I. S. Koba et al /J. Pharm. Sci. & Res. Vol. 10(10), 2018, 2582-2585

ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

# Prevention of Mastitis in Dairy Cows on Industrial Farms

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**Abstract:**

This article presents the results of the prophylactic efficacy assessment of new probiotic agent Dipal for treating udder nipples in lactating cows after milking. It has been established that Biomastim for 5 weeks helps preventing clinical mastitis in 97.5%, subclinical mastitis in 90.4% and cracks in the udder's nipples in 80.8% of cases. Also, the results of experiments on the use of Profmastit agent during the dry period in comparison with ProfilacDryOff are presented. As a result, it was found that with the use of Profmastit the incidence of cows with mastitis was reduced to 10% or by 3.4 times compared to the negative control, or by 1.6 times compared to the positive control, where the ProfilacDryOff was used.

**Keywords**: Biomastim, clinical mastitis, lactating cows, mammary gland, mastitis prevention, milk.

## INTRODUCTION

Milk is one of the most valuable products of the livestock sector. Therefore, increasing the productivity of cows and improving the quality of milk, as well as maintaining the mammary gland of cows in a healthy state are the main tasks of the development of dairy cattle [1-6].

Various violations related to the content and the rules of animal milking lead to serious diseases of the mammary gland and to mastitis in particular [7-10]. As a result, milk is not suitable for consumption and should be disposed of, expensive medications are used for treatment, and often animals are discarded. All these factors lead to large economic losses [11-14].

Mastitis is one of the most common diseases [15-17]. It is widespread not only during lactation, but also during the dry period. The main problem occurs in the early dry period, when the mammary gland is more vulnerable to pathogenic microorganisms [18-21]. Infection of the mammary gland occurs, as a rule, galactopoietically, through the teat canal, especially after milking, when it remains open for 1-2 hours, and the local antimicrobial protection appears to be reduced [22-27]. Therefore, the main work on the prevention of mastitis in cows should be conducted in order to exclude the entry of pathogenic microflora into the mammary gland of animals.

**Objective:** The present research was performed to determine the preventive efficacy of new agents Biomastim and Profmastit.

## MATERIALS AND METHODS

To compare the prophylactic efficacy of the probiotic preparation Biomastim, the experiment was performed with Dipal (manufactured by DeLaval, Sweden) most often used in the Krasnodar Territory. It contains iodine as the active ingredient and sorbitol as the auxiliary emollient component.

104 animals were used in the experiment. All animals were treated with an udder treatment agent after milking Dipal prior to the start of the experiment. The animals were divided into two groups: experimental and control (52 dairy cows in each group). The nipples of each udder of the experimental animals were sprayed with Biomastim immediately after milking. Those nipples of the control animals were treated with the after-milking solution Dipal by immersing the nipple in a plastic cup containing the solution. The animals were monitored continuously for a month and monitored during milking for latent mastitis using the express diagnosticum - Kerba TEST every 14 days. Also, during every control milking, cracked nipples were identified. Milk was taken from the experimental and control group cows for laboratory tests, which included the determination of somatic cells in the milk after the use of the preparations, as well as the determination of fat, protein, density and MSNF in the milk, with the help of the milk analyzer Klever -2M.

The total microbial contamination of the skin of the udder nipples and the secretion of the mammary gland before and after application of Biomastim was studied in 12 clinically healthy cows [28]. The animals were divided into 2 groups of 6 cows. Milking was carried out in a barn with a linear milking system.

Before milking, once a week for 5 weeks, the swabs were taken from the skin surface of the nipples of cows from the experimental and control groups before and after washing the udder using a sterile sponge swab in order to count the total microbial contamination. Samples of secretions from all parts of the udder were taken to a sterile container for the collection of biological fluids.

The number of microorganisms was determined using the method described in GOST [29].

To assess the prophylactic efficacy of Profmastit during the dry period, the production experiment was conducted with 300 animals, which were divided into three equal groups. During the start, nipples belonging to cows in the experimental group were treated with the Profmastit preparation immediately after the last milking by immersing the nipple in a plastic cup containing the preparation. During the start, the cows of the positive control group were treated with ProfilacDryOff (manufactured by GEA Farm Technologies) by immersing the nipple in a plastic cup containing the preparation; after which, the cows were determined to be the dry period group. The animals in the negative control group were determined to be the dry period group without pharmacoprophylaxis. On the 15th day of the dry period and after calving, the mammary glands of the animals in all three groups were examined by clinical methods and by setting the test response to the latent form of mastitis using the express diagnosticum – KerbaTEST.

## RESULTS

A summary of the results obtained for the microbial contamination of the skin of the udder nipples is presented in Table 1.

From the obtained data, it can be seen that in the control group before udder washing the total microbial contamination of the skin of the udder nipples was $3.4 \pm 3.4 \times 10^{14}$ per $cm^2$, and after udder washing, it was $2.0 \pm 0.8 \times 10^6$. In the experimental group, before udder washing the total microbial contamination of the skin of the udder nipples was $1.5 \pm 1.5 \times 10^{15}$, and after washing it was $1.3 \pm 1.1 \times 10^7$, which was 10 times higher than in the control group. It should be noted that before the experiment,

the total microbial contamination of the skin of the udder nipples was approximately the same as in the control group, but after washing them with Biomastim, the number increased by 10 times.

