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MICROBIOLOGICAL SUPPLEMENTS FOR THE METABOLIC RATE CORRECTION IN CALVES

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ABSTRACT

This work focused on the effects of yeast probiotic supplements on the metabolic rate in calves up to six months of age. Studies have established that the use of the optical-yeast probiotic supplement Optisaf in the diets of young cattle at a dose of 10 g per animal per day increased the digestibility of dry matter by 3.71% (P <0.05), organic matter 2.95%, crude protein 4.26% (P <0.01), crude fat 3.95% (P <0.05), crude fiber 2.85%, and nitrogen-free extract fractions (NFE) by 2.41%; increased the efficiency of metabolic energy and nitrogen by 6.91% (P <0.01) and 2.42%, respectively; contributed to the better utilization of calcium and phosphorus by 6.32% and 9.95%, respectively, in comparison with the experimental control group. The use of Optisaf yeast probiotic supplement led to an increase in the number of Lacto- and Bifidobacteria in the intestines of the 3rd experimental group by 42.19% (P <0.05) and 45.93% (P <0.05), respectively, and a decrease in the number of E.coli bacteria by 36.14%, compared with the control group. The introduction of Optisaf supplements into the diet of calves had a positive effect on their physiological state. The number of erythrocytes in the blood of calves of the 3rd experimental group increased by 9.20% (P <0.05), the hemoglobin content by 9.35% (P <0.05), total protein by 9, 11% (P <0.05), phagocytic activity by 3.67%, compared with the control group.

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1. INTRODUCTION

Within the framework of the Russian Federal priorities for the development of the agricultural sector, the development of livestock breeding plays an important role in food providing of the population [1, 2]. In modern conditions of industrial livestock breeding, a rational system for cattle rearing has an important place in the effective technology for the production of cattle breeding. It provides normal growth, development of an animal with a strong constitution, forms its future productivity and longevity in economic use. In the dairy period, calves, regardless of breed characteristics, must be reared under conditions of intensive feeding, which ensures high weight gain [3]. In the first six months of life calves are the most demanding of feeding and keeping conditions. With balanced feeding and good care, they will grow rapidly; they will be more stress-resistant, which will lead to high productivity in maturity. Inadequate and incomplete feeding during this period causes permanent damage to the growing organism, not only in the early stages of ontogenesis but also during further growth and fattening [4].

The most effective complex solution to these problems today is the new biologically active substances – yeast probiotic supplements. The bacteria that make up their composition, help to optimize digestion, better absorption of nutrients and biologically active substances, participate in the metabolism of proteins, carbohydrates, lipids, bile, and nucleic acids, and synthesize some biologically active substances. They stimulate the growth and development of bacteria, which improve the digestibility of all food components, releasing maximum energy from it, increasing eatability, which ultimately stimulates the growth and development of rearing animals, and helps to increase the safety and productivity of animals [5-11]. In this regard, studies on the effectiveness of the use of yeast probiotic supplements in the diets of rearing cattle are of scientific and practical interest, and also determine its relevance.

The aim of our research was to study the effect of yeast probiotic supplements on the metabolism rate of calves up to six months of age.

2. METHOD

The experimental part of the work was carried out at "Glinki" production in the Kurgan Region (Russia) on heifers of Russian Black Pied breed up to 6 months of age. For the research, 4 groups of 10 heifers of 10 days old were formed, taking into account the weight and origin (Figure 1).

Figure 1: Group heifers of Russian Black Pied breed.

When compiling calves rations, they adhered to the generally accepted norms of feeding according to the Russian Academy of Sciences, which is designed to obtain 800-900 g of the average daily gain in body weight, which was changed every ten days in the process of the research. The calves of the control group were fed according to the scheme adopted at the farm, the studied feed supplements were fed to the heifers in the milk period from 10 days of age (the beginning of feeding of concentrated feeds) to 4 months of age, and the study of the supplements' effect lasted up to 6 months. In the composition of concentrated feeds per 1 heifer per day, the 1stexperimental group was fed the Yea-Sacc 1026 yeast supplement (Alltech, USA) in the amount of 10 g; the 2ndexperimental group were fed the Levucell SC+ yeast supplement (Lallemand, UK) in the amount of 6 g; and heifers of the 3rdexperimental group were fed the Optisaf yeast supplement 10 g (Saf-Neva, St. Petersburg, Russia).

The studied feed supplements are the unique strain of live yeast *Saccharomyces cerevisiae*. The optimal dosage of the Russian-made Optisaf yeast probiotic supplement (Saf-Neva, St. Petersburg) was determined in the diets of Russian Black Pied heifers during the first experiment. Thus, calves of the 1st experimental group were fed 5 g of the studied supplement, calves of the 2nd experimental group 10 g and calves of the 3rd experimental group 15 g per animal per day as part of concentrated feed. Optisaf is a culture of live dried yeast *Saccharomyces cerevisiae* (strain NCYC Sc 47) $1x10^9$ CFU *cerevisiae*, as well as excipients: calcium carbonate 20% and wheat flour up to 100%.

