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Studying the Influence of Microbial Preparations of the Vetom Series on the Productivity and Quality of Cow-Derived Product

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Abstract

The influence of microbial preparations Vetom 1 and Vetom 1.23 on cows of CJSC Stepnoye in the Iskitimsky District of the Novosibirsk region of the Russian Federation has been studied. Microbial preparation Vetom 1 was taken at the dosages of 50 and 12.5 mg/kg of body weight once a day for 1 month. Microbial preparation Vetom 1.23 was taken at the dosages of 1 and 0.5 µl/kg of body weight once a day for 1 month. During the research, the percentage of fat, protein and skimmed milk solids were determined in milk, as well as the milk yield in the morning, in the evening, and the total yield. Fat content in milk increased during the period when the preparation was introduced. In the period after the preparation termination, this effect was retained only for the case where Vetom 1.23 was used. Concentration of protein in the milk increased only in the final period of using Vetom 1. Concentration of dry skimmed milk solids increased under the influence of Vetom 1.23 in the period when it was used. Milk yield in cows increased when a microbial drug Vetom 1 was used at a dosage of 50 µl/kg.

Keywords: *Bacillus subtillis*, cows, dry skimmed milk residue, fat, milk, milk yield, product quality, productivity, protein, Vetom.

INTRODUCTION

Efficient development of the domestic agricultural sector, namely livestock breeding, is possible upon solving a number of problems: ensuring the genetic growth potential of newborn calves; disease prevention; ensuring high animals preservation rate; ensuring environmental safety; obtaining high quality products that are safe for the man, and reducing the cost of the obtained products [1, 2, 3, 4, 5].

The fundamental basis of high cows' productivity is maintaining health, high growth rate, and prevention of diseases in heifers in the early postnatal period [6, 7].

According to some authors [8, 9], progressive development of the modern agricultural complex is possible only in close cooperation with science and active introduction of efficient innovative technologies.

During the last decades in dairy and beef cattle breeding, loss of calves in the first weeks after birth has occurred mainly due to noncontagious diseases. In the structure of noninfectious diseases in calves up to 10 days age, gastrointestinal diseases reach 60 to 90% [10].

One reason for the high morbidity rate in cattle with violations of the functional state of digestive organs are errors in feeding and keeping; reduced resistance of the organism and immunodeficiencies; technological stress; degradation of the habitat environment; and significant pharmacological pressure due to unprofessional use of antibiotics. Due to violation of the technology of keeping, feeding and exploitation of cows, they develop diseases of various etiologies resulting in early culling of animals, which causes a considerable economic damage to the livestock [11, 12].

Since the 60s of the last century up to present, antibiotics have been widely and actively used in treatment of cows. Prolonged and not always reasonable use of antibiotics contributed to the formation of resistant strains of bacteria and other side effects. With that, efficiency of treatment undoubtedly decreased. Most antibiotics, if used incorrectly, can accumulate in the animal products, and may have adverse effects on the human organism through milk consumption [13, 14].

In 1999, the World Veterinary Association, the International Federation of Agricultural Producers and the World Veterinary Association signed a Protocol on maintaining a set of standard principles that allow for a more cautious approach to the use of antibacterial preparations [15].

According to the protocol, in the countries of the European Union since 2006 the use of antibiotics as growth promoters has been prohibited in animal breeding, due to the emergence of microorganisms that are resistant to antibiotics not only in animals, but also in humans that consume the products of livestock breeding [16].

In this respect, searching for pharmacological preparations that allow increasing efficiency of treating diseases of the digestive system and do not cause formation of resistant strains of bacteria is required. In the last decade, probiotic and prebiotic preparations have been successfully used as alternatives to antibiotics [17, 18].

The use of probiotic preparations for young stock for preventive purposes stimulates the immune status and resistance of the organism to adverse environmental factors, prevents occurrence of diseases, and increases their productivity. Probiotics are not hazardous to humans and to the environment. Today, most probiotics are made based on lacto- and bifidobacteria with probiotic properties [19, 20].

In the last decade, spore-forming bacteria have also been used in this role. Currently, bacteria of genus *Bacillus* are the most promising for probiotics' development and production. Most bacteria of genus *Bacillus* (including *B. subtilis*) are not hazardous to humans, and are widespread in the environment. Probiotic preparations of the Vetom series have been created on the base of *B. subtilis, B. licheniformis, and B. Amyloliquefaciens* [21, 22, 23, 24].

