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Use of the Bioprimum Sukhoy Feed Additive in Cow Feeding

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Abstract

Currently, the search for alternative ways to replace the use of antibiotics in animal husbandry is being intensively conducted all over the world, including in Russia. One of the possibilities for the replacement of antibiotics in feed mixtures is the development and testing of probiotics in production conditions. They are biomass of bacteria in vegetative or spore form with a clearly expressed antagonistic activity to the pathogenic and conditionally pathogenic microflora of the gastrointestinal tract chyme. Probiotics have a beneficial effect on the animal's body. Animals' saprophytic microflora is capable of producing biologically active substances in the course of their vital activity, suppressing the growth of pathogenic microorganisms, malignant tumors, and normalizing various pathological and biochemical processes in the animal body. The outcomes of research on the use of the Bioprimum Sukhoy (dry) feed additive added in different dosages into cows' diets. It was found that feed additive introduction in the cows' diet composition at a dosage of 75 mg/kg of dry matter of feed resulted in an increase of hemoglobin and red blood cell content in the bloodstream by 11.40 and 6.05%, respectively, compared with analogs of the control group, an increase in milk productivity by 13.8%, the amount of milk fat by 14.8% and milk protein by 14.2%.

Keywords: Diets, Hematological parameters, Red blood cells, Protein, Milk yield increase, Lactation

Introduction

To prevent and treat gastrointestinal diseases of bacterial etiology and reduce economic losses when changing feed, after courses of antibiotic therapy and vaccination, about 10 years ago, after numerous tests, several probiotic preparations of a wide spectrum of action were created based on strains of bacteria B. Bacillus subtilis as producers of biologically active substances (BAS), such as enzymes, antibiotics, insecticides, and other substances that regulate and stimulate digestion and have anti-allergenic and antitoxic effects. Bacteria B. Bacillus subtilis are highly adaptable to various conditions of existence (presence or absence of oxygen, growth, and development in a significant temperature range, the use of various organic or inorganic compounds as food sources, etc.), contribute to the spread of bacilli in soil, water, air, food and other objects of the external environment, as well as in the animal bodies (Ernst & Naumenko, 2006; Pestis *et al*., 2006; Khaziahmetov *et al*., 2016; Mikolaichik *et al*., 2017a;2017b; Jacquier *et al*., 2019; Chaudhary *et al*., 2021; Zhang *et al*., 2021; Wang *et al*., 2022).

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B. Bacillus subtilis strains produce antagonistically active biomass against pathogens, as well as proteolytic, amylolytic, and lipolytic enzymes. The B. Bacillus subtilis strains used for the development of the preparation, multiplying in the intestines of animals, release BAS, under the influence of which the digestion processes are activated, as a result of which the average daily gain in live weight increases, productivity increases together with the safety of the livestock, and feed cost per unit of production is reduced.

A new effective strain from the genus Bacillus amyloliguefaciens B-20/VKPM has been invented for a feed additive that increases the productivity of farm animals, poultry, and fish (Ciric *et al*., 2019; Mancini *et al*., 2019; Imade *et al*., 2021). The strain of Bacillus amyloliguefaciens B-20/VKPM was isolated from the soils of the ecologically clean Prioksko-Terrasny Nature Reserve, identified to the species by analyzing 16 S RNA with the All-Russian Collection of Industrial Microorganisms (VKPM) of Federal State Unitary Enterprise State Science and Research Institute (FGUP GosNII) Genetica and entered into the depository of this collection under the number Bacillus amyloliguefaciens B-20/VKPM B 12168. The strain does not grow under anaerobic conditions, does not form acetylmethylcarbinol from Voges-Proskauer glucose, and ferments glucose, mannose, fructose, ribose, lyxose, cellobiose, trehalose, maltose, and turanose, forming acid. It hydrolyzes starch, urea, and esculin. It has lecithinase and catalase activity. The strain produces biologically active metabolites, including antibiotics and broad-spectrum enzymes that inhibit the growth of pathogenic and opportunistic bacterial and fungal microflora (Mancini *et al*., 2019; Karouche *et al*., 2020; Wang *et al*., 2020).