Yea-Sacc1026 is a live yeast culture of a specially selected strain of *Saccharomyces cerevisiae1026*, lyophilized together with medium made of corn, molasses, malt, and trace elements. 1 g of Yea-Sacc1026 contains $5x10^9$ living yeast cells.

Levucell SC+ is an active living yeast *Saccharomyces cerevisiae* (strain CNCM-1077), specialized for rumen, at a concentration of 1.0×10^{10} colony units per 1 g of the supplement.

The studied supplements were introduced to the concentrates by the method of stepwise mixing at the dose recommended by the manufacturer. The experimental animals were kept in group cells of 10 animals in each. In order to determine the digestibility of nutrients in the body of heifers at the end of the experiment, physiological studies were carried out according to generally accepted methods. The chemical composition of feed, its residues and animal biosubstrates was studied in the "Veles" test laboratory, D.V. Iltyakova (Chastoozerye village, Kurgan Region, Russia) and in the laboratories of the department of Animal Feed Storage and Processing Technologies of the Kurgan State Agricultural Academy by T.S. Maltsev (Lesnikovo village, Kurgan region, Russia).

Feed, their residues, and metabolic products obtained from animals during the period of the balanced experiment were subjected to chemical analysis according to generally accepted methods [12] and based on their results, the digestibility of nutrients of diets, the balances of nitrogen, calcium, phosphorus and the metabolic energy in animals were calculated.

In order to determine the intestinal microbiota, feces from three animals in each group were examined. Feces were taken in sterile tubes and diluted in sterile saline from 10^{-1} to 10^{-8}. Of the four diagnostically significant dilutions (10^{-4}–10^{-8}), cultures were made on the differential diagnostic medium (Endo, Ploskireva) [13].

To monitor the state of metabolic processes in the body of the heifers, the morphological composition and blood metabolites were determined: erythrocytes, hemoglobin, leucocytes, alkaline reserve, glucose, residual nitrogen, total protein, and its fractions, calcium and inorganic phosphorus.

Blood samples were taken in the morning, 2 hours before feeding, from three animals from each group. The studies were carried out according to the methods described in [14].

The obtained digital data are processed by methods of variation statistics. Statistical processing of the obtained digital data was carried out using a computer with the processor Intel Core2 Quad (USA), licensed software package Microsoft Office 2007 (USA). To assess the significance of differences between the two average values, the Student's t-test was used. Differences were considered statistically significant at $P < 0.05$; $P < 0.01$; $P < 0.001$.

3. RESULTS AND DISCUSSION

The most important aspects of the interaction of yeast probiotic supplements with intestinal microbiota are the formation of antibacterial substances, as well as competition for nutrients and a change in microbial metabolism, and stimulation of the immune system, which contributes to an increase in digestibility of food nutrients. The amount of nutrients digested by calves during a physiological experiment is presented in Table 1.

Table 1: The average daily amount of nutrients digested by calves, g ($\bar{X} \pm S_{\bar{x}}$)

Index	Group			
	control	1st experimental	2nd experimental	3rd experimental
Dry matter	2073.52±21.76	2151.02±16.62	2192.99±26.17	2245.54±34.99
Organic matter	1954.91±19.39	2013.91±18.52	2054.22±18.37	2090.10±18.64
Crude protein	413.02±4.61	425.62±2.63	432.02±5.08	442.23±3.18
Crude fat	144.36±2.55	148.25±2.16	150.53±2.70	154.04±1.52
Crude fiber	328.86±8.80	343.60±3.72	348.79±6.95	357.88±7.91
NFE	1068.67±17.15	1096.44±12.08	1122.88±8.40	1135.95±12.67

