

Effect of the *Bacillus subtilis*-based drug on the morphobiochemical and productive parameters of young goats

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Abstract. The effect of Extrasol based on *Bacillus subtilis* (Bisolby-Inter LLC) on the physiological, biochemical and productive parameters of young goats of the Zaanen breed was studied. The research and production experience were carried out on the 20 Zaanen goats on the Peasant Farm "Semkina O.V." in the Samara Region. The biological effect of the drug Extrasol is due to adsorption properties, the ability to enhance the activity of enzyme systems and increase intestinal and general immunity of the body. The use of the drug increases the intensity of anabolic processes in the body of animals: the amount of total protein in the blood serum of goats of the experimental group at 120 and daily age was higher than 9.7% ($r \leq 0,05$), albumins - by 33% ($r \leq 0,001$), compared with control animals. The blood glucose content of 120-day-old goats of the experimental group was 11.2% higher ($r \leq 0,05$) relative to control data.

1 Introduction

In recent years, dairy and meat goat breeding has become widespread in the Russian Federation. According to the research of domestic and foreign authors, dairy goat breeding is one of the most promising and profitable areas of animal husbandry. Balanced feeding of goats of dairy productivity makes it possible to fully realize the genetic potential inherent in their breed to obtain high-quality dairy products. Scientists have proved that the use of probiotics and other biologically active substances in addition to the basic diet leads to an increase in metabolism in the body of farm animals, an increase in nutrient absorption and a reduction in feed costs per unit of live weight gain [1-4].

Researchers Dementieva E.P. and Lobozhina Z.V. note in their scientific work that the use of probiotics in animal husbandry becomes an integral part of this process, since the growth and health of animals depend on the work of the intestines, the synthesis of vitamins and amino acids, the digestion of food and the assimilation of all necessary vitamins and minerals from feed, the utilization of metabolic products [5].

Plotnikova E.Y. in a scientific paper writes that among the most important biochemical properties inherent in *Bacillus subtilis*, it is necessary to highlight the ability of acidification of the medium, as well as the production of antibiotics. It is thanks to these properties that the hay wand from the genus of bacilli is able to reduce the impact of various conditionally pathogenic, as well as pathogenic microorganisms. *Bacillus subtilis* is an antagonist to yeast fungi, salmonella, proteus, streptococci, staphylococci. Other important properties

of *Bacillus subtilis* include: synthesis of vitamins, amino acids and immunoactive factors; active production of enzymes capable of removing products of putrefactive decay of tissues [6].

Author Volodkina G. M. found that the use of the probiotic "Vetom 1.1", the active component of which is *Bacillus subtilis*, has a hematopoietic and immunostimulating effect, positively affects the growth rate of young cattle and reduces feed costs per unit of production [7].

Scientists Chelnokov V.A. and Sein O.B. studied the effect of the probiotic drug Vetom 1.1 on the physiological status and meat productivity of red-mottled bulls. Submitted to the experiment in experimental animals would have a higher hematocrit index ($40.0 \pm 3.7\%$), the content of erythrocytes ($7.2 \pm 0,11 \cdot 10^{12/l}$) and hemoglobin at (120.0 ± 6.4 g/l). At the same time, the differences in the content of erythrocytes were statistically significant ($p < 0.05-0.01$). By the end of fattening, the bulls of the experimental group exceeded the animals of the control group by an average of 33.0 kg in slaughter weight. Carcasses of bulls taking the drug Vetom 1.1 differed in the content of the most valuable (69%) nutritionally components (muscles, fat), and the proportion of inedible parts (tendons, fascia, ligaments, bones) was less (31%) than in control animals (63% and 37%) [8].

Scientists Egorova T.A. and co-authors studied the effect of the drug Cellobacterin-T (contains a live culture of *Bacillus subtilis* bacteria and filler) on the productivity of broilers. Cellobacterin-T has a high probiotic activity, having a positive effect on the composition of the bacterial community in the blind

processes of the intestine in broiler chickens. As a result of feeding the drug, there was a significant increase in the number of normoflora, as well as a decrease in the number of microorganisms traditionally associated with intestinal dysbiosis in humans and animals. In the group that consumed Cellobacterin-T, chickens were characterized by the greatest increase in live weight, accelerated growth; in addition, they had higher digestibility of feed nutrients and accumulation of vitamins A, E, B₂ and carotenoids in the liver [9].

Skvortsov E.V. and colleagues studied the effect of the probiotic drug *Bacillus subtilis* emulsified in palmitic acid on the physiological state and growth rate of laboratory rats. The results showed the presence of a positive effect of the use of emulsified bacteria on their survival during the passage of the gastrointestinal tract, that is, emulsified bacteria are resistant to low gastric pH and high concentrations of bile in the duodenum. An increase in the number of bacteria *B. subtilis* was accompanied by a decrease in the number of *Bifidobacterium* sp., *Lactobacillus* sp. and *E. coli* in the intestine. The ability of *B. subtilis* bacteria to have a positive effect on the body weight gain of rats has been shown. This means that emulsified *Bacillus subtilis* preparations show signs of effective probiotics and can be recommended for use in animal husbandry [10].

Afanasyev E.N. and colleagues have developed a probiotic drug for farm animals and poultry, which contains a mixture of suspensions of bacterial strains and a protective environment. After taking the drug daily for 18 days in the experimental group of calves, the total weight gain (by 25 heads) per day was 15 kg (0.6 kg per 1 head), and 270 kg per 18 days. The difference in the daily weight gain of calves for the experimental and control groups was 3.7 kg, and for the entire time of the experiment 67.5 kg. In the experimental group of piglets receiving this biopreparation, the total weight gain (for 20 heads) per day was 5.5 kg (0.275 kg per head), and for 18 days 99 kg. The difference in the daily weight gain of piglets for the experimental and control groups was 3.1 kg, and for the entire time of the experiment 55.8 kg. The use of the drug increased the total weight gain of poultry by 25% and reduced the incidence from 10% to 4% compared to the control [11].

In connection with the above, the use of modern domestic biologically active substances that improve the physiological and productive indicators of farm animals is an urgent research topic.

The purpose of the research is to study the effect of the drug Extrasol based on *Bacillus subtilis* H-13 1.5×10^8 (Bisolbi-Inter LLC) on the physiological, biochemical and productive indicators of young goats of the Zaanen breed.

2 Material and methods

The scientific work was conducted at the Department of "Epidemiology, pathology and pharmacology", test

research laboratory, Department of biotechnology and veterinary medicine FSBEI HE "Samara State Agrarian University" and the dairy farm of KFX "Semkina O.V." of Privolzhsky district, Samara region.

The research and production experience was conducted on goats of 60 days of age, selected according to the principle of analogues, taking into account the breed, age, sex, body weight, physiological and clinical condition and physiological maturity. The animals in the control group received the basic diet (BD), balanced on the major indicators of nutritional quality in accordance with the rules of the RAAS. Animals of the experimental group BD with the addition of a solution of Extrasol based on *Bacillus subtilis* 5 ml per head once a day for 15-20 minutes before feeding. Solutions were administered to goats through a drencher in compliance with the rules of asepsis and antiseptics. The composition includes *Bacillus subtilis*, strain H-13 and metabolites obtained during the cultivation of the strain in a concentration of at least 100 million mg. CFU / ml on a mineral-silica powder filler. The drug has a positive expert opinion on the toxicological and hygienic assessment of the strain of the drug Extrasol based on *Bacillus subtilis* H-13 1.5×10^8 (LLC "Bisolbi-Inter") from 30.03.2010 from the Research Center for Toxicology and Hygienic regulation of Biological products (FSUN SIC TBP). The biological effect of the drug is provided by its high adsorption properties and surface activity. That allows it to adsorb a wide range of mycotoxins, pesticides, toxic metals, radionuclides contained in feed and simultaneously inhibit the development of pathogenic and conditionally pathogenic microorganisms, creating favorable conditions for the development of lacto- and bifidobacteria in the digestive tract. This generally reduces the toxic load on the body and simultaneously increases the activity of a number of enzyme systems of the animal body [12].

3 Results and discussion

Zoogenic indicators in the livestock premises of KFH "Semkina O.V." comply with the standards for the maintenance of small cattle. The microclimate in the room was characterized by the following indicators: the average air temperature was $18.60 \pm 0,30$ °C, the relative humidity was $73.80 \pm 1.50\%$.

The chemical composition and nutritional content of the feed used in the farm for feeding goats corresponds to all-Russian data (Table 1). Felucene - salt for small cattle (MRS) was added freely to the feeders.

General physiological indicators: body temperature, pulse rate, respiration in goats from 60 to 120 days of age varied evenly and corresponded to their calendar day of development. The body temperature of the animals ranged from 39.2 to 41.250 C; pulse rate from 94 to 99 beats per minute; respiratory rate from 18 to 21 respiratory movements per minute.

Table 1. Structure of the main diet of goats, %.

stern	moisture	protein	fat	cellulose	BEV	ashes	dry matter	Nutritiousness, g	
								feed units	digestible protein
Grain-and-grass hay	17.0	8.4	0.9	23.4	41.1	10.0	83.0	0.46	41
grassy grass	64.8	4.2	1.3	10.8	18.9	1.53	35.2	0.21	15
Compound feed Megamix for calves	12.0	18.3	4.5	4.7	54.8	9.5	88.0	1.3	116

The effect of the drug Extrasol based on *Bacillus subtilis* H-13 1.5×10^8 on the biochemical parameters of young goats of the Zaanen breed is shown in Table 2.

Table 2. Clinical and physiological parameters of goats' blood serum.

