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Meat Productivity And Quality Of Rabbit Meat Using Probiotic Additives And Sorbents

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ABSTRACT

In the field of animal husbandry promising is the use of probiotic additives that contribute to the normalization of microbiocenosis of the animal body, as well as their resistance to pathogenic microflora, which ultimately affects the increase in meat productivity. The influence of probiotic additive "Prostor" and "Enzimsporin" together with the adsorbent "Fungistat-GPK" on the productivity, chemical composition and biological value of rabbit meat was studied. To study the effect of probiotic - sorbent complexes, 30 rabbits at the age of 60 days were selected. The control group of rabbits received a basic ration consisting of fodder PK-90, rabbits of the 1st experimental group received all-mash PC-90-1, to which was introduced complex "Prostor"-"Fungistat - GPK" in the dosage of 1 g/ kg and 0.2 g/kg of all-mash, respectively, and rabbits of the 2nd experimental group received all-mash PK-90-2, to which was introduced "Enzimsporin"- "Fungistat - GPK" in the dosage of 1 g/ kg and 0.2 g/kg of all-mash, respectively. Meat quality was carried out at the age of 120 days after control slaughter in the amount of 3 heads from each group. Morphological composition data showed that the mass of the muscular tissue of the rabbits of the 1st and 2nd experimental groups was superior to the rabbits of the control group by 8.09% and 16,96%, respectively. The study of the histological characteristics of the stomach and liver of rabbits, can positively appraise the effect of the probiotic preparation on the growth and development of the animal. Analysis of chemical, amino acid and fatty acid composition of muscle tissue showed that the use of probiotic preparation "Enzimsporin" in a dosage of 1 g and adsorbent-neutralizer of toxins "Fungistat-GPK" in a dosage of 0.2 g per 1 kg of all-mash increases the average daily gains and as a consequence of meat productivity, improves the balance of amino acid and chemical composition, which is confirmed by the appraisement of physico-chemical and organoleptic characteristics of the obtained raw meat.

Keywords: probiotic preparation, rabbits, meat productivity, biological value, morphological composition

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INTRODUCTION

In the livestock industry in recent years due to the active economic activity there is an increase in physical and chemical factors that adversely affect the physiological processes occurring in the body of animals. In this connection, there is need to develop scientific approaches and recommendations on the technology of feeding farm animals, including young rabbits using environmentally friendly additives that provide qualitative and safe raw materials.

The introduction of intensive breeding technologies in the rabbit industry, as well as an increase in livestock has led to a significant increase in the anthropogenic and microbiological load on the body of rabbits, which in turn causes a violation of the processes of digestion, metabolism, reduced productivity and the occurrence of intestinal infections [26, 27].

The most difficult period for young rabbits is weaning from rabbits. At this time the body of the rabbit are under severe stress, increases the risk of disease infections, resulting in reduced growth rate. The most frequent diseases in this period are diseases of the gastrointestinal tract [1, 3]. It is known that probiotics contribute to the correction of digestive processes, affect the immune system of rabbits as a result of optimizing the protective functions of the body. In this regard, the problem of studying the effectiveness of the use of various feed additives and probiotics and their impact on the productivity of rabbits, the quality of the products, the physiological state, economic indices is relevant, has scientific and practical interest [2, 4, 9, 11, 12, 24, 25, 28].

Intensive development of rabbit breeding industry dictates new requirements to feed quality and technology of feeding rabbits. In this regard, it is particularly important to improve the technology of feeding the rabbit population, which is possible with the use of science-based nutrition standards, better principles of feed evaluation, the use of biologically active substances and other micro-additives that ensure the full value of diets. In this regard, it is necessary to change qualitatively the nature of the food base by creating and using effective biologically active feed additives and new generation of preparation that have not only nutritional value, but also a protective effect on the body of rabbits, and also have the ability to optimize the metabolic processes of the body, as well as to treat and prevent diseases of the gastrointestinal tract and restore normal intestinal microflora [12-14, 18].