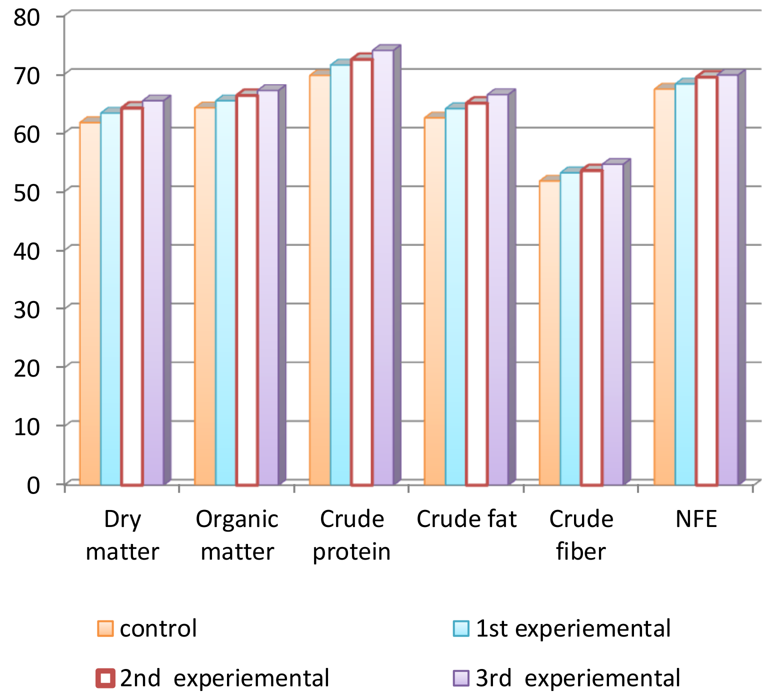

Figure 2: Digestibility coefficients of nutrients (%).

Analyzing the data, we can conclude that animals of the 3rd experimental group better digested the dry matter,compared with the calves of the control, 1st, and 2nd experimental groups, by 172.02 g (8.29%), 94.52 g (4.39%) and 52.55 g (2.40%), respectively; organic matter – by 135.19 g (6.92%), 76.19 g (3.78%) and 35.88 g (1.75%); crude protein – by 29.21 g (7.07%), 16.61 g (3.90%) and 10.21

g (2.36%); crude fat – by 9.68 g (6.71%), 5.79 g (3.91%) and 3.51 g (2.33%); crude fiber – by 29.02 g (8.82%), 14.28 g (4.16%) and 9.09 g (2.61%); NFE– by 67.28 g (6.29%), 39.51 g (3.60%) and 13.07 g (1.16%), respectively.

Figure 2, the digestibility coefficients characterize the utilization of nutrient rations in experimental animals.

Studies have established that the digestibility coefficients of nutrients of dietary feeds are greater in the 3rd experimental group compared to the control, 1st and 2nd experimental groups in terms of: dry matter by 3.71% ($P < 0.05$), 2.10 and 1, 24%, respectively; organic matter – by 2.95%, 1.75 and 0.84%; crude protein – by 4.26% ($P < 0.01$) and 1.53%; crude fat – by 3.95% ($P < 0.05$), 2.39 and 1.45%, crude fiber – by 2.85%, 1.44 and 1.07%; NFE– by 2.41%, 1.53 and 0.39%, respectively.

Thus, feeding the calves of the 3rd experimental group with the Optisaf yeast probiotic supplement at a dose of 10 g /animal/day contributed to better digestion of the nutrients of the diet.

It is impossible to get a correct idea of the animal's need for nutrients without taking into account the characteristics of the processes of energy metabolism in the body.

The metabolism that occurs in the body is interconnected and occurs simultaneously with the exchange of energy. In zootechnical practice, energy is one of the most important normalized indicators of animal diets.

It was established that the feed and the nutrients contained in them are not only a source of energetic materials but also represent a complex of adequate physiological stimuli that affect the animal organism, which affects the change in metabolism and energy. The indicators for calculating the energy efficiency in calves are shown in Table 2.

Table 2: Indicators of energy consumption in calves (MJ/day), ($\bar{X} \pm S_{\bar{x}}$)

Index	Group			
	control	1st experimental	2nd experimental	3rd experimental
Gross energy consumed	62.11±0.69	62.74±0.48	63.08±0.54	63.36±0.40
Energy released with feces	20.62±0.63	20.16±0.55	19.74±0.64	19.34±0.70
Energy digested	41.49±0.36	42.58±0.35	43.34±0.35*	44.02±0.37**
% of NFE	66.80	67.87	68.71	69.48
Energy released with urine	5.14±0.14	5.20±0.13	5.19±0.10	5.32±0.04
Losses in the gastrointestinal tract with methane and heat of fermentation	4.35±0.21	4.43±0.19	4.55±0.06	4.49±0.11
Metabolic energy	32.00±0.31	32.95±0.29	33.60±0.30*	34.21±0.27**
% of NFE	51.52	52.52	53.27	53.99
Thermogenesis	22.46±0.49	22.60±0.52	23.13±0.52	23.61±0.55
Energy of production	9.54±0.17	10.35±0.44	10.47±0.39	10.60±0.29*

When analyzing the obtained results, we found that the consumption of gross energy by experimental animals is practically no different and is at the level of 62.82 MJ / day. At the same time, animals of the 3rd experimental group released less energy with feces by 1.28 MJ (6.62%), 0.82 MJ (4.24%) and 0.40 MJ (2.07%), respectively compared with the control, 1st and 2nd experimental groups.

