

# Effect of probiotic supplement on biochemical status and calves' body weight

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## Abstract

To increase the production efficiency and competitiveness of livestock products, the rearing of young calves is important, one of the main conditions of which is a full-fledged feeding. An indispensable task is to create conditions in the rumen of ruminants in which feed mixtures are maximally digested and assimilated, and also serve as preventive measures against diseases. For these purposes, on the basis of two farms of the Vologda Oblast (Ltd "Zazerkal'e" and SPK "Kolkhoz Andoga") we conducted a scientific-economic experience of using the probiotic preparation "Rumit" in feeding the Russian Black Pied calves during dairy rearing period. For this purpose, we formed two groups of animals at the age of 2 months in experimental farms by paired-analogy method; each group contained 10 animals. The experimental group was fed Rumit supplement in addition to the basic diet at the rate of 15 g per day per head. The duration of feeding the probiotic was 90 days. We found that the calves of Ltd "Zazerkal'e", which received the biological preparation in addition to the basic ration, in comparison with the control group showed the increase in the total blood protein content by 5.3% ( $p>0.95$ ) and decrease in the urea and creatinine concentration by 8.2 and 8.1% respectively. In SPK "Kolkhoz Andoga", we noted an increase of total protein content in blood by 7.8% ( $p>0.95$ ), glucose by 21.5% ( $p>0.95$ ). We established that blood urea decreased by 12.5% ( $p>0.95$ ), bilirubin and cholesterol by 5.5 and 11.8% ( $p>0.95$ ) respectively. When analyzing the calf growth dynamics during the dairy rearing period, the calves of the experimental groups were characterized the higher absolute and average daily growth. Calves in SPK "Kolkhoz Andoga" had a difference of 3.8 and 4.6% compared to the control group, in Ltd "Zazerkal'e" – 4.8 and 4.5% respectively. Consequently, the use of the probiotic based on cellulolytic bacteria in calf feeding had a positive effect on the level of metabolic processes and growth rate of young animals.

**Keywords:** calves in the dairy rearing period; probiotic Rumit; biochemical blood parameters; absolute and average daily gain.

## Introduction

In modern conditions, young-stock breeding is necessary for increasing the production of competitive livestock products (Donnik et al., 2016). During early postnatal ontogenesis, due to the immaturity of a number of systems, calves are significantly affected by environmental factors and technological factors promoting industrial livestock breeding. In addition, at this age period calves have physiological dysbacteriosis, which is largely due to the imbalance of the normal intestinal microflora, which makes them particularly vulnerable to gastrointestinal pathology. Therefore, in order to maintain the normal physiological status of calves and normalize metabolic processes, probiotic preparations containing live microorganisms and their metabolites have recently become widespread (Liu et al., 2015; Yu et al., 2016; Ma et al., 2018; Niranjana D. et al., 2023).

We have found that probiotics have a positive effect on gut microbiocenosis; in particular, they increase the diversity of infusoria (Litonina et al., 2022). According to a number of scientists, due to the enzymatic activity, symbiont flora is able to synthesize many biologically active substances, which, being absorbed into the bloodstream, participate in energy and vitamin metabolism, and play an important role in the life support of the host organism (Biernasiak et al., 2011; Angelakis, 2017; Deng et al., 2021).

Possible mechanisms of probiotic-host and probiotic-microbiota interaction can be divided into three main categories: direct interaction with host cells, suppression of pathogen growth, and modulation of host immune responses (Bajaj et al., 2015; Angelakis, 2017).

To date, a lot of scientific and practical material has been accumulated on the use of probiotic and complex enzyme-biotic preparations in feeding animals and birds (Pereira et al., 2019; Yadav & Jha, 2019; Ovcharova et al., 2022). In practice, the use of probiotics in growing young cattle is studied widely enough. For instance, the effect of the probiotic “Cellobacterin” on the growth parameters of calves during the dairy rearing period has been studied. The average daily growth of calves of the experimental group was higher in comparison with the control group analog by 10.8% (Tyukavkina & Krasnoshchekova, 2018). When using the yeast probiotic supplement “Optisaf” in the diets of heifers up to 6 months of age at a dose of 10 g per head per day, the body weight in the experimental group was higher by 5.03%. In addition, the authors also noted a positive dynamics in the formation of body shape (Mikolaychik et al., 2017).

According to the research of the scientists of the L.K. Ernst Federal Research Center for Animal Husbandry, during the period of feeding the probiotic preparation “Amylocin”, the efficiency of ration use by dairy calves was significantly increased; at the end of the experiment the average daily gain in body weight of calves in the experimental group exceeded the control group by 11.8% (Duborezov & Duborezova, 2016).

