Improving the environmental safety of milk and the productivity of dairy cows

L V Khoroshevskaya, A P Khoroshevsky, A A Mosolov, Yu V Starodubova, M V Frolova, N A Karabalina and M I Slozhenkina

1. Introduction

The large-scale growth in the production of livestock and poultry products is directly related to the growth in the number of livestock and poultry around the world. To prevent the emergence and spread of various bacterial diseases in large volumes of livestock of large industrial enterprises, the veterinary service has to resort to the widespread use of feed and therapeutic forms of antibiotics.

At the same time, the often unsystematic use of antibiotics in veterinary medicine has now led to an aggravating crisis in the field of antibiotic therapy, both in animal husbandry [1, 2, 3] and in human treatment [2, 4], since the residual low concentrations of antibiotics in animal husbandry products ensured the rapid adaptation of pathogens living in the human body to them. The fact that the crisis is of a planetary nature and threatens all of humanity was especially seriously discussed when COVID-19 emerged. In a pandemic, Escherichia coli, enterococci, staphylococci, Friedlander's bacillus, acinetobacters, pseudomonas and enterobacteria, then there are conditionally pathogenic bacteria that...
live in our bodies and the environment, as a rule, without causing any problems, in conditions of infection in patients with weakened immunity against the background of COVID-19 in the case of resistance to antibiotics, they cause dangerous nosocomial infections, up to death [1, 5, 6].

Residual concentrations of antibiotics are dangerous not only for human health, but also pose a serious problem for the dairy industry, as they can disrupt the technological process, sharply reducing the number or suppressing the viability of the starter microflora, changing the useful and taste qualities of the finished product [7, 8]. As a result, serious economic and legal problems arise for the manufacturer of the products.

In order to reduce mastitis in highly productive dairy cows and stabilize somatic cells in milk of dairy cattle to increase the yield of premium milk on the farms of Agrocomplex Novokubansky, Krasnodar territory, an experiment was conducted on the use of a new ecologically clean probiotic feed additive (a mixture of dried yeast cultures and “Laktuvet”), which promotes the activation of the cellulolytic microflora of the digestive tract in ruminants, which in turn makes feed fiber more accessible, improves the breakdown of neutral detergent fiber, leads to an increase in proteins of microbial origin and reduces the breakdown of feed proteins in the proventriculus and metabolic acidosis in ruminants, eliminating the need for feed antibiotic.

The end result of a synergistic combination of probiotic yeast cultures and the drug "Laktuvet" in the composition of the studied feed additive should lead to an increase in milk yield and an increase in the quality of milk from the studied animals.

2. Materials and methods

Place of the experiment: MTF "Pobeda". For the experiment, two experimental groups of animals of the second phase of the dry period were formed, 47 heads in each group (registration by individual numbers).

The first, experimental group was fed a diet with the introduction of a new feed additive in the composition of the compound feed in an amount of 0.4% of the diet for 30 days during the second half of the dry period (KK-60-3-2-681) and another 30 days from the beginning of lactation in the amount of 1.25% of the diet (KK-60-4-2-682).

The second experimental group was fed a diet, with the introduction of the studied new feed additive into the compound feed for 30 days only during the onset of lactation in the amount of 1.25% of the diet (KK-60-4-2-682).

The control group of animals was fed a standard diet at the same time of their physiological state. Holstein cows were used for the experiment. The experience period is September-November 2020.