Rabbit breeding is the industry that allows obtaining a wide range of livestock products and requires special attention and development of scientific approaches for rational regulation and balancing of rabbit diets with a wide range of nutrients and feed probiotic additives that contribute to the preservation of livestock by normalizing the microbial balance in the digestive tract, stimulating growth, increasing the growth of live weight [1, 8].

The productivity of rabbits is influenced by a number of factors. First of all, heredity, physiological state, feeding rations. As a rule, special attention is paid to the balance of diets for basic nutrients, which in turn affects the productivity of animals [11].

One of the important biological risks on rabbit farms is the high sensitivity of livestock to pathogenic microflora. To reduce the susceptibility of livestock to pathogenic infections, antimicrobial growth promoters are used – antibiotics as feed additives, the mechanism of action of which is to reduce the competition of microorganisms in the fight for nutrients with the body and reduce their metabolites that inhibit the growth of the animal [1, 2]. From the use of this group of drugs often get side effects, therefore, it is necessary to find alternative means of contributing to the stimulation of animal growth. Such drugs primarily include feed probiotics, which contribute to the increase of resistance of the animal organism, normalization of intestinal microbiocenosis, improvement of the processes of assimilation of feed nutrients [6, 7, 9]. Recently, the use of probiotic feed additives, which have the ability to optimize the metabolic processes of the body, as well as to treat and prevent diseases of the gastrointestinal tract, has become increasingly important to solve this problem today, the creation of conditions for forecasting and managing the quality of products by lifetime biocorrection of nutritional status largely determines the quality of products obtained from raw meat.

Rabbit meat is a dietary raw meat, characterized by pale pink color, rather delicate texture and different fine-fibrous muscle tissue. The amount of connective tissue in the meat of the rabbit is small, so it is

characterized by a gentle consistency. Rabbit meat contains a lot of nitrogenous, mineral (acid salts of phosphorus (246 mg%) and potassium (364 mg%). The presence of extractives gives the meat a specific smell and taste. The cholesterol content of rabbit meat is 25 mg per 100 g of meat.

At balanced feeding, the body of rabbits accumulates a large number of biologically active substances contained in grain raw materials, such as polyunsaturated fatty acids, dietary fibers, vitamins, minerals, as well as minerals and vitamins necessary for humans: iron, selenium, fluorine, cobalt, B vitamins, vitamin C, which predetermines the use of this type of meat in therapeutic and preventive nutrition.

To create complete diets, it is necessary to use the most promising, cost - effective and safe mineral feed additives that contribute to the introduction of easily accessible forms of macro-and microelements into the body, which are actively involved in metabolism. As a result, along with an increase in digestibility and digestibility of nutrients of the diet, the body of rabbits is enriched with minerals that have a versatile effect. In addition, the use of mineral supplements helps to increase the productivity of rabbits and improve product quality, is one of the factors to strengthen the feed base, reducing feed consumption per unit of production.

The aim of the work is to increase the meat productivity of young rabbits on the basis of integrated use of probiotic additives and adsorbents and appraisement of their impact on the quality of the raw meat.

MATERIALS AND METHODS

Scientific and economic experiments were carried out by the method of balanced groups of analogues in two periods (preparatory and record) according to the generally accepted methods [2]. Experimental groups were formed from clinically healthy animals. We took into account the origin, sex, age and live weight. To conduct the experiment, 30 rabbits (males) of the Soviet chinchilla breed were selected, which at the age of 60 days were divided into 3 groups according to the principle of groups – analogues. In each group 10 heads were picked up. The maintenance and feeding of the rabbits conformed to the hygienic and zootechnical standards. Rabbits were kept in mini-farm type, quart. There has been used dry type of feeding-granular feed. Animals had unlimited access to water. Experimental and control groups of animals were in the same conditions of keeping, feeding and care. The research was conducted in the conditions of personal home farm “O. V. Kuznetsova” (Voronezh) in 2018. As the main diet we used feed PK-90, obtained on the basis of grain crops, sunflower meal, wheat bran, herbal flour and premix KVP P90-1K. Rabbits of the 1st group (control) received only feed the PC-90, the rabbits of group 2 received feed PC-90-1, into which it was introduced probiotic preparation “ProStor” in the amount of 1 g per 1 kg of all-mash and mycotoxin adsorbent “Fungistat –GPK” at a dosage of 0.2 g per 1 kg of all-mash, rabbits 3group 3 feed PC-90-2, into which it was introduced probiotic preparation “Enzimsporin” in the dosage of 1 g per 1 kg of all-mash and the adsorbent “Fungistat –GPK” in the optimal dose (0.2 g per 1 kg of all-mash).