The diets of the calves of the 2nd and 3rd experimental groups were better digested than the control group by 1.85 MJ or 4.46% ($P < 0.05$) and 2.53 MJ or 6.09% ($P < 0.01$), respectively than the control group, and when compared to 1st experimental group – by 0.76 MJ or by 1.78% and by 1.44 MJ or by 3.38%, respectively. There was no significant difference between the groups in the energy released with urine, losses in the gastrointestinal tract with methane and the heat of fermentation. A higher rate of metabolic energy was also noted in calves of the 2nd and 3rd experimental groups, compared with the control group by 1.60 MJ (5.00%) ($P < 0.05$) and 2.21 MJ (6.91 %) ($P < 0.01$), respectively.

The amount of heat generated by the calves of the experimental groups per day amounted to 23.11 MJ on average, which is 0.65 MJ or 2.89% more compared to the control group. The greatest amount of energy spent on production was observed in animals of the 3rd experimental group as compared with the control, 1st and 2nd experimental groups by 1.06 MJ (11.11%) ($P < 0.05$), 0.25 MJ (2.42%) and 0.13 MJ (1.24%), respectively.

In the metabolism between the body and the environment, the leading place is taken by nitrogen metabolism. This is explained not only by the fact that the main structural elements of cells, tissues and animal organs are protein formations but mainly the nature of proteins, their various specific physicochemical and biological properties inherent in them as carriers of life. Based on the data of physiological experience and the chemical composition of feed, residues, feces, urine, the nitrogen balance was calculated (Figure 3).

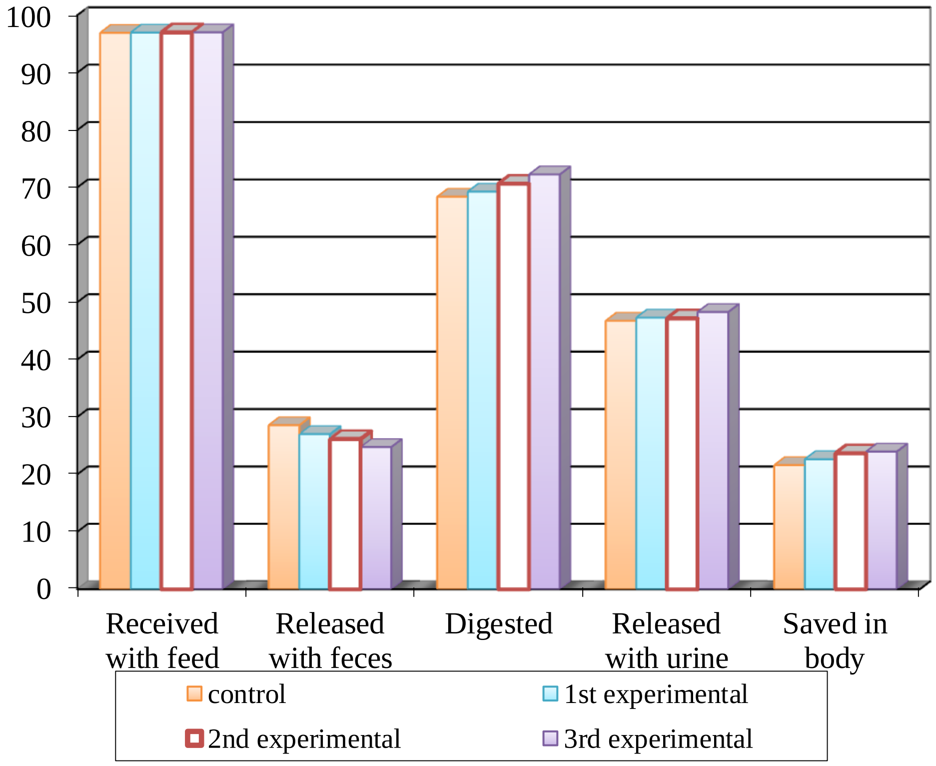

Figure 3: Nitrogen balance in the body of calves (g/animal).

During the physiological experiment, all animals had a positive nitrogen balance, but there are some differences in their utilization between the experimental groups. So, calves of the 3rd experimental group isolated nitrogen with feces at 3.81 g or 15.39% ($P < 0.05$) less than animals in the control group; and 2.26-1.4 g, or 9.13-5.65% in comparison with animals of the 1st and 2nd experimental groups, respectively.

There was no significant difference in urinary nitrogen excretion in the groups. Calves of the 3rd experimental group digested nitrogen better. This indicator is lower for the control, 1st and 2nd experimental groups by 5.68% ($P < 0.05$), 4.33 and 2.28%, respectively.

The highest positive nitrogen balance was in calves of the 3rd experimental group and amounted up to 23.97 g, which is 10.92% more than in animals of the control group, by 5.87% than in the 1st experimental group and by 1, 27% than in the 2nd experimental group. The level of nitrogen consumption in calves is shown in Figure 4.