A number of authors also note the change of certain indicators of blood systems when using probiotics in animal feeding. Their effect is to normalize the level of metabolic processes in animals (Afanasyeva et al., 2018; Tyukavkina & Krasnoshchekova, 2018).

The majority of modern probiotics are rather effective, but at the same time monitoring of the feed additives market has shown that some of them are not in demand in practice for their high cost. Therefore, more effective and cheaper preparations are being developed. An example of such a preparation is enzymatic probiotic “Rumit” developed by Russian company Biotrof+ (Smirnova et al., 2021).

Biopreparation “Rumit” is intended for the use in cattle diets of different age groups and serves not only as a probiotic, but also as a feed enzyme. As known, feed enzymes work as a biological catalyst and accelerate all biochemical reactions occurring in the animal body. Due to this, the digestibility of the nutrients of the received feed is improved, which allows increasing the production of livestock products and, consequently, increasing the percentage of profitability of agricultural enterprises (Schofield et al., 2018).

The purpose of the research is to study the biochemical status and age variability of calves against the background of the probiotic supplement “Rumit” obtained on the basis of microorganisms isolated from the reindeer rumen.

## Material and methods

The scientific-economic experiment was conducted on the basis of two agricultural enterprises (Vologda Oblast, Russia) Ltd “Zazerkal’e” of Gryazovetsky district (Panfilovo 58.978275 N, 39.873296 E) from January to April 2022 and SPK “Kolkhoz Andoga” of Kaduysky district (Nikolskoye 59.353728 N, 37.177021 E) from January to April 2021. All the manipulations with the experimental animals were performed according to the rules of the European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (Official Journal of the European Union L276/33, 2010). The experimental farms formed two groups of heifers of the Russian Black Pied at the age of 2 months by 10 animals by the method of paired peers by origin, sex, age, and body weight (Fig.1,2). The duration of supplementation was 90 days. Animal housing in groups (10 animals per cage) was identical for control and experimental groups and complied with zoohygienic control norms.

Feeding technology of young cattle during the experiment in the studied farms involved a gradual transition from dairy feed to bulk feed combined with concentrates, and was developed according to generally accepted standards (Nekrasov et al., 2018).

Feeding calves in experimental farms differed only in the fact that the animals in Ltd “Zazerkal’e” were fed full milk substitute according to the scheme, and young calves in SPK “Kolkhoz Andoga” used fermented milk. During the period of the scientific and economic experiment calves of the control group consumed the ration accepted in the farm; calves of the experimental group in addition to the basic diet with milk feed received enzymatic and probiotic additive “Rumit” 15 g per day per head. The preparation was produced by Ltd “Biotrof+” (Saint Petersburg, Russia), it is a new probiotic preparation which is an association of bacteria (genera *Bacillus*, *Bacteroides*, *Porphyromonas*, *Pseudomonas*) isolated from the reindeer rumen (*Rangifer tarandus*), applied to sunflower meal in the amount of  $10^8$  CFU/g and dried to obtain a dry concentrate as powder. The probiotic is safe for feeding cattle, contains no conditionally pathogenic or pathogenic microflora, including *Pseudomonas aeruginosa*, Enterobacteriaceae, *Staphylococcus aureus*, *Candida albicans*.

The growth of calves was estimated according to systematic individual weighing, which was carried out at the same time in the morning before feeding and watering at the beginning and at the end of the accounting period, as well as monthly. We obtained the absolute and average daily gain of body weight on the basis of the results. To assess the metabolic processes in the calves’ body we analyzed the biochemical composition of the blood at the end of the experiment. We carried out the blood serum analysis on an automatic biochemical analyzer iMagic-S7 (China) in the RSC (Research Sharing Center) of the Center for Agricultural Research and Biotechnology of VolRC RAS. The obtained data were processed biometrically using Microsoft Excel data analysis software package. We compared the data with each other using Student’s t-test at three probability levels: \*( $p>0.95$ ); \*\*( $p>0.99$ ); \*\*\*( $p>0.999$ ).

## Results and Discussion

Blood takes part in metabolic processes and is in close relationship with all organs and tissues, so the change in blood composition allows judging about dynamic processes of organism development, formation of internal environment constancy, level and degree of adaptive manifestations of the organism (Sjaastad et al., 2010). In this regard, we analyzed the biochemical blood composition of the experimental animals, the results of which are given in Table 1.

During the experiment period, the content of total protein in the blood of all tested calves was within the recommended values. At the end of supplementation and “Rumit” feeding the calves of the experimental groups showed an increase in the total blood protein in comparison with the control group, in Ltd “Zazerkal’e” by 5.3% ( $p>0.95$ ) and in SPK “Kolkhoz Andoga” by 7.8% ( $p>0.95$ ), which may be associated with more intensive use of amino groups not for urea formation, but in the synthesis of other compounds in the calves that were consuming probiotic.