Taking into account this circumstance, the employees of Biopark-21 LLC have created a feed additive BioPrimum Sukhoy based on the spore-forming bacteria Bacillus subtilis WB3482 (VKPM B-1722) and Bacillus amyloliguefaciens 31 (VKPM B-2336), which can normalize the intestinal microflora and make up for chromium deficiency, and increase productivity and safety of farm animals and poultry.

Up until now, there is not enough practical and scientific data in zootechnical to justify the effect of BioPrimum Sukhoy on the

metabolic parameters in the body of dairy cows, their productivity, and the quality of products.

Materials and Methods

The purpose of our study was to evaluate the impact on multiple levels of the BioPrimum Sukhoy feed additive on biochemical and morphological blood properties, quantitative and qualitative indicators of milk produced.

To achieve this, an economic and methodical test in the production provisions of Agrosoyuz LLC of the Ruzaevsky municipal district of the Republic of Mordovia on cows with the inclusion of variable dosages of the BioPrimum Sukhoy feed additive in their diets.

To experiment with the basis of pairs of analogs, whilst considering the age, lactation period, breed, and live weight 40 cows were selected on the twentieth day after calving, and 4 - 10 head groups were formed. All were medically healthy and in similar environments. The cows were fed three times a day during the experiment. The diets were compiled as per the suggested detailed standards of the Russian Academy of Agricultural Sciences (RASKhN) (2003), with regards to the productivity of the cows, live weight, chemical composition of fee, and physiological state. with the control group of animals getting a basic diet. The analogs of the 1st, 2nd, and 3rd experimental groups, were fed the BioPrimum Sukhoy feed additive at the rate of 60; 75; 90 mg/kg of dry matter in addition to the diet, respectively, or 1,200, 1,500, and 1,800 mg per head per day, respectively **(Table 1)**. The BioPrimum Sukhoy feed additive contains lyophilized microbial mass of spore-forming bacteria Bacillus subtilis WB3482 (VKPM B-1722) and Bacillus amyloliguefaciens 31 (VKPM B-2336) at least $2x10^9$colony-forming units (CFU) in 1 g, 15% of chromium picolinate, and up to 100% of filler: calcium carbonate. The chromium content is 0.018 to 0.02 g in 1 g of the preparation. It does not have genetically modified organisms and products. Nonetheless harmful impurities are not more than the maximum permissible force regulations in the Russian Federation. In appearance, it is a loose powder from beige to cream color.

Table 1. Scheme of an economic and scientific experiment

Group	heads in the group	Level of feed additive in the diet, mg/kg of dry matter	Qty of feed additive per head per day, mg
Control	10	Basic diet	-
1st experimental	10	60	1,200
2nd experimental	10	75	1,500
3rd experimental	10	90	1,800

To control the physiological state and the course of biochemical processes in the body of dairy cows under the influence of different dosages of BioPrimum Sukhoy **(Table 1)**, we conducted a study of the dynamics of morphological and biochemical parameters of the cows' blood at the beginning and end of lactation.

Results and Discussion

According to the results of our study, it was found that diverse amounts of the BioPrimum Sukhoy feed additive in the diets of cows at the beginning of lactation had a certain effect on hematological parameters. Thus, in the blood of cows of the 2nd experimental group, there was an upsurge in the content of hemoglobin and RBC count by 11.40% and 6.05% compared with the control group and by 6.05% and 2.78% compared to the peers of the 1st test group. A rise in the feed additive in the diets of cows of the 3rd experimental group to 90 mg/kg of the dry matter of the diet contributed to a slight decrease in the studied indicators compared to the 2nd experimental group. A decrease of 3.95% and 2.03%, respectively, of red blood cells and hemoglobin, was observed **(Table 2)**.

A similar pattern was observed in the morphological parameters of blood at the end of lactation. Thus, in the blood of cows of the 2nd experimental group, the content of red blood cells and hemoglobin increased by 6.01% and 6.65% compared with analogs of the regulation group.

The number of white blood cells almost did not change, with only a slight increase in regulated groups' blood. It can be assumed that all this indicated a more rigorous course of processes of reduction and oxidation in the body of animals.