The evaluation criterion from the use of a new feed additive was carried out according to the following parameters:

- consumption of feed by dry matter;
- general condition of animals in the prenatal and postnatal period;
- biochemical blood test of experimental animals (n = 15 animals);
- study of the level of ketone bodies with test strips on the 3rd and 7th day of calving;
- the number of manifestations of mastitis when animals are milked;
- the content of somatic cells in milk during the experiment on the 40th day after the end of the experiment to determine the effect of the test drug on the subsequent lactation period after its introduction into the diet;
- dynamics of the disease, treatment, retirement of animals during the test period;
- productivity of the tested animals during the period of the experiment;
- dynamics of reaching the peak of lactation;
- quality indicators of milk (milk fat, protein, level of somatic cells);
- economic justification of the results from the use of the tested probiotic feed additive.
3. Results and discussion

Biochemical blood tests of some cows from each group, by individual selection before the start of the experiment, were carried out on a PE-5300VI spectrophotometer manufactured by Ekohim LLC using Vital diagnostic kits. The obtained results of a biochemical blood test before the start of the experiment revealed in both experimental groups and the control group a discrepancy between the normative ratio of calcium and phosphorus in the blood, an excess of the content of urea, glucose in the blood serum, the total reserve alkalinity in the blood was below the level of 46%, which indicates an overfeeding of women animals and whether they have acidosis.

Biochemical studies of the blood of cows in both experimental groups at the end of the experiment showed the presence of a standard level of calcium, phosphorus, bilirubin, glucose, urea, carotene, iron, cholesterol, magnesium, reserve blood alkalinity, ALT, AST, protein, which indicates a good physiological state of the experimental animals, without pathological conditions by the end of the experiment.

Biochemical studies of the blood of cows in the control group revealed some of the animals with signs of acidosis and ketosis in animals. The eatability of feed in all three groups was good, no residues of feed dispensed according to the standard were observed.

Calving in both test groups passed without complications, the average live weight of newborn calves in the first group was 27.6 kg in the second group - 28.2 kg, in the control group - 30.2 kg with a weight spread from 27.0 to 32.0 kg, as a result, it was necessary to involve specialists in obstetrics for two heifers and the treatment of mastitis in one of the cows.

The number of somatic cells, milk fat, and the level of protein in milk were monitored every ten days for the entire period of the experiment and 40 days after the completion of the experiment. Commissioned sampling of milk to determine the content of somatic cells was taken from each section of the milk tanker. The study was carried out using a viscometric milk analyzer "Somatos-V" designed to control the quality of milk and determine the number of somatic cells in milk by the conditional viscosity in a licensed laboratory of the agricultural holding.

Throughout the experiment, the content of somatic cells in the milk of cows in the control group was significantly higher than in the experimental groups (Table 1). Cows in both test groups reached peak performance faster than the control group with higher performance at peak performance. This can be explained by the fact that the tested probiotic supplement in the body of experimental cows provided an increase in rumen biomass, where bacterial protein is an additional source of lysine and methionine for the body and replaces part of the dietary protein, which led not only to improved rumen health, increased milk fat, and increased productivity, but also a decrease in the consumption of concentrates, an increase in the consumption of roughage, a decrease in the cost of feed and dairy products in general.

Table 1. Results of the experiment.

| Name                          | 1 decade of experience | 2 decade of experience | 3 decade of experience | 40 days after the end of the experiment |
|-------------------------------|------------------------|------------------------|------------------------|----------------------------------------|
|                               | I   | II | C  | I   | II | C  | I   | II | C  | I   | II | C  | I   | II | C  | I   | II | C  |
| Milk fat level                | 4.5 | 4.4| 4.4| 4.1 | 3.9| 3.8| 3.9 | 3.8| 3.7| 3.8 | 3.8| 3.7| 3.1 | 3.1| 3.1| 3.1 | 3.1| 3.2|
| Milk protein level            | 3.0 | 3.0| 3.0| 3.1 | 3.1| 3.0| 3.1 | 3.1| 3.1| 3.1 | 3.1| 3.1| 141 | 146| 235| 139 | 171| 181|
| The presence of somatic cells | 16  | 16 | 16 | 16  | 16 | 16 | 16  | 16 | 16 | 16  | 16 | 16 | 26.7 | 25.6| 22.4| 27.8| 27.4| 25.7|
| Acidity of milk, °Т           | 16  | 16 | 16 | 16  | 16 | 16 | 16  | 16 | 16 | 16  | 16 | 16 | 33.4 | 32.6| 29.7| 33.0| 32.3| 29.4|
| Milk yield per cow, kg        | 26.7| 25.6| 22.4| 27.8 | 27.4| 25.7| 33.4 | 32.6| 29.7| 33.0 | 32.3| 29.4|



In addition, the strong immune system of the tested animals in both groups made it possible to qualitatively milk the animals after calving, not a single animal had an udder disease in the form of mastitis, which made it possible in these groups to do without the use of medicinal antibiotics.