“Prostor” is a feed synbiotic additive of a new generation, providing bioprotection of the body, increasing the productivity of animals, birds, fish, by increasing the conversion of feed, stimulation of metabolic and immune processes of the body. The “Prostor” has probiotic, antibacterial, antiviral and antimicotic properties, provides increased digestibility of feed, stimulation of metabolic and immune processes, increases the efficiency of feed rations. The “Prostor” contains cultures of microorganisms Bacillus subtillis, Bacillus licheniformis immobilized on phytosorbent, lactic acid bacteria and products of their metabolism — a set of important enzymes, biologically active substances, vitamins and amino acids.

“Enzimsporin” contains spore-forming bacterium Bacillus subtilis VKM B-2998D (PMBC In-314), Bacillus licheniformis VKM B-2999D, Bacillus subtilis VKM B-3057D in equal ratios and fillers - whey powder, maltodextrin, corn flour. 1 g of feed additive contains at least $5x10^9$ CFU/g (colony forming units) of spore-forming bacteria of the genus Bacillus. Included in the feed additives live bacteria of the genus Bacillus prevent colonization of the intestine by conditionally microorganisms, contribute to the restoration of intestinal normoflora. Due to the production of biologically active substances and enzymes, the additive activates the digestive processes, stimulates metabolic processes and increases the absorption of feed nutrients.

"Fungistat-GPK" contains spores of bacteria of the genus Bacillus subtilis with pronounced antifungal activity. This culture is traditionally used as a probiotic, a producer of a number of essential amino acids, enzymes and antibiotics of polyene nature. When you make "Fungistat- GPK ", metabolites of Bacillus subtilis

prevent the development of fungi. When injected into the gastro-intestinal tract, Bacillus subtilis, inhibiting pathogens, triggers the growth of Bifidobacterium animals. The composition of the toxin neutralizer includes a composition of two sorbents with sorption activity, both in acidic and in a slightly alkaline medium. The optimum ratio of sorbents allows the maximum sorption of the five most dangerous mycotoxins in the stomach and their minimum desorption in the intestine. The structure of "Fungistat-GPK" is a proteolytic complex, which increases the efficiency of digestibility of proteins and activates, thus, the metabolic processes in the animal body, as well as immune stimulator and regulator of metabolism “Purivitin”, which increases metabolism, normalizes energy balance, decreases stress and increases overall immunity of the body [15, 16].
The practical efficiency of the sorbent is determined as a percentage of the difference between adsorption (binding) and desorption (release). The higher the coefficient, the more effective the adsorption and the more bound, and hence deactivated mycotoxin.

The practical efficiency is the sorption capacity equal to the difference between the amount of adsorption and desorption, that is, the amount of toxin remaining associated with the sorbent and present in the mixture. Researchers [15] found that “Fungistat-GPK” has a practical coefficient of efficiency against T-2 toxin, ochratoxin, aflotoxin and DON, as it is proved that a significant part of the toxins in the feed-sorbent system is not sorbed, that is, under experimental conditions remains in the aqueous phase. This is due to the fact that the mentioned mycotoxins are hydrophilic enough and in the studied concentrations are markedly solvated by the aqueous phase. These four mycotoxins bind to feed components, as well as to sorbents, due to Van der Waals interactions, the energy of which is not much higher than the energy of solvation by hydrogen bonds. When the concentration of the sorbent in the mixture increases, the ratio increases towards the sorbent and the residual concentration of toxins decreases.