The work is aimed at studying the effect of microbial preparations Vetom 1 and Vetom 1.23 on the productivity and quality of cow milk.

MATERIALS AND METHODS

The experiment for studying the effects of preparations Vetom 1 and Vetom 1.23 was performed on lactating cows.

The objects of study were black-motley holsteinized cows.

The subjects of the study were preparations Vetom 1 and Vetom 1.23, milk and productivity of cows.

To implement the objectives of the study, 4 experimental and 1 reference groups were formed, 7 cows in each. Cows in the 1st experimental group received microbial preparation Vetom 1 at the dosage of 50 mg/kg of body weight once a day for 30 days. Cows in the 2nd experimental group received microbial preparation Vetom 1 at the dosage of 12.5 mg/kg of body weight once a day for 30 days. Cows in the 3d experimental group received microbial preparation Vetom 1.23 at the dosage of 1 µl/kg of body weight once a day for 30 days. Cows in the 4th experimental group received microbial preparation Vetom 1.23 at the dosage of 0.5 µl/kg of body weight once a day for 30 days. Cows of the reference group did not receive the preparation. Checkout milkings were performed on the 15th, 30th and 60th day of the experiment. The numerical data were statistically processed in Microsoft Office Excel. The median and quartiles were

calculated using the built-in functions of the application, the median error was calculated as the product of the variance (built-in function) and the square root of the quotient of π divided by the double number of animals (7). The reliability of differences was tested with the nonparametric Q-test of Dunn for comparison with the reference group. Box-and-whisker diagrams were built in Excel by adapting the stock market chart.

RESULTS AND DISCUSSION

Productivity of cows with the use of probiotic preparations changes (Table 1).

In the 15th day of the experiment, the median of daily milk yield of dairy cows in experimental groups 1 and 2 was higher by 23.08 and 23.08 %, while in cows of experimental groups 3 and 4 it was lower by 10.26 and 5.13%, respectively, than in the counterparts from the reference group. On the 30th day of the experiment, the median of daily milk yield of dairy cows in experimental groups 1 and 2 was higher by 15.38 and 19.23% (P<0.05), while in cows of experimental groups 3 and 4 it was lower by 17.95 and 10.26%, respectively, than in the counterparts from the reference group. On the 60th day of the experiment, the median of daily milk yield of dairy cows in experimental groups 1 and 2 was higher by 2.63 and 9.21%, respectively, while in cows of experimental groups 3 and 4 it was lower by 21.05 and 10.53%, respectively, than in the counterparts from the reference group (Table 1, Figure 1).

Thus, the use of Vetom 1 increased cows' productivity. The maximum growth was noted in case of using Vetom 1 at the dosage of 50 mg per kg of body weight. Milk yield in cows increased during the period when the preparation was used. After cessation of the preparation, milk yield in the animals that received Vetom 1 also remained slightly higher. However, the overall milk yield per 24 hours from cows of the reference and all experimental groups gradually decreased.

Under the influence of the studied preparations, fat content of milk changed (Table 2). On the 15th day of the experiment, the median of fat content in the milk of cows in experimental groups 1, 3 and 4 was higher by 1.05, 87.43 (P<0.05), and 10.21%, respectively, while in cows of experimental group 2, it was lower by 33.25% than in the counterparts from the reference group. On the 30th day of the experiment, the median of fat content in the milk of cows in experimental groups 3 and 4 was higher by 95.94, (P<0.05) and 7.92%, respectively, while in cows of experimental groups 1 and 2, it was lower by 32.18 and 34.65% than in the counterparts from the reference group. On the 60th day of the experiment, the median of fat content in the milk of cows in experimental groups 1, 3 and 4 was higher by 37.07, 23.03 (P<0.05) and 4.31%, respectively, while in cows of experimental group 2, it was lower by 23.28% than in the counterparts from the reference group (Table 2, Figure 2).

Thus, fat content in the milk during the period of preparation administration increased when Vetom 1 was used at the dosage of 50 mg/kg, and Vetom 1.23 was used at the dosage of 1.0 and 0.5 µl/kg of the body weight, both during the application of the preparation and 60 days after the use of the preparation was stopped (Figure 2). Since the trend of overall decrease of the fat content in experimental groups 1-3 and 4 was less pronounced than in the reference group (-17.62; -30.30 and +7.26%, compared to -39.27%), one could speak of more positive effect of the schemes used in experimental groups 1-3 on fat content.