Stabilization of somatic cells in milk throughout the entire experimental period provided an increase in the yield of premium milk in the experimental groups not only for the period of the experiment, but also in the next 40 days of control after the end of the experiment. Treatment of one head of a cow in the control group after calving due to mastitis with the use of an antibiotic and the period of its elimination from the animal's body became the reason for obtaining non-grade milk in the first decade of the experiment in the control group, which is reflected in the economic indicators for the group based on the results of the experiment (Table 2).

### Table 2. Economic feasibility of experience.

| Name                      | I group |          | II group |          | Control |          |
|---------------------------|---------|----------|----------|----------|---------|----------|
| Milk yield, ton           |         |          |          |          |         |          |
| Total for the group for the test period, t | 1361.2  | 47642    | 1332.2   | 4662.7   | 1200.4  | 4042.7   |
| Premium milk, ton         | 1361.2  | 47642    | 1332.2   | 4662.7   | 887     | 3104.5   |
| First grade, ton          | -       | -        | -        | -        | 310.9   | 932.7    |
| Non-graded, ton           | -       | -        | -        | -        | 2.5     | 5.5      |

Selling price of premium milk - 35.0 rubles a liter, first grade - 30 rubles, second - 27.5 rubles, non-graded - 22.0 rubles. The average cost of 1 liter of milk on the farm at the time of the experiment was 19.7 rubles. Application of the test program gave rise in the price of the diet for the first test group by 107,600 rubles, for the second test group - by 82,260 rubles for the entire period of the experiment.

Net profit based on the results of the experiment, minus the cost of milk and additional costs for the tested additive, was obtained:
• 1 (experimental) group – 2072.8 thousand rubles;
• 2 (experimental) group – 1956.0 thousand rubles;
• 3 (experimental) group – 1677.1 thousand rubles.

4. Conclusion
The experiments have shown the positive effect of the new probiotic feed additive on the milk productivity and quality of milk of cows by improving the breakdown of fiber and proteins, activating the cellulolytic microflora of the digestive tract of animals. At the same time, the possibility was revealed to refuse the use of feed and medicinal antibiotics in milk production.

5. Acknowledgements
This work was carried out under the grant of the Russian Science Foundation 21-16 00025, SSI NIIMMP. Grant sponsors were not directly involved in the development, analysis, or writing of this article.

References
[1] Mahase E 2020 Antimicrobial resistant infections keep rising despite fall in GP prescriptions British Medical J. 371 4502
[2] Global Action Plan to Combat Antimicrobial Resistance 2015 (Geneva: World Health Organization) p 29
[3] Khoroshevskaya L V 2016 New approaches to increasing the productivity of animals and poultry based on the use of non-traditional biologically active substances Veterinary Medicine and Feeding 3 20-21
[4] Ganina V I 2015 Microbiological safety of milk raw Dairy Industry 11 22-23
[5] Namazova-Baranova L S 2017 Antibiotic resistance in the modern Pediatric Pharmacology 10 341-354
[6] Frisch M 2021 Basic facts you need to know about reducing the intake of antibiotics TSENOVIK. Agricultural Review 3 36-41
[7] Slyusa A 2020 Milk business without antibiotics, seriously and for a long time Compound Feed 6 66-67
[8] Shcherbinin S 2021 The basis of biological safety on the farm TSENOVIK. Agricultural Review 3 48-49