It has been proved [16] that wheat as the main component of the all-mash absorbs a significant amount of toxins, and this grain component contains mobile low - molecular compounds (mono-and disaccharides, fatty acids, triglycerides, inorganic salts, etc.), which pass into the introduced sorbent and deactivate it, competing with toxins. In connection with which the use in the composition of all-mash sorbent “Fungistat-GPK” the code of civil procedure is a promising and relevant.

Dynamics of live weight was taken into account by individual weighing. To determine the meat efficiency of conducted the slaughter at the 3 heads of the rabbits from each group according to the method of CABINDA, evaluation of meat quality was carried out according to methods [19]. Studies were carried out using the material and technical base of the Institute of pathology, pharmacology and therapy (Voronezh).

Amino acid composition was determined according to GOST 13496.21-2015 using hydrolysis and determination of amino acids by high-performance liquid chromatography. Fatty acid composition was determined according to GOST R 55483-2013c using the method of gas chromatography. The quality of rabbit meat was evaluated according to GOST 20235.0-74. Assessment of chemical composition and biological value, physical and chemical parameters of rabbit meat was carried out in accordance with the recommendations [17].

RESULTS AND THEIR DISCUSSION

Table 1 - Dynamics of live weight of rabbits, g (x±S)

Age, days	Group		
	Group 1 (control)	group 2 (1 experimental group)	Group 3 (2 experimental group)
1	38.58 ±0.10	38.60 ±0.12	38.78 ±0.11
60	1487.14 ±20.17	1487.43 ± 17.50	1486.20 ±18.24
120	2980.5±20.17	3112.8±22.24	3325.2±20.39
Average daily growth	24.88±0.75	27.12±0.86	30.65±0.74
Safety, %	90.0	90.0	100.0

The dynamics of live weight reflects the nature and level of feeding of young rabbits. At the initial stage of the experiment the weight of the rabbits of control and test groups was similar and amounted to an

average of 38.6 g. At the age of 120 days, the rabbits of the 1st group (control) was characterized by live weight, which was less than the mass of animals of the 1st experimental group on 132,3 g, or 4,43 % ($P < 0.05$), 2nd experimental group - a on of 144.7 g, or of 4.85 % ($P < 0.01$) (table 1).

Indices of slaughter of animals give an idea of the quantitative side of the meat productivity of the animal. But such indices as pre-slaughter weight, mass of fresh-killed carcass and its yield do not give a complete picture of the nutritional value. Important is the morphological composition of carcasses, which reflects the quantitative ratio of muscle, fat, bone and connective tissue.

High biological plasticity and adaptability to a variety of conditions distinguishes rabbits from all farm animals. It should be noted that insufficient and unbalanced feeding leads to a delay in the growth of individual parts of the body of animals, especially reduced output of muscle tissue and increases the proportion of bone and connective tissue. Therefore, the results of the study of the morphological composition of rabbit carcasses allow us to characterize more accurately the changes that occur against the background of the use of probiotic preparation "Prostor" and "Enzimsporin" against the background of the use of the toxin neutralizer "Fungistat -GPK".

Studies have established clear intergroup differences in the morphological composition of rabbit carcasses. The inclusion of probiotic preparations and hepatoprotector "Fungistat -GPK" in the diet of rabbits had a favorable effect on the output of muscle tissue (table 2). It was found that the pre-slaughter live weight, as well as the mass of the chilled carcass of rabbits of the experimental groups, was higher compared to the weight of the animals of the control group.

The highest pre-slaughter weight was in the 2nd experimental group of rabbits and amounted to 3025 g, which exceeded the pre-slaughter weight in the control and 1st experimental group by 5.78% and 1.85%, respectively.

Compared with the control group of rabbits, the pre-slaughter mass of the 2nd experimental group of rabbits was higher by 165.2 g or 5.78%, compared with 1st experimental group by 132.3 g, or 1.85 % ($P < 0.05$). In the 2nd experimental group of rabbits carcass yield was 77.97 %, which is more than in the control group by 6.08%.