Over the period of the study, high interquartile fluctuations of fat content in milk were observed in the 2nd experimental group on the 15th day of the experiment (2.28%) and in the 3rd experimental group on the 30th day of the experiment (2.20%). Since the trend of much stronger fluctuation, compared to the rest, was not observed in other periods, one could draw a conclusion that the research results depended on the preparation used, the dosage, and the application scheme.

Table 1. Productivity of experimental cows, l

Group	15th day			30th day			60th day		
	Me±me	Q_1	Q_2	Me±me	Q_1	Q_2	Me±me	Q_1	Q_2
Reference	19.50 ± 3.09	17.25	24.00	19.50 ± 2.86	16.00	20.75	19.00 ± 3.09	17.25	20.00
1st experimental	24.00 ± 3.49	19.50	26.75	22.50 ± 3.80	21.25	25.25	19.50 ± 3.22	18.00	22.00
2nd experimental	24.00 ± 4.52	21.63	26.75	23.25 ± 4.49 *	21.50	23.88	20.75 ± 4.18	20.00	22.25
3rd experimental	17.50 ± 2.73	15.25	19.75	16.00 ± 2.24	12.50	19.00	15.00 ± 1.83	10.25	18.75
4th experimental	18.50 ± 3.27	18.25	22.00	17.50 ± 3.00	16.75	18.75	17.00 ± 2.55	14.25	18.50

Hereinafter: * P<0.05; ** P<0.01; *** P<0.001

Table 2. Changes in fat concentration in milk under the influence of the studied preparations, %

Group	15th day			30th day			60th day		
	Me±me	Q_1	Q_2	Me±me	Q_1	Q_2	Me±me	Q_1	Q_2
Reference	1.91 ± 0.33	1.83	2.53	2.02 ± 0.28	1.55	2.53	1.16 ± 0.12	0.66	1.96
1st experimental	1.93 ± 0.26	1.45	1.97	1.37 ± 0.22	1.26	1.70	1.59 ± 0.21	1.19	2.19
2nd experimental	1.28 ± 0.19	0.90	3.18	1.32 ± 0.24	1.15	1.46	0.89 ± 0.17	0.82	1.01
3rd experimental	3.58 ± 0.55 *	3.08	3.91	3.95 ± 0.40 *	2.26	4.46	3.84 ± 0.64 *	3.60	4.15
4th experimental	2.11 ± 0.39	1.86	2.52	2.18 ± 0.31	1.76	2.43	1.21 ± 0.16	0.88	1.97

Table 3. Changes in protein concentration in milk under the influence of the studied preparations, %

Group	15th day			30th day			60th day		
	Me±me	Q_1	Q_2	Me±me	Q_1	Q_2	Me±me	Q_1	Q_2
Reference	3.10 ± 0.54	3.02	3.26	3.08 ± 0.54	3.04	3.15	3.18 ± 0.56	3.15	3.21
1st experimental	3.03 ± 0.52	2.91	3.20	3.09 ± 0.54	3.03	3.13	3.12 ± 0.54	3.02	3.20
2nd experimental	2.94 ± 0.57	2.74	3.16	3.15 ± 0.65	3.11	3.25	3.16 ± 0.65	3.13	3.20
3rd experimental	2.99 ± 0.51	2.85	3.09	2.94 ± 0.50	2.80	3.02	2.82 ± 0.50	2.79	3.00
4th experimental	3.11 ± 0.63	3.03	3.16	3.06 ± 0.54	3.02	3.19	3.01 ± 0.53	2.95	3.14

Table 4. Changes in the concentration of skimmed milk solids under the action of the studied preparations, %

Group	15 day			30 day			60 day		
	Me±me	Q_1	Q_2	Me±me	Q_1	Q_2	Me±me	Q_1	Q_2
Reference	8.79 ± 1.57	8.76	8.98	8.76 ± 1.53	8.54	8.97	8.78 ± 1.57	8.76	8.91
1st experimental	8.46 ± 1.48	8.25	8.80	8.70 ± 1.53	8.52	8.77	8.53 ± 1.51	8.43	8.69
2nd experimental	8.60 ± 1.78	8.51	8.67	8.80 ± 1.81	8.66	9.10	8.70 ± 1.80	8.62	8.75
3rd experimental	8.85 ± 1.54	8.62	9.07	8.80 ± 1.56	8.72	8.83	8.61 ± 1.51	8.42	8.81
4th experimental	8.82 ± 1.84	8.79	8.87	8.83 ± 1.55	8.64	9.01	8.51 ± 1.51	8.44	8.74