Indicators	Group	
	control	experienced
60 days		
Red blood cells, $10^{12/l}$	7.32±0.12	7.56±0.25
White blood cells, $10^9/l$	10.72±0.31	10.35±0.28
Hemoglobin, %	125.3±5.01	122.9±4.36
Total protein, g/l	64.18±2.12	66.86±2.23
Albumins, g/l	24.34±0.97	25.26±0.76
Globulins, g/l	39.84±1.45	40.60±1.32
Glucose, mmol/l	5.41±0.26	5.68±0.17
120 days		
Red blood cells, $10^{12/l}$	7.31±0.12	7.82±0.19*
White blood cells, $10^9/l$	12.54±0.36	12.10±0.32
Hemoglobin, %	126.4±5.15	130.6±5.01
Total protein, g/l	64.28±2.01	70.54±2.16*
Albumins, g/l	25.71±0.91	31.74±1.25***
Globulins, g/l	38.57±1.21	38.80±1.15
Glucose, mmol/l	5.43±0.20	6.04±0.19*

Here and further note: * - $p \leq 0.05$, ** - $p \leq 0.01$, *** - $p \leq 0.001$ – relative to the control data.

All the studied indicators were within the physiological norm. The content of erythrocytes in the peripheral blood of experimental animals at the age of 120 days after 60 days of daily administration of the drug was 6.8% higher ($p \leq 0.05$) compared with similar data of control animals. The main function of hemoglobin is the transfer of oxygen to tissues. In the goats who took the drug Extrasol in addition to the main diet, there was an increase in hemoglobin compared to the control by 3.3%, which indicates a higher intensity of metabolic processes in the body of the goats.

The state of protein metabolism is determined by the total protein content. In the body, protein performs the following functions: participates in blood clotting, maintains blood pH constancy, performs a transport function, participates in immune reactions and many other functions. The amount of total protein in the blood serum of the experimental group of goats at 120 days of age was 9.7% higher ($p \leq 0.05$), albumins by 23% ($p \leq 0.001$) compared with the data of control animals. The use of the drug Extrasol increases the intensity of anabolic processes in the body of animals, as evidenced by a higher content of total protein and specifically its albumin fraction.

Glucose supports the normal functioning of individual cells, organs and the body as a whole. The results of the studies showed that the glucose content in

the blood of 120-day-old goats of the experimental group was 11.2% higher ($p \leq 0.05$) and was 5.68 ± 0.31 mmol/l relative to the data of the control group and was 6.04 ± 0.19 mmol/l. The use of the drug Extrasol to goats for 2 months contributed to an increase in the intensity of carbohydrate-lipid metabolism.

Table 3. Dynamics of growth and weight indicators of calves.

Indicators,	Group	
	control	experienced
1	2	3
60 days		
Body weight, kg	11,64±1,16	11,82±1,23
Body temperature, °C	40,23±1,02	40,13±0,92
Heart rate, beat / min	98,56±3,41	96,55±3,37
The respiratory rate and respiratory movements /min	19,06±1,21	19,34±1,01
120 days		
Body weight, kg	21,32±1,79	23,25±2,58*
Average daily gain, kg	0,161±0,02	0,190±0,04*
Body temperature, °C	40,02±1,25	39,9±1,22

Heart rate, beat / min	82,12±1,23	83,41±1,24
The respiratory rate and respiratory movements /min	16,32±1,23	17,36±1,14

All clinical and physiological parameters corresponded to the norm, but in the experimental group during the experiment, the indicators were higher, which indicates metabolic processes in the body of goats that are more intensive. The body weight of the goats in the control group at 120 days of age was 21.32±1.79 kg, in the experimental group - 23.25±2.58 kg, which was significantly higher by 1.93 kg relative to control. The average daily increase in the experimental group was significantly higher by 0.029 kg. The administration of the drug Extrasol based on *Bacillus subtilis* to goats increased the weight indicators of the animals.

Calculations of economic efficiency were carried out taking into account the costs of meat production and the proceeds from its sale at a price of 117 rubles per kg according to the website [https://rosstat.gov.ru/storage/mediabank/cena_sx .xlsx](https://rosstat.gov.ru/storage/mediabank/cena_sx.xlsx), as well as the contractual cost of the drug based on *Bacillus subtilis* 350 rubles per 1 liter. The norm of feeding according to the experimental scheme is 0.5% of the preparation based on *Bacillus subtilis* from the dry substance OR 5 ml in liquid form, taking into account the recalculation of the active substance. The scientific experiment was carried out for 60 days. For one animal during the period of the scientific experiment, 300 ml of the drug was spent on preventive measures, which corresponds to the amount of 105 rubles, as well as 50 rubles for additional maintenance of the animal. The economic effect of the additional profit received at the end of the research and production experience was calculated on the basis of the data obtained. The use of the drug Extrasol contributed to an increase in the live weight of the animal, the possible profit from the sale of meat of young goats of the experimental group was higher by 70.81 rubles from each head.

4 Conclusion

The administration of the drug Extrasol based on *Bacillus subtilis* H-13 (Bisolbi-Inter LLC) to the young goats of the Zaanen breed in a dose of 5 ml per head daily from the age of 60 days allowed one to optimize the intensity of metabolic processes in the body of animals and increase the average daily gain. Based on the conducted studies, it is possible to recommend the drug Extrasol as a biologically active additive for young goats in order to increase the productive performance of animals and to obtain conditionally additional profit of 70.81 rubles per head.

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