Table 2 - Morphological composition of carcasses (n=3)

Indicator	Group 1 (control)	group 2 (1 experimental group)	Group 3 (2 experimental group)
Pre-slaughter live weight, g	2860.5±11.10	2912.8±13.60	3025.20±12.40
Weight of chilled carcass, g	1708.0±11.19	1789.5±11.24	1905.00±12.75
Slaughter output, %	59.72±0,10	61.41±0.17	62.97±0.14
Weight of boneless meal, g	1255.5±0.12	1325.20±0.16	1485.40±0.19
Output, of boneless meal %	73.50±2.25	74.04±1.89	77.97±3.18
Bone mass, g	353.2±0.11	342.00±0.13	312.80±0.16
Bones output, %	20.68±0.22	19.11±0.19	15.89±0.21
Fat weight, g	99.30±0.15	122.00±0.18	106.80±0.16
Fat output, %	5.81±0.05	6.82±0.06	5.60±0.09
Index flesh meat	3.55±0.78	3.87±0.62	4.74±0.55

Rabbits of the 1st experimental group surpassed animals of the control group by weight of the cooled carcass on 81,5 g (4,77%; P<0,05), the 2nd experimental groups – on 197 g (11,53%; P<0,01). A similar pattern was observed in the output of muscle tissue obtained after boning. Rabbits of the control group were inferior to peers of the experimental groups by 69.7 and 229.9 g (5.55 and 18.31%, respectively; P<0.01).

The calculated index of flesh meat showed that rabbits receiving all-mash PK-90-2 with the introduction of probiotic supplements "Enzimsporin" and hepatoprotector – sorbent «Fungistat-GPK» code of

civil procedure" (2nd experimental group) have a greater index of flesh meat - of 4.74, compared to the rabbits of the experimental group 1 and control of 3.87 and 3.55 units, respectively.

Meat quality indices directly depend on the chemical composition and energy value [7, 19, 20, 21, 22, 23]. Table 3 shows the chemical composition of rabbit meat. Use in the feeding of rabbits the probiotic supplements "Prostor" and "Enzimsporin" together with neutralization of toxins "Fungistat-GPK" contributed to the increase of mass fraction of protein in muscle mass. The content of the mass fraction of fat in the muscle tissue of rabbits of the control group and experimental groups differed slightly, no significant differences were found.

Table 3 - Chemical composition of rabbit meat, m±s

Indicator	Group		
	Group 1 (control)	group 2 (1 experimental group)	Group 3 (2 experimental group)
Mass fraction of moisture, %	74.40±0.51	73.00±0.61	73.05±0.54
Mass fraction of protein, %	18.03±0.22	19.02±0.31	20.45±0.36
Mass fraction of fat, %	6.37±0.42	6.50±0.37	6.40±0.35
Ash mass fraction, %	1.03±0.03	1.04±0.02	1.05±0.03

The highest protein content was observed in the meat of rabbits of the 2nd experimental group and amounted to 20.45%. According to the fat content, rabbits of the experimental groups did not differ significantly between themselves and the control group. The maximum amount of mineral substances was observed in rabbits of the 2nd experimental group.

The value of meat as a protein component is determined by a set of amino acids, both non-essential and essential, determining the biological value of the products.

Table 4 - Content of essential amino acids in muscle tissue, mg / 1 g protein

Amino acid	Experimental group			
	Ideal protein FAO/who, mg/g protein (2011) [10]	Group 1 (control)	Group 2 (1 experimental group)	Group 3 (2 experimental group)
Valine	40.0	38.7	40.6	44.2
Isoleucine	30.0	34.4	36.3	39.8
Leucine	61.0	67.9	68.8	73.0
Lysine	48.0	43.5	45,2	47.7
Methionine+ cystine	23.0	22.8	24.4	26.2
Threonine	25.0	32.7	33.4	37.0
Tryptophan	6.6	3.10	3.40	3.59
Phenylalanine+tyro sine	41.0	38.2	39.5	40.8
Histidine	16.0	30.5	31.8	32.6

The biological value of rabbit meat proteins was evaluated by amino acid composition, in which the presence of all essential amino acids was established. The research data are given in table 4.