According to the results of the microbiological studies, it was established that the increase in the total microbial contamination of the skin of the udder nipples in the experimental group was due to the predominance of bacteria of the genus Bacillus and Enterococcus. It was also noted that in the experimental group, the amount of opportunistic microflora decreased in comparison with the control group.

The analysis of the microbial contamination of milk in healthy cows showed that in the experimental group, the total microbial contamination of milk decreased in comparison with the control group (Table 2).

The quantity of staphylococci in the experimental group's milk was $5.6 \pm 4.9 \times 10^3$. In the control group, however, it was $2.6 \pm 1.2 \times 10^5$, which was about 100 times higher than in the experimental group. The number of lactobacilli in the experimental group was $9.0 \pm 4.4 \times 10^2$ whereas in the control group it was 10 times more - $1.7 \pm 0.7 \times 10^3$. The same trend was observed with regard to the total contamination of the milk, which in the experimental group was $6.8 \pm 4.7 \times 10^4$, and in the control it was 10 times higher - $2.6 \pm 1.6 \times 10^5$. It should be noted that the bacteria from the *E. coli* group were not found in the milk of either group.

The experiment on the study of the prophylactic efficacy of Biomastim and Dipal showed the following results (Table 3).

**Table 1. The total microbial contamination of the skin of the udder nipples**

| Group | The total microbial contamination of the skin of the udder nipples per 1 $cm^2$ | Bacteria of the genus *Bacillus* | Bacteria of the geni *Enterococcus* and *Lactobacillus* | Bacteria of the family *Enterobacteriaceae* |
|---|---|---|---|---|
| Experimental (before udder washing) | $1.5\pm1.5\times10^{15}$ | $8.9\pm8.2\times10^5$ | $6.0\pm0.5\times10^6$ | $1.1\pm0.4\times10^8$ |
| Experimental (after udder washing) | $1.3\pm1.1\times10^7$ | $2.0\pm0.3\times10^3$ | $1.1\pm0.4\times10^4$ | $1.1\pm0.5\times10^4$ |
| Control (before udder washing) | $3.4\pm3.4\times10^{14}$ | $1.0\pm0.5\times10^2$ | $2.7\pm1.5\times10^2$ | $3.9\pm3.2\times10^{10}$ |
| Control (after udder washing) | $2.0\pm0.8\times10^6$ | $1.5\pm0.7\times10^1$ | $6.6\pm2.9\times10^1$ | $5.2\pm3.0\times10^5$ |

**Table 2. The total microbial contamination of the udder secretion**

| Group | The microbial contamination of milk, CFU | | | |
|---|---|---|---|---|
| | Enterobacteria | Staphylococci | Lactobacilli | The total microbial contamination of milk |
| experimental | – | $5.6\pm4.9\times10^3$ | $9.0\pm4.4\times10^2$ | $6.8\pm4.7\times10^4$ |
| control | – | $2.6\pm1.2\times10^5$ | $1.7\pm0.7\times10^3$ | $2.6\pm1.6\times10^5$ |

**Table 3. The prophylactic efficacy of Biomastim and Dipal used for washing the udder nipples after milking, n=52**

| Group | The research period | Clinical mastitis | | Latent mastitis | | Cracks in the udder's nipples | |
|---|---|---|---|---|---|---|---|
| | | animals | % | animals | % | animals | % |
| Experimental | 1st week | 3 | 5.7 | 4 | 7.7 | 14 | 26.9 |
| | 3rd week | 1 | 1.9 | 3 | 5.7 | 8 | 15.4 |
| | 5th week | 0 | 0 | 8 | 15.4 | 8 | 15.4 |
| | The average of an observation | 1.33 | 2.5 | 5 | 9.6 | 10 | 19.2 |
| Control | 1st week | 2 | 3.8 | 9 | 17.3 | 18 | 34.6 |
| | 3rd week | 3 | 5.7 | 4 | 7.7 | 12 | 23.0 |
| | 5th week | 0 | 0 | 8 | 15.4 | 14 | 26.9 |
| | The average of an observation | 1.67 | 3.2 | 7 | 13.4 | 14.7 | 28.1 |

**Table 4. Indicators of milk quality and the number of somatic cells in the cow milk**

| The indicator | The experimental group | | The control group | |
|---|---|---|---|---|
| | The start of the experiment | The end of the experiment | The start of the experiment | The end of the experiment |
| A mass fraction of fat, % | 3.118±0.195 | 3.323±0.108 | 2.992±0.205 | 3.235±0.101 |
| A mass fraction of protein, % | 3.245±0.07 | 3.457±0.094 | 3.075±0.055 | 3.31±0.087 |
| Density, $kg/m^3$ | 29.413±0.494 | 30.443±0.523 | 28.888±0.497 | 30.002±0.265 |
| MSNF | 8.362±0.108 | 8.517±0.177 | 8.365±0.101 | 8.39±0.074 |
| Somatic cells, thousand/ml | 105±6.583 | 97.5±5.59 | 112.5±6.801 | 104.167±5.974 |

**Table 5. The difference in the prophylactic efficacy of Profmastit and ProfilacDryOff during the dry period**

| Group | Cows with clinical mastitis | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | On the 15th day | | | | During the entire dry period | | | |
| | Clinical mastitis | | Subclinical mastitis | | Clinical mastitis | | Subclinical mastitis | |
| | Number | % | Number | % | Number | % | Number | % |
| Experimental | 0 | 0 | 4 | 4 | 6 | 6 | 4 | 4 |
| Positive control | 4 | 4 | 4 | 4 | 10 | 10 | 6 | 6 |
| Negative control | 18 | 18 | 8 | 8 | 24 | 24 | 10 | 10 |

According to the results of monitoring the animals, it has been established that by the end of the first week of using Biomastim, the number of cows with clinical mastitis was 5.7%, while in the control group it was 3.8%. In the third week of the experiment, the percentage of cows with mastitis in the first group decreased to 1.9%, while in the control group it increased to 5.7%. According to the results of the 5th week, animals with clinical mastitis were not found.

Analyzing the incidence of latent mastitis in cows it should be noted that there was a clear tendency to reduction of morbidity in the experimental group. By the end of the first week of the probiotic use, the incidence of latent mastitis in cows was 7.7, while in the control group it was 17.3%. In the third week of the experiment, there were by 2% fewer cows with latent mastitis in the experimental groups than in the control ones and the values were 5.7% and 7.7%, respectively. However, by the 5th week of the experiment, each group had 8 cows with latent mastitis.

The performed studies of the state of the udder nipples on the presence of cracks showed that this they decreased in cows in the experimental group throughout the experiment. On average, this was 19.2%, while in the group where Dipal was used, cracks in the udder were found in 28.1% of cases.

During the course of checking the preventive efficacy of Biomastim, milk quality indicators were checked and somatic cells were counted in the milk (Table 4).

During the course of testing the milk quality indicators at the beginning and at the end of the experiment, there were no deviations from the physiological norm. Throughout the entire experiment, the milk quality indicators did not change and they remained at a relatively similar level. When calculating somatic cells in milk, it was found that throughout the experiment, they were at a physiological level and there were no significant abnormalities in the experimental and control groups. That is, for the entire study period, the number of somatic cells in the experimental and control group did not exceed the physiological norm.

As a result of the experiment to test the difference in the prophylactic efficacy of Profmastit and ProfilacDryOff during the dry period, the obtained results were presented in Table 5.

Analyzing the obtained results, it was revealed that the subclinical mastitis was found in the experimental group on the 15th day in 4 (4%) cows, where the nipples were treated with Profmastit. Besides, 6 animals became ill in the interval between the 15th day of the dry period and the calving period. Thus, for the entire dry period, 10 cows were diagnosed with mastitis, of which 6 (6%) cows had the clinical form, and 4 (4%) - the subclinical form, which equaled to 10% of the livestock.

In the positive control group, where the nipples were treated with ProfilacDryOff, on the 15th day of the dry period the number of cows with clinical mastitis was 8 (8%), of which 4 (4%) cows had the clinical form, and 4 (4%) – the subclinical one. In the interval between the 15th day until calving, 8 cows also became ill. As a result, 16 (16%) cows were found sick in the first control group, 10 (10%) of them had the clinical form of mastitis, and 6 (6%) – the subclinical one.

In the negative control group, on the 15th day of the dry period 26 (26%) cows were diagnosed with mastitis, of which 18 (18%) had the clinical form, and 8 (8%) – the subclinical one. In the interval between 15 days to calving, 8 (8%) cows became ill. Thus, 34 cows or 34% were ill during the entire dry period in the negative control group.

## CONCLUSIONS

In conclusion, it can be summarized that using the Biomastim preparation, the contamination of the udder nipples with the opportunistic pathogenic microflora decreases but the prevalence of the bacteria of the geni Bacillus and Enterococcus increases. The Biomastim preparation reduces the total microbial contamination of the milk by 10 times compared with the Dipal preparation. Using Biomastim for 5 weeks helps preventing clinical mastitis in 97.5%, latent mastitis - in 90.4%, and cracks in the udder's nipples - in 80.8% of cases. Dipal prevents clinical mastitis in 96.8%, latent mastitis - in 86.8%, and cracks in the udder's nipples - in 71.9% of cases. Also, the tested preparations do not degrade the quality of milk. The number of somatic cells, fat, density and MSNF in the milk remained at the physiological level. The use of Profmastit makes it possible to reduce the incidence of cows with mastitis by 10% or 3.4 times, compared to the negative control, or by 1.6 times compared to the positive control, where the ProfilacDryOff was used.

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