Widely known, currently a variety of antibiotics are widely used in animal husbandry. In necessary cases, they are used for the treatment and prevention of diseases, in others they are added to feed to stimulate the growth and development of animals (poultry). As a result, antibiotics are transformed into food products - milk, meat, eggs - enter the human body, affect its immune system and contribute to the development of antibiotic-resistant microflora. The problem of resistance of pathogenic microorganisms to antibacterial agents widely used in medicine became clear when attention was drawn to the fact that the active substances of antibiotics used in medicine are often used to treat animals and poultry or stimulate their productive capacity. Considering the problem, it should be said that the simple exclusion of antibiotics from the technology of growing productive animals and poultry is impossible.

When treating sick animals, antibiotics are often the only cardinal means of saving animals. But the need to use them to accelerate the growth and development of animals is ambiguously resolved in different countries. It should be noted that in recent years, there has not yet been a ban on the treatment of sick farm animals and poultry with antibiotics in the West, but the ban on feed antibiotics in Europe and the United States was introduced more than a decade ago. The process of banning feed antibiotics has started more slowly in Russia and its neighboring countries. Nevertheless, the global trend to reduce the use of antibiotics in the cultivation of productive animals and poultry is a goal that modern agricultural producers should strive for [1]. In recent years, scientific research has been conducted in many countries of the world to find alternative antibiotics for use in livestock and poultry farming. These include probiotics, prebiotics, synbiotics, phytobiotics, mannanooligosaccharides, organic acids and their extracts of essential oils, etc. [2]. This article presents data on the use of feed additives containing natural antioxidants in the aspect of influence on the quality indicators of the resulting meat. The
Various factors influence the productivity of rabbits that are characterized by multiple fertility and high precocity [2, 3]. It is worth noting that natural feed additives are currently being used both in rabbit breeding and in other animal husbandry industries, since many consumers are wary of consuming products obtained using antibiotics or synthetic feed additives. Methods of increasing meat productivity of animals using biologically active preparations, vitamins, minerals, antioxidants, immunomodulating agents and various probiotic feed additives have been widely used in animal husbandry practice [5, 6].

In recent years, scientists have found the use of various biologically active substances with an antioxidant effect, such as bioflavonoids, to be not only promising, but also economically feasible, since their introduction into feed reduces the level of oxidative processes in the body, ensures high safety of young animals, increases live weight, General resistance and productivity of animals [7, 8, 9].

2. Methods and materials

2.1. Experimental model
The research was carried out on the basis of the rabbit breeding complex of CF Korneev N.E., in the personal subsidiary farm of Mosolov A. A. (Volgograd region). The duration of the experiment was 45 days.

The object of research was the meat of rabbits of the California breed. Groups were formed according to the principle of analogues, taking into account body weight, gender, and health status. From the age of 45 days, feeding and keeping animals was the same for all groups. All animals received a basic diet consisting of full-fledged compound feed PK3-93 and a food additive "Glimalask" consisting of organic acids (aminoacetic, ascorbic, malic) in an amount of 0.026%, while the animals of the experimental groups received additional new complex additives of natural origin:

- "Vitazar" (wheat germ flour) in the amount of 5% (V-group);
- powdered feed additive "Ekostimul-2 " (with a content of at least 70% dihydroquercetin in terms of pure) in the amount of 0.002% (E-group).

2.2. Physical and chemical studies of meat
After the control slaughter of animals at 120 days of age, the meat quality was analyzed. In the laboratory conditions of the Volga research Institute for the production and processing of meat and dairy products, the mass fractions of moisture, protein, fat, and ash in m. Longissimus dorsi were determined according to established methods [10].

The amino acid composition of muscle tissue protein was studied using the aracus amino acid analyzer. The biological value of meat was determined by the ratio of essential and non-essential amino acids. The moisture-binding capacity was determined by centrifugation, and the moisture-retaining capacity was determined according to [10, 11].

2.3. 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 Chemical composition of meat

Quality indicators of meat consist of indicators of protein, fat, moisture and other substances. One of the main components of meat is muscle tissue, so it is important to study the chemical composition of the meat part of the carcass as one of the main indicators that characterize the quality of meat products, its nutritional and energy value. In our research, we studied the chemical composition of meat in the longest back muscle. The analysis of the data obtained by us indicates certain intergroup differences in chemical composition (table 1). The established differences are due to the fact that the process of accumulation of nutrients in the body of rabbits occurred differently.

Table 1. Chemical composition of rabbit’s m. Longissimus dorsi.

| Indicators                                | Control     | V-group    | E-group    |
|-------------------------------------------|-------------|------------|------------|
| Mass fraction of moisture, %              | 72.00±1.30  | 72.50±0.50 | 72.80±0.52 |
| Mass fraction of protein, %               | 21.90±0.21  | 22.60±0.52 | 23.50±0.56 |
| Mass fraction of fat, %                   | 3.90±1.80   | 3.72±1.20  | 3.49±1.00  |
| Mass fraction of ash, %                   | 1.05±0.10   | 1.06±0.10  | 1.07±0.15  |

Analysis of the chemical composition of the longest back muscle of rabbits showed that the protein content in animals of the experimental groups exceeded this indicator in animals of the control group, while in group E the protein content was higher by 3.98 and 7.31% than in the rest. In terms of moisture content, the experimental groups also exceeded the control by 0.69 and 1.10%. There was also a decrease in the mass fraction of fat in rabbits of the experimental groups by 4.62 and 10.51% compared to the control group, respectively.

The data obtained indicate an improvement in the chemical composition of the meat of the experimental groups, an increase in its nutritional value. This leads to the conclusion that the use of Vitazar and Ecostimul feed additives in the diets of rabbits from the age of 45 days had a positive effect on the nutritional value of meat, especially in group E.

For an objective assessment of the biological value of the resulting meat, the composition of proteins of the longest back muscle of experimental rabbits of all groups was studied (table 2).

Table 2. The content of amino acids in meat samples obtained from animals of the experimental groups.

| Indicators  | Control    | V-group   | E-group   |
|-------------|------------|-----------|-----------|
| Arginine    | 6.16±0.04  | 6.19±0.04 | 6.21±0.05 |
| Valine      | 4.48±0.03  | 4.52±0.02 | 4.60±0.04 |
| Histidine   | 2.16±0.03  | 3.10±0.04 | 3.15±0.04 |
| Leucine     | 7.25±0.05  | 7.69±0.06 | 7.75±0.10 |
| Isoleucine  | 3.48±0.02  | 4.16±0.03 | 4.25±0.06 |
| Lisine      | 8.48±0.05  | 8.92±0.04 | 9.05±0.08 |
| Methionine  | 1.93±0.07  | 1.96±0.05 | 2.03±0.05 |
| Threonine   | 3.68±0.02  | 3.70±0.02 | 3.68±0.09 |
| Tryptophan  | 1.38±0.01  | 1.49±0.01 | 1.54±0.06 |
| Phenylalanine| 2.34±0.01 | 3.11±0.02 | 3.08±0.03 |
| the amount  | 41.64±0.31 | 44.84±0.33 | 45.34±0.42 |

| Indicators  | Control    | V-group   | E-group   |
|-------------|------------|-----------|-----------|
| Alanine     | 4.82±0.04  | 4.84±0.06 | 4.88±0.05 |
| Glycine     | 6.35±0.06  | 6.32±0.05 | 6.36±0.07 |
The results presented in table 2 indicate the complete composition of rabbit meat proteins in the study groups. The most interesting are essential amino acids. The quantitative composition was dominated by lysine, leucine, arginine and valine. The content of lysine in the first and second experimental groups is higher by 1.59 and 3.08%; leucine-by 6.07 and 6.9%; histidine – by 43.52 and 45.83%; isoleucine – by 19.54 and 22.13%; tryptophan – 7.97 and 11.58%; phenylalanine – 32.91 and 31.62%, respectively, compared with the content of these amino acids in the meat protein of animals in the control group.

The total content of essential amino acids in the protein of rabbit meat in the first and second experimental groups was higher than in the control group by 7.68 and 8.99%, respectively. In relation to tryptophan to oxyproline, as well as the total content of amino acids in the meat samples studied, it can be concluded that the introduction of feed additives of natural origin in the diet of rabbits increases the content of full-fledged proteins and increases the biological value.

3.2. The study of functional and technological properties of meat

For expert assessment of meat quality, functional and technological indicators were measured and analyzed: moisture-binding, moisture-retaining and fat-retaining abilities. These indicators relate to the determining factors that affect the yield and consumer properties of meat, such as juiciness, tenderness, losses during heat treatment, presentation, and technological advantages. The test results are shown in the figure 1. Measurements were made during autolysis for 24 hours.

Analyzing the data, it can be noted that the highest indicators were noted for paired meat, while the FTP of the first and second experimental groups exceeded the control by the value of WSA-by 0.85 and 1.32%, WUA – by 0.76 and 1.30%. When maturing, the indicators of the FTP begin to increase. The results of the analyses showed that the meat of rabbits of the experimental groups was characterized by
high values of FTP, while the meat obtained from animals of the second experimental group, in which rabbits with the main diet received additional "Ecostimul", these indicators had the maximum values. It can also be concluded that the increase in the above indicators in the samples proves that the introduction of a biologically active additive leads to the stabilization of meat coagulation structures.

4. Conclusion
Thus, the use of «Vitazar» and «Ecostimul» feed additives in the diet of rabbits in the specified amounts had a positive effect on the physical and chemical parameters and functional and technological properties of the studied rabbit meat samples, so in order to obtain high-quality rabbit meat grown without the use of feed antibiotics, it is important to use feed additives of natural origin.

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