Table 2. Morphological parameters of cows' blood

Group	Red blood cells, 10^{12} g/l	White blood cells, 10^9 g/l	Hemoglobin, g/l
Beginning of lactation			
Control	6.14±0.03	9.22±0.12	104.17±0.81
1st experimental	6.45±0.05	8.98±0.06	107.47±1.60
2nd experimental	6.84±0.04	8.32±0.10	110.46±1.31
3rd experimental	6.58±0.10	8.54±0.06	108.26±1.04
End of lactation			
Control	6.06±0.09	9.03±0.03	101.98±1.14
1st experimental	6.13±0.13	8.81±0.11	105.34±1.55
2nd experimental	6.42±0.10	8.32±0.10	108.77±0.90
3rd experimental	6.24±0.09	8.54±0.07	106.37±1.12

An important indicator of the state of protein metabolism in the body is its total and fractional content in the blood. Our studies have shown employment of BioPrimum Sukhoy feed additive in the diets of cows of the 2nd experimental group at the rate of 75 mg/kg of diet dry matter, led to an upsurge in the blood protein amounts as compared to analogs from the control group by 5.87% and 4.25% compared to the 1st experimental group ($P<0.001$). A parallel pattern was seen for the albumin and globulin count. In the blood of cows of the 2nd experimental group, the content of albumins by 9.86% and globulins by 2.31% is greater, contrasted to the control group peers and by 6.47 and 2.19% respectively, assessed against the animals of the 1st experimental group. Of the globulin fraction, gamma globulins occupy the largest share, and their lowest concentration in all age periods was noticed in the 2nd experimental group animals. The number of alpha- and beta-

globulins in the 2nd group was relatively higher when contrasted to the control, 1st, and 3rd experimental groups.

As a result of the conducted study, it was found that the inclusion of different dosages of the BioPrimum Sukhoy in the diets of cows had a positive effect on the quantitative and qualitative indicators of milk. It was found that during the first lactation, 8,806.6 kg of milk was obtained from the first-calf cows of the 2nd experimental group, which is 13.8% (P<0.001) and 5.0% (P<0.001) more compared to the analogs of the 1st and control groups. The increase of the dosage of the BioPrimum Sukhoy feed additive to 90 mg/kg of the dry matter diet did not contribute to a further increase in milk productivity. However, milk yield for the first lactation was higher by 443.2 kg or 5.7% (P<0.001) compared to the analogs in the control group (Taranov, 1976; Tarakanov, 2001).

The qualitative indicators of milk are directly dependent on the intake of nutrients and BAS into the body and their ratio in the diet and bioavailability.

In general, 326.7 kg of milk fat was obtained from cows of the 2nd experimental group during lactation, which is 42.1 or 14.8% (P<0.001) more than in comparison with analogs of the control group and 13.1 or 4.2% (P<0.01) matched to the 1st test group.

A comparable pattern is seen in the yield of the amount of milk protein. Thus, from cows of the 2nd experimental group we obtained 295.9 kg of protein during the lactation, while the amount of protein obtained from peers of the control group was less than that by 14.2% (P <0.001) and 5.0% (P <0.01) less than from the 1st experimental group. Significant differences in the qualitative composition of milk were observed after the first days of feeding the BioPrimum Sukhoy feed additive to animals of the 2nd experimental group. Thus, the amount of dry matter increased by 0.58%, the non-fat milk solids (NFMS) by 0.37%, fat content by 0.03%, protein content by 0.01% compared to analogs of the control group (Ovsyannikov, 1976; Taranov, 1976; Aliev, 1997; Goncharova *et al*., 1989; Tarakanov, 2001; Danilevskaya & Subbotin, 2008; Artemov *et al*., 2011; Ciric *et al*., 2019).

Conclusion

Based on the above, it was found that the inclusion of 75 mg/kg of dry matter of the feed additive, BioPrimum Sukhoy in the cows' diet contributed to the normalization of blood composition and an increase in quantitative and qualitative indicators of milk productivity.

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Conflict of interest: None

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