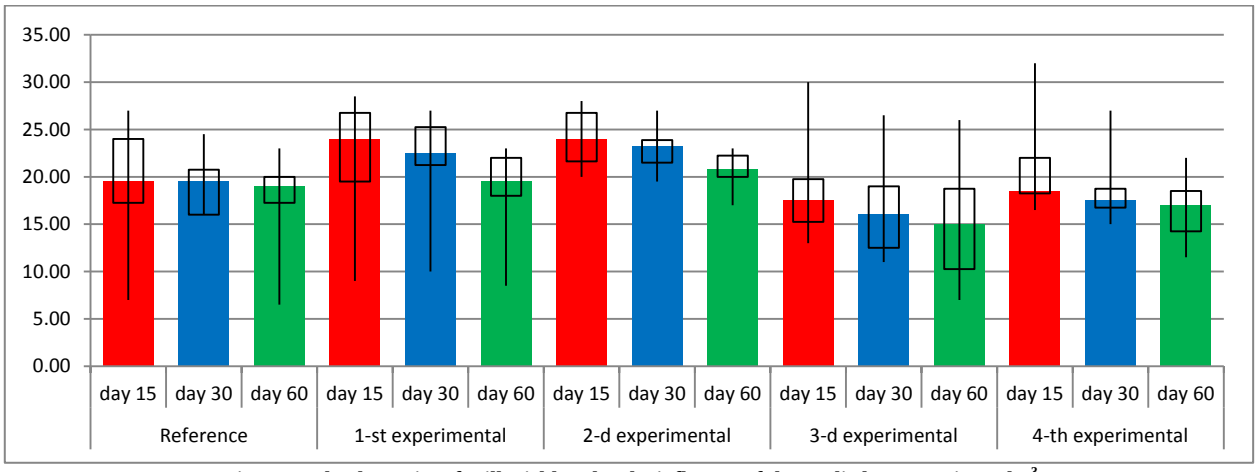

Figure 1. The dynamics of milk yield under the influence of the studied preparations, dm^3

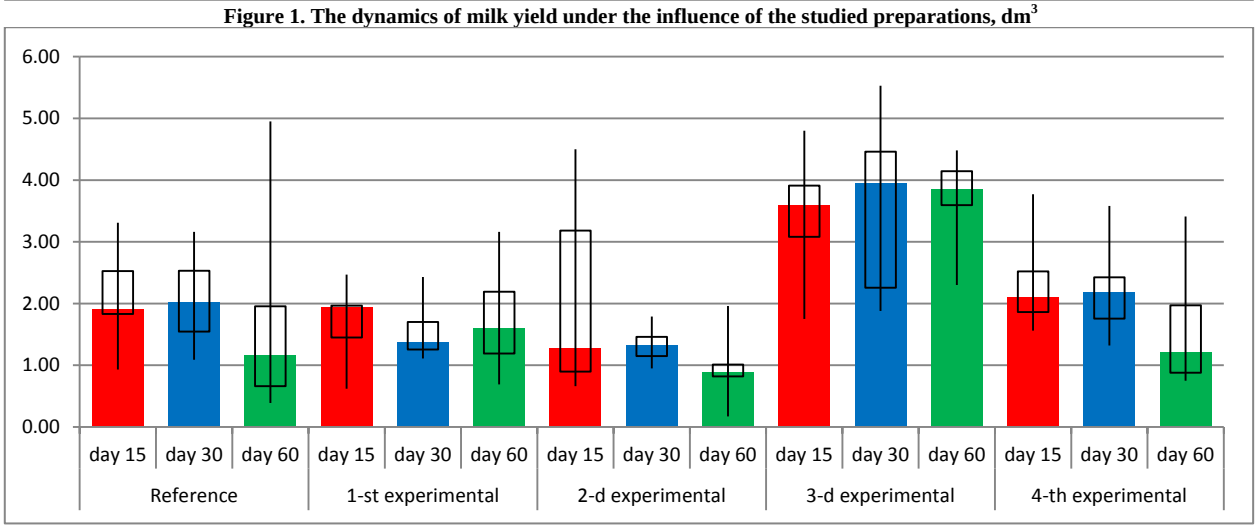

Figure 2. Dynamics of changes in fat concentration in milk under the influence of the studied preparations, %