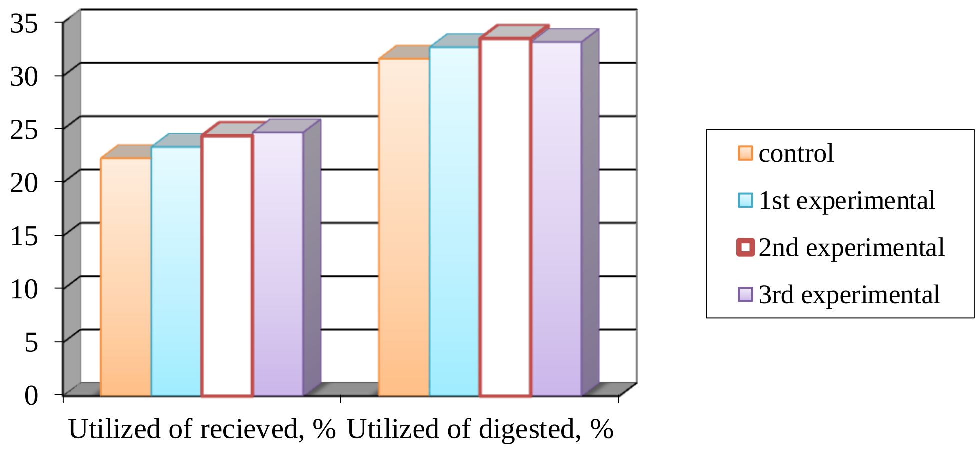

Figure 4: Utilization of nitrogen in the body of calves (%).

An analysis of the results indicates that the calves of the 3rd experimental group more efficiently consumed nitrogen from the received and digested – by 2.42% and 1.57% compared with the control group, and by 1.36% and 0.49% in comparison with the 1st experimental group.

The inclusion of the yeast probiotic additive Optisaf at a dose of 10 g (per animal per day) in the diet of calves provided a more efficient utilization of energy and nitrogen for increasing the live weight.

Among the factors determining the balance of feeding agricultural animals, the conditions of mineral nutrition are essential. Minerals are of great importance for the normal functioning of the organism since they are the necessary basis for building supporting system (bones, etc.); they are part of cells, tissues, organs, and fluids; they are involved in all biochemical processes that take place in a living organism on all structural levels.

Analyzing Table 3 data, it can be noted that the level of calcium consumed in experimental animals was almost at the same level and amounted to an average of 32.56 g. Calves of the 3rd experimental group released calcium with feces by 5.92% and 4.53% less than the animals of the 1st and 2nd experimental groups, respectively, and by 10.03% in comparison with the control group. The calves of the control group excreted more calcium in the urine compared to the experimental groups by an average of 10.87%.

Table 3: Calcium balance in the body of calves (g/animal), ($\bar{X} \pm S_{\bar{x}}$)

Index	Group			
	control	1st experimental	2nd experimental	3rd experimental
Received with feed	32.33±0.24	32.51±0.16	32.67±0.07	32.73±0.03
Released in feces	15.79±0.93	15.20±0.92	15.00±0.75	14.35±0.56
Released in urine	1.02±0.03	0.95±0.01	0.92±0.02	0.90±0.03
Saved in body	15.52±0.83	16.36±0.84	16.75±0.70	17.48±0.55
Utilized of received, %	48.00	50.32	51.27	54.32

The highest positive calcium balance was observed in calves of the 3rd experimental group and amounted to 17.48 g, which is 12.63% and 6.84% more than that of the control and 1st experimental group, respectively, and 4.36% in comparison with animals of the 2ndexperimental group. Calcium was better consumed by calves of the 3rd experimental groups by 6.32% and 4.00% than by the animals of the control and 1st experimental groups, respectively, and by 3.05% than the calves of the

3rd experimental group.

Based on the data in Table 4, it should be noted that experimental animals released phosphorus with feces and urine without any significant difference.

Table 4. Phosphorus balance in the body of calves (g / animal), ($\overline{X} \pm S_{\bar{x}}$)

Index	Group			
	control	1st experimental	2nd experimental	3rd experimental
Received with feed	21.02±0.08	21.13±0.03	21.23±0.03	21.26±0.04
Released in feces	13.50±0.51	12.99±0.76	12.19±0.46	11.67±0.68
Released in urine	1.03±0.18	0.98±0.02	0.95±0.04	0.91±0.04
Saved in body	6.49±0.39	7.16±0.78	8.09±0.44	8.68±0.68
Utilized of received, %	30.88	33.89	38.11	40.83

On average, animals of the experimental groups excreted 12.28 g of phosphorus with feces and 0.95 g with the urine, which is 9.93% and 8.42% less than in the control group. The greatest amount of phosphorus is deposited in the body of animals of the 3rd experimental group– 8.68 g, which is 33.74% and 21.23% more than in the control and 1st experimental groups, respectively, and 7.29% more in comparison with the 2nd experimental group.