**Table 1.** Biochemical blood parameters of experimental animals in agricultural enterprises ( $M\pm m$ ,  $n = 10$ )

Indicators	Ltd “Zazerkal’e”		SPK “Kolkhoz Andoga”	
	Control group	Experimental group	Control group	Experimental group
Total protein, g/l	71.8±1.0	75.6±1.2*	65.4±1.21	70.5±1.79*
Albumen, g/l	34.6±0.96	35.1±0.50	34.1±0.56	34.2±0.95
Urea, mmol/L	3.28±0.59	3.01±0.12	3.75±0.11	3.28±0.17*
Glucose, mmol/L	4.34±0.24	4.85±0.15	2.37±0.13	2.88±0.05**
Total bilirubin, mcmol/l	1.28±0.20	1.28±0.34	2.72±0.10	2.57±1.12*
Creatinine, mcmol/l	96.5±4.70	88.7±8.6	82.1±4.40	73.4±4.27
Total cholesterol, mmol/L	2.60±0.29	2.78±0.16	2.12±0.06	1.87±0.09*

\* $p>0.95$ ; \*\* $p>0.99$ .

At the end of supplementation the urea concentration in the blood of the experimental group of calves in Ltd “Zazerkal’e” decreased by 8.2% and in SPK “Kolkhoz Andoga” by 12.5% ( $p>0.95$ ), which indicates increased efficiency of using feed nitrogen for microbial protein synthesis. In addition, the blood of the experimental groups of calves in the SPK “Kolkhoz Andoga” showed a 21.5% ( $p>0.99$ ) increase in the concentration of glucose compared to the control, which indicates that they were well provided with energy. Normalization of glucose in the blood of experimental animals is explained by the normalization of symbiotic microflora by displacing pathogenic microorganisms and reducing the toxic effect of mycotoxins (Syrtsev, 2019).

Lower blood glucose levels in the control group of calves may indicate a decrease in glycogen stores in the liver and muscles compared to calves receiving probiotic supplement “Rumit”. It is known that when glucose levels decrease, the body seeks to compensate for the energy deficit by burning fats, resulting in an increase in cholesterol concentration, which is confirmed by a higher concentration of cholesterol – by 11.8% ( $p>0.95$ ) in the serum of blood of young calves of the control group.

We noted a decrease in creatinine in the blood of calves of the experimental groups in the studied farms by 8.1–10.6% compared with the control group, which indicates the expenditure of energy released in the process of decomposition of phosphatocreatine in metabolic reactions.

The most important indicators of calves’ development and health are the growth of their body weight. In addition, they reflect the level and completeness of calf feeding. Absolute body weight gain to a certain extent allows judging about animal’s growth rate; it is important for the national economy, as fast-growing animals

consume significantly less nutrients of feed per unit of production (Tyukavkina & Krasnoshchekova, 2018). Table 2 presents growth indicators of calves in the agricultural enterprises.

The table shows that the higher absolute body weight gain (174.2 kg) is in the group of calves of Ltd “Zazerkal’e” receiving the feed additive in addition to the basic diet and the difference with the control group is 5.0%. The average daily gain of the experimental group calves is 968 g, which is 4.8% higher compared to the control group calves. The calves of the experimental group exceeded the control group by this value due to their more intensive growth during the experiment.

**Table 2.** Growth indicators of calves in agricultural enterprises (M±m, n=10)

Indicators	Ltd “Zazerkal’e”		SPK “Kolkhoz Andoga”	
	Control group	Experimental group	Control group	Experimental group
Body weight at the beginning of the experiment, kg	88.2±4.8	88.7±4.4	66.8±3,1	66.7±3,0
Body weight at the end of the experiment, kg	169.6±5.9	174.2±5.4	138.3±3.1	140.9±2.8
Absolute gain,	81.4±2.8	85.5±2.7	71.5±1.85	74.2±2.41
Average daily gain, g	924±29.8	968±22.7	654±21.4	684±24.5

According to the research results, the absolute body weight gain in the experimental group of heifers of the SPK “Kolkhoz Andoga” was higher than in the control group by 2.7 kg (3.8%), the relative gain by 0.7%. During the period of the probiotic feeding in the experimental group the average daily gain of body weight was higher by 4.6% than in the control group.

The increase in the average daily gain of body weight of calves, received in addition to the main feed probiotic “Rumit”, is explained by the fact that the additive, used in feeding, characterized by high antagonistic activity in suppressing pathogenic microflora, helps to improve the digestibility of nutrients in the diet.

## Conclusion

The conducted research allows concluding that the use of fermentative and probiotic additive “Rumit” in the feeding of calves in the dairy rearing period at different feeding technologies normalizes and stimulates metabolic processes in the body of animals and increases calves’ growth intensity.

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