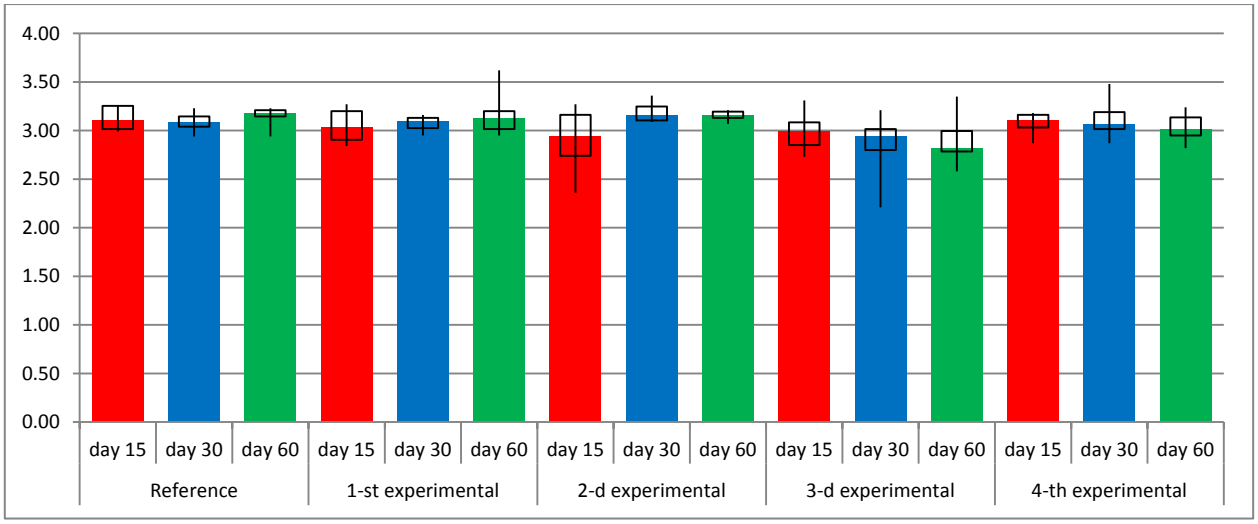

Figure 3. Changes in protein concentration in milk under the influence of the studied preparations, %

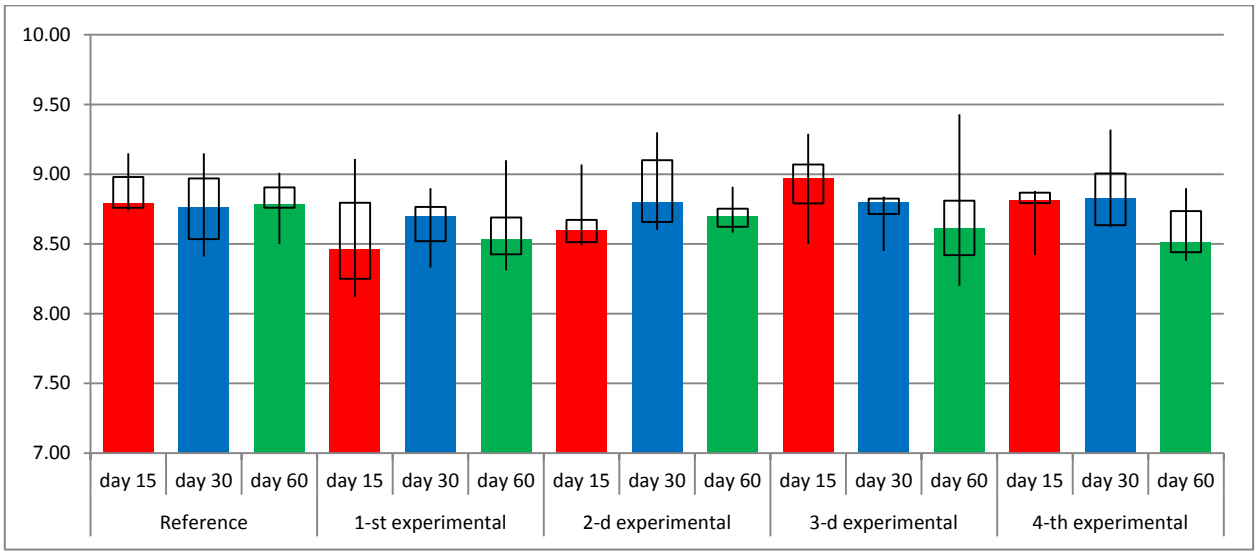

Figure 4. Changes in the concentration of skimmed milk solids under the action of the studied preparations, %