Calves of the 3rd experimental group were better to utilize the received phosphorus. Thus, animals of the 3rd experimental group utilized phosphorus 9.95% and 6.94% more compared with the control and 1st experimental groups, respectively, and 2.72% more than the 2ndexperimental group.

Thus, the minerals were better consumed by calves that were receiving the Optisaf yeast probiotic supplement at a dose of 10 g /animal/day as a part of the diet.

Currently, much attention is paid to the formation of a normal microbiocenosis of the gastrointestinal tract, which is associated with its multifaceted effect on the physiological functions of the animal’s body. In this regard, it is necessary to study the intestinal microbiota under the influence of yeast probiotic supplements. Some indicators of calf feces microbiota are presented in Figure 5.

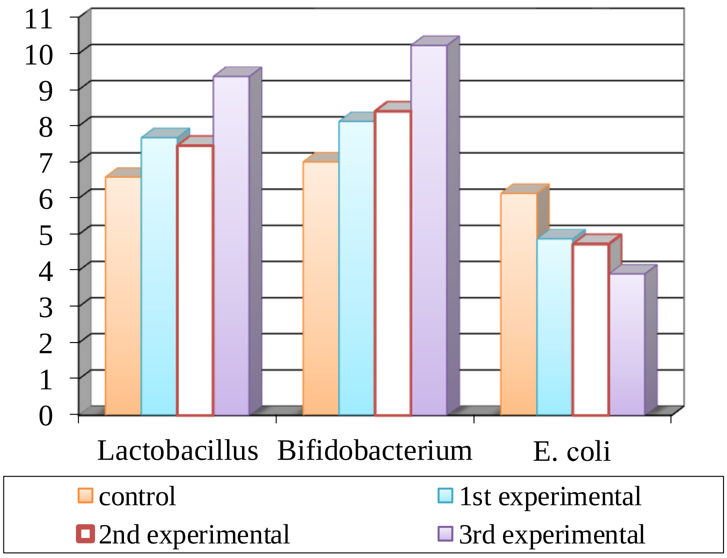

Figure 5. The number of microorganisms in the feces of calves, million CFU/g.

When studying the microbial landscape of the large intestine of calves, it was found that the content of lactobacilli in the feces of calves of the 3rd experimental group amounted up to 9.37 million CFU/g, which is 42.19% more than the same indicator in the control group (P <0.05), and in comparison with the 1st and 2nd experimental groups by 22.01% and 25.60%, respectively.

The greatest number of bifidobacteria was also noted in the feces of calves of the 3rd experimental group, which is 45.93% (P <0.05) more in comparison with the control group and 25.83% and 21.64% compared with the 1stand 2nd experimental groups, respectively. At the same time, the use of yeast probiotic supplement helped to reduce the number of E. coli in the feces of calves. Thus, the number of E. coli in the feces of calves of the experimental groups averaged 4.51 million CFU / g, which is 36.14% less than in the control group.

The application of the yeast probiotic supplement Optisaf at a dose of 10 g per animal per day contributes to an increase in the number of lactobacilli and bifidobacteria in the intestine and inhibits the growth of pathogenic and conditionally pathogenic microorganisms.

The morphological and biochemical blood composition is quite constant with the correct and complete supply of animals with nutrients. Insufficient or excessive intake of nutrients violates the nature of metabolic processes in the tissues, which affects the composition of the blood. Blood test data of experimental animals are presented in Table 5.

Table 5: Morphological and biochemical parameters of the blood of calves, ($\bar{X} \pm S_{\bar{x}}$).

Index	Group			
	control	1st experimental	2nd experimental	3rd experimental
Erythrocytes, 10^{12}/l	6.52±0.14	6.88±0.15	6.97±0.12	7.12±0.15*
Hemoglobin, g/l	104.95±1.81	109.68±2.60	110.92±2.99	114.76±2.81*
Globular value	1.05±0.01	1.04±0.01	1.03±0.01	1.05±0.05
Leukocytes, 10^9/l	6.46±0.14	6.79±0.12	6.82±0.16	6.93±0.15
Alkaline reserve, mg%	541.54±8.79	532.65±9.55	526.28±7.61	521.94±9.54
Total protein, g/l	71.03±1.21	73.10±2.24	76.05±2.05	77.50±1.96*
Residual nitrogen, мг%	28.95±1.94	31.03±1.65	31.46±1.71	33.83±2.40
Calcium, mmol/l	2.33±0.08	2.47±0.11	2.54±0.12	2.63±0.11
Inorganic phosphorus, mmol/l	1.61±0.03	1.64±0.03	1.66±0.03	1.72±0.03

Studies have established that the morphological and biochemical parameters of the blood of calves were within the physiological norm. Moreover, the maximum number of red blood cells was noted in the blood of animals of the 3rd experimental group – 7.12 * 10^{12} / l, which is 9.20% (P <0.05); 3.49% and 2.15% more in comparison with the control, 1st and 2nd experimental groups, respectively. The hemoglobin content was significantly higher in the blood of calves of the 3rd experimental group by 9.35% (P <0.05); 4.63% and 3.46%, than in the control, 1st and 2nd experimental groups, respectively.