Meat of rabbits grown with the use of probiotic preparation and toxins neutralizator “Fungistat-GPK” (table 4). contains valine, isoleucine, leucine, lysine, methionine+cystine, threonine, tryptophan and phenylalanine in significant amounts, indicating the protein value of rabbit meat of experimental groups.
The data on fatty acid composition of carcasses of rabbits on the background of the u

se of probiotic supplements and toxins neutralizator “Fungistat-GPK” code of civil procedure" are given in table 5.

Table 5- Fatty Acid composition of rabbit meat

Indicator	Content, g per 100 g of product		
	Group 1 (control)	group 2 (1 experimental group)	Group 3 (2 experimental group)
Cholesterol	0.071	0.044	0.032
Fatty acids	2.31	2.30	2.30
Saturated, including:	1.24	1.06	1.02
myristin	0.05	0.04	0.07
pentadecanol	0.03	0.02	0.02
palmitic	0.66	0.54	0.50
margarine	0.02	0.02	0.02
stearic	0.48	0.42	0.38
Monounsaturated, including	0.93	1.06	1.09
myristoleic	0.09	0.14	0.15
palmitoleate	0.05	0.07	0.08
oleic	0.79	0.85	0.86
Polyunsaturated, including	0.14	0.20	0.22
linoleic	0.04	0.08	0.09
linolenic	0.06	0.06	0.07
arachidonic	0.04	0.06	0.06

The fatty acid composition of rabbit meat is characterized by a high content of polyunsaturated fatty acids: linoleic, linolenic, arachidonic, and there is a decrease in cholesterol against the background of the use of the probiotic preparation.

Rabbits of the 2nd experimental group is superior to other investigated group of rabbits on the content of monounsaturated and polyunsaturated fatty acids, indicating the benefits of use of probiotic preparation "Enzimsporin" together with the neutralizer of toxins "Fungistat-GPK". Carcasses of the 2nd rabbits of experimental group also have the lowest cholesterol content in comparison with control and rabbits of the 1st experimental group.

Carried out organoleptic evaluation of the meat and broth of rabbit of the control and test groups showed a positive effect of probiotic feed additive "Enzimsporin" together with the neutralizer of toxins in the formation of the sensory profile of boiled meat and broth. The highest score was characterized by samples of boiled meat and broth obtained from the carcasses of the 2nd experimental group (8,6 and 8,1 points, respectively). Samples of boiled meat and broth obtained from the carcasses of rabbits of the control and the first group did not differ significantly (7.7 – 7.9 and 7.3 - 7.5 points, respectively).

The veterinary and sanitary examination of meat and products of slaughter of rabbits of control and experimental groups deviations from the existing norms did not reveal (table 6).

Physical and chemical parameters of meat corresponded to indices for fresh meat with normal course of autolytic processes and maturation.

Table 6 - Indicators of veterinary and sanitary examination of meat and products of slaughter of rabbits

Indicator	Group		
	Group 1 (control)	group 2 (1 experimental group)	Group 3 (2 experimental group)
Physical and chemical parameters			
the pH of	5.81±0.03	5.84±0.04	5.85±0.02
Reaction to peroxidase	+	+	+
Reaction with $CuSO_4$	-	-	-
Volatile fatty acids	2.10±0.03	2.14±0.01	2.16±0.01
Amino-ammonia nitrogen	0.86±0.02	0.91±0.04	0.93±0.03

CONCLUSIONS

Enrichment of feed rations of young rabbits with probiotic microorganisms and toxin neutralizer has a positive effect on meat productivity, safety, increase of biological value of rabbit meat. Analysis of the chemical, amino acid and fatty acid composition of meat obtained from rabbits of the control and experimental groups showed that the use of the probiotic preparation "Enzymsporin" together with the toxin neutralizer "Fungistat-GPK" promotes the accumulation of protein substances in muscle tissue, while balancing the composition of unsaturated fatty acids.

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