Under the action of the studied preparations, protein concentration in the milk of cows in the experimental groups changed (Table 3). On the 15th day of the experiment, the median of protein content in the milk of cows in experimental groups 1-3 was lower by 2.26, 5.16, and 3.55%, respectively, while in cows of experimental group 4, it was higher by 0.16% than in the counterparts from the reference group. On the 30th day of the experiment, the median of protein content in the milk of cows in experimental groups 3-4 was lower by 4.55 and 0.65%, respectively, while in cows of experimental groups 1-2, it was higher by 0.32 and 2.27%, respectively, than in the counterparts from the reference group. On the 60th day of the experiment the median of the protein content in milk from cows in experimental groups 1-4 was lower by 1.89, 0.79, 11.32, and 5.35%, respectively, than in the counterparts from the reference group.

Thus, protein concentration increased in milk from cows in experimental groups 1-2, and reduced in the animals in experimental groups 3-4. The increased protein content was observed in the final period of feeding Vetom 1 on the 30th day of the experiment (Figure 3). During the use of Vetom 1.23, protein content in the blood remained unchanged.

Interquartile fluctuations in the concentration of the protein in the milk from animals in experimental groups had no significant differences; this speaks of the stability of the indicator and the absence of individual differences of these indications in groups.

Under the action of the studied preparations, the concentration of skimmed milk solids in milk also changed (Table 4). On the 15th day of the experiment, the median percentage of dry nonfat milk solids in the milk of cows in experimental groups 1-2 was lower by 3.75 and 2.16%, respectively, while in the milk from cows in experimental groups 3-4, it was higher by 0.68 and 0.28%, respectively, than in the counterparts from the reference group. On the 30th day of the experiment, the median percentage of dry nonfat milk solids in the milk of cows in experimental groups 2-4 was higher by 0.46, 0.46 and 0.80%, respectively, while in the milk from cows in experimental group 1, it was lower by 0.68% than in the counterparts from the reference group. On the 60th day of the experiment, the median percentage of dry nonfat milk solids in the milk from cows in experimental groups 1-4 was lower by 2.85, 0.97, 1.94, and of 3.08%, respectively, than in the counterparts from the reference group.

Thus, concentration of dry skimmed milk solids during the use of Vetom 1 decreased, and during the use of Vetom 1.23 it increased (Figure 4). This is an evidence of the fact that the accumulation of additional nutrients occurs only during the period of using Vetom 1.23.

The interquartile fluctuations in the concentration of skimmed milk solids in the milk from animals in experimental

groups had no significant differences; this speaks of the stability of the indicator and the absence of individual differences of these indications in groups.

Thus, under the influence of the studied preparations, both productivity of cows and milk quality changed. The nature and the extent of changes depended on the used preparations and dosages. The increased milk yield and protein content in the blood was most largely observed during the use of Vetom 1 at the dosage of 50 mg/kg, and fat content in milk – during the use of Vetom 1.23.

CONCLUSIONS

1. Fat content in the milk in case of using Vetom 1.23 at the dosages of 1 and 0.5 µl/kg increased both during the period of using the preparation, and 30 days after the use was terminated. The maximum increase in the fat content in milk was observed during the use of Vetom 1.23 at the dosage of 1 µl/kg of body weight. In case of using Vetom 1 at the dosage of 50 mg/kg of weight, fat content in milk increased on the 15th day of using the preparation, and 30 days after the use was terminated.

2. Concentration of protein in the milk increased only in the final period of using Vetom 1 at the studied dosages. The use of Vetom 1.23 did not increase protein content in milk.

3. Concentration of dry skimmed milk solids increased under the influence of Vetom 1.23 in the period when it was used. Increased content of the studied component in milk was observed in the final period of using Vetom 1 at the dosage of 12.5 mg/kg.

4. Productivity of lactating cows increased during the period of using Vetom 1 at the studied dosages, and during the use of Vetom 1.23 at the dosage of 1 µl/kg in the period of introduction and 30 days after the use of the preparation was stopped.

5. The severity and the duration of the effect were directly dependent on the preparation used, and its dosage. The maximum increase in the milk yield was observed during the use of Vetom 1 at the dosage of 50 mg/kg of body weight, not only during the use of the preparation, but also 30 days after the use was terminated.

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