The globular value in experimental animals was at the same level and averaged 1.04. The number of leukocytes in the groups did not have any significant differences and was within the physiological norm. However, in the 3rd experimental group, the level of the leukocyte was 7.28% and 2.06% higher than in the control and 1st experimental group, respectively, and 1.61% than in the 2nd experimental group.

The alkaline reserve of the control group was 1.67% higher in comparison with the 1st experimental group, and 2.90% and 3.76% higher than in the 2nd and 3rd experimental groups, respectively.

The total protein content in the 3rd experimental group was 77.50 g / l, which is 9.11% (P <0.05) more than in the control group and 6.02% and 1.91% more than in the 1st and 2ndexperimental groups.

The residual nitrogen index was higher in calves of the 3rd experimental group by 4.88 mg% (16.86%) than in the control group and by 2.80 mg% (9.02%) and 2.37 mg% (7.53%) compared with the 1st and 2nd experimental groups, respectively.

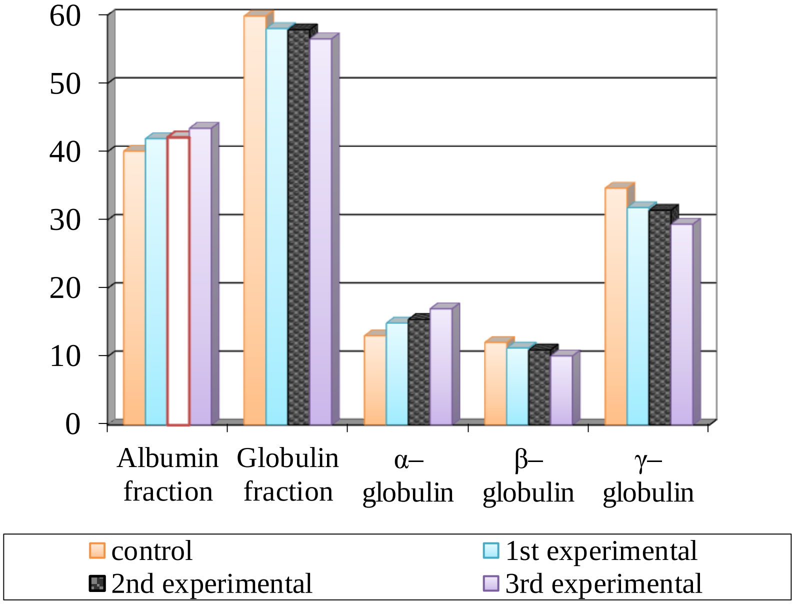

Figure 6: Protein spectrum of blood serum of calves (%).

The content of calcium and phosphorus was higher in the blood of calves of the 3rd experimental groups by 12.88% and 6.83% compared with the control group; by6.48% and 4.88% compared with the 1st experimental group; by3.54% and 3.61%compared with the 2nd experimental group. The serum protein content is shown in Figure 6.

For protein fractions, we found that the highest percentage of the albumin fraction was noted in the blood of calves of the 3rd experimental group. So, the percentage of the albumin fraction in this experimental group was 43.45%, which is 3.33% more than in the control group. The protein ratio is also higher in the 3rd experimental group, when compared with the control group by 14.93%; when compared to the 1st experimental group by 6.94%; when compared to the 2nd group by 5.48%.

Evaluation of natural immune resistance was carried out at the beginning and at the end of the experiment in the control and experimental groups. At the beginning of the experiment, all the studied parameters in the experimental calves were close in absolute values, which indicate a good selection of analogues. In the process of experiments, under the influence of yeast probiotic supplements, the level of immune resistance in calves of the experimental groups increased significantly. The generalized results are presented in Table 6.

Table 6: Indicators of immune resistance of experimental animals, ($\bar{X} \pm S_{\bar{x}}$)

Index	Group			
	control	1st experimental	2nd experimental	3rd experimental
Phagocytic activity, %	50.83±2.24	53.33±1.76	53.67±1.76	54.50±2.57
Phagocyte count	3.14±0.17	3.63±0.21	3.68±0.22	4.01±0.20
Phagocyte index	6.22±0.58	6.79±0.24	6.91±0.17	7.02±0.24
Phagocytic capacity, thousand microbial bodies	40.11±4.57	46.59±4.45	47.97±3.54	49.55±3.75

So, phagocytic activity (the percentage of leukocytes actively participating in phagocytosis to the total number of counted neutrophilic leukocytes) in animals of the 1st experimental group is 2.50%, 2nd experimental group– 2.84% and 3rd experimental group– 3.67% higher than in the control group.

An additional indicator of cellular immunity, characterizing the aggressiveness and activity of leukocytes, is the phagocyte count (the ratio of phagocytosed bacteria to the total number of leukocytes counted). The blood of calves of the experimental groups that were treated with yeast probiotic supplements had a phagocytic number that averaged 3.77 units, which is 0.63 more than in the control group.

The phagocytic index characterizes the intensity of phagocytosis, which is determined by the average number of phagocytized microorganisms per active leukocyte. Studies have found that calves of the experimental groups had a higher level of phagocytic index, with a tendency to decrease in the control group.

Phagocytic capacity determines the number of microbial bodies phagocytosed in 1 mm^3 of blood. The phagocytic capacity was less in the serum of the calves of the control group in comparison with the 1st experimental group by 16.15%; the 2nd experimental group by 19.59% and the 3rd experimental group by 23.53%.

It should be noted that all these indicators did not go beyond the physiological norm and testify to the activation of the immune defenses in calves.

Studies have shown that the content of white blood in animals of the control and experimental groups has significant differences. The leukogram is presented in table 7.

Table 7: Leukocyte count and leukocyte formula in the blood of calf (%) ($\bar{X} \pm S_{\bar{x}}$).

Index	Group			
	control	1st experimental	2nd experimental	3rd experimental
Neutrophils:				
banded	0.29±0.05	0.26±0.04	0.25±0.04	0.22±0.04
segmented	22.74±0.07	23.09±0.56	22.91±0.55	23.78±0.57
Eosinophils	0.69±0.08	0.88±0.06	0.85±0.08	0.93±0.10
Basophils	0.55±0.04	0.42±0.08	0.45±0.05	0.36±0.05
Monocytes	3.47±1.13	4.31±0.48	4.76±0.48	5.11±0.36
Lymphocytes	72.26±1.56	71.04±0.50	70.78±0.59	69.60±0.77

Data analysis Table 7 allowed us to establish that the greatest number of banded neutrophils was observed in the blood of calves of the control group. In this case, there were more segmented granulocytes in the blood of calves of the 3rd experimental group than in the analogues of the control, 1st, and 2nd experimental groups by 0.07%, 0.04%, and 0.03%, respectively. Also, thee eosinophils and monocytes count was higher in the blood of calves of the 3rd experimental group, in comparison with the control group by 0.24% and 1.64%; 1st experimental group by 0.05% and 0.80%; 2nd experimental group by 0.08% and 0, 35% respectively.

The content of basophils decreased as a result due to the added yeast probiotic supplement. So, the smallest number of basophils was noted in the 3rd experimental group, which is 0.19% less than the same indicator in the control group.

Simultaneously with an increase in neutrophilic granulocytes in animals of the 3rd experimental group, the number of lymphocyte cells decreases 2.36% in comparison with the control group, 1.14% in comparison with the 1st experimental group and 1.18% compared with the 2nd group.

Thus, in calves of the 3rd experimental group that were receiving Optisaf yeast probiotic supplement at a dose of 10 g /animal/day, metabolic processes proceeded more intensively, which positively affected the morphological, biochemical and immunological parameters of the blood.

4. CONCLUSION

The introduction of Optisaf yeast probiotic supplement in the diets of young cattle in the optimal dose increased the digestibility of dry matter by 3.71% ($P < 0.05$), organic matter by 2.95%, and crude protein by 4.26% ($P < 0.01$), crude fat by 3.95% ($P < 0.05$), crude fiber by 2.85% and NFE by 2.41%, when comparing to the control group. Animals of the 3rd group utilized the metabolic energy and nitrogen of the diets more efficiently: 6.91% ($P < 0.01$) and 2.42%, respectively, than the calves of the control group. The use of Optisaf yeast probiotic supplement contributed to the better consumption of calcium and phosphorus – by 6.32% and 9.95%, compared with the control group. The use of Optisaf led to an increase in the number of Lacto- and bifidobacteria in the intestine by 42.19% ($P < 0.05$) - 45.93% ($P < 0.05$),respectively,and a decrease in the number of E. Coli bacteria by 36.14%, compared with the control group. The number of red blood cells increased by 9.20% ($P < 0.05$), hemoglobin content by 9.35% ($P < 0.05$), total protein by 9.11% ($P < 0.05$), phagocytic activity by 3.67%. The phagocytic capacity of the blood serum of calves in the control group was 23.53% less in comparison with the 3rd experimental group.

5. MATERIALS AND DATA AVAILABILITY

All relevant information is given in this study.

6. CONFLICT OF INTEREST

The authors confirm that the presented data do not contain a conflict of interest.

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