

# Assessment of the efficiency of therapeutic and prophylactic treatment of cows' hooves using a modern antiseptic

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**Abstract.** The search for modern effective means for prevention and treatment of diseases of hooves of farm animals is an urgent and timely issue. The study considers assessment of the incidence and nature of hoof pathologies in highly productive cows in one of the livestock farms of Ryazan region with a production line system and loose housing of animals. The total percentage of lameness in the farm was 17.3%, including acute lameness, when the cow does not lean on a bad limb - 3.6%. After assessing the significance and relevance of the study for this farm, there was an experiment to assess the efficiency of the use of a new antiseptic drug for preventive and therapeutic treatment of hooves based on quaternary ammonium salts, nonionic surface-active materials, copper aldehyde and sulfate. The drug showed high bactericidal activity when studying the total microbial count (51.2% lower than in the control group) and the presence of *E. coli* bacteria (not detected after exposure). When assessing the presence and nature of the growth of microorganisms on the Endo nutrient medium in the experimental group of animals, the results similar to the comparison drug were noticed.

## 1 Introduction

The problem of cows' hoof pathology in modern livestock complexes occupies one of the leading places among non-infectious pathology. The relevance of the issue is also determined by large economic costs associated with the loss of productivity, which, according to a number of well-known scientists [1, 2, 3, 4], can be about 20%, while the percentage of cows' disposal can reach 30-35%. According to a number of authors, economic costs are associated, among other things, with a decrease in productivity due to some violation of the feeding behavior of cows, a decrease in feed consumption, an increase in feeding time, and, consequently, some violation of temporary technological intervals [5].

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Among the methods of solving the problem of orthopedic pathology, it is important to highlight timely and regular clearing and trimming of hooves, correct and timely diagnosis, and, accordingly, competent treatment. In general, the most important thing, in our opinion, remains a properly organized system of preventive measures, the leading link of which is the periodic treatment of cow hooves with antiseptic and disinfectants using mechanical aerosol application or hoof baths for mass processing of livestock.

Today, both in Russia and abroad, hard work is underway to improve methods to prevent and treat hoof diseases. Scientists and practitioners are actively working on methods and modes of hoof bandaging when treating a specific sole ulcer. An analysis of the dependence of the severity of pathology and the rate of healing on the number of lactations and productivity is carried out, which is extremely important and can help to predict this problem and timely prevent in a satisfactory herd [6, 7]. Some authors place an emphasis on stabilizing metabolism, activating the antioxidant system, and reducing the stress sensitivity of cows [8, 9].

*The use of hoofed baths in livestock farms with loose cows.*

The hoof treatment is carried out in 2 stages. First, the cows are carried out through baths with plain water or with the addition of detergents, then through an antiseptic (or disinfectant) agent. As antiseptic (or disinfectant) agents, 5-10% solutions of copper sulfate, zinc sulfate, glutaraldehyde, quaternary ammonium compounds, and their combinations are most often used. In addition, in the modern world, the popularity of products based on chelated copper and zinc for the treatment and prevention of hoof diseases is growing [10, 11, 12, 13].

The purpose of this work was to establish the frequency of registration and the nature of hoof pathologies in livestock breeding with loose housing, as well as approbation and assessment of the efficiency of a modern drug for hoof baths.

## 2 Materials and methods

Clinical and diagnostic studies were carried out in the livestock farm of LLC "Agrocapital" in Ryazan district of Ryazan region. The farm specializes in breeding and keeping Holstein cattle. The type of housing is loose, boxed. The maintenance technology is flow-shop. It is known that this technological system makes it possible to foresee the location of hoof baths on the way of animals' movement, as a result of which their use is one of the main methods of preventing hoof diseases.

The objects of research were cows with an average live weight of 600 kg, 2-3 lactations, which corresponds to 3-4 years of age.

In order to study the prevalence of hoof diseases, there was an orthopedic clinical examination, during which the data in retrospect were studied (registers of sick animals, data from herd manager Dairy Comp 305), a clinical examination of the herd in accordance with the technological groups took place, assessing the characteristics and nature of walking, the presence, the degree and nature of lameness.

The assessment of lameness and walking was carried out according to the method of Sprecher E.A. (1997). For the purpose of an accurate diagnosis, all animals with established lameness were examined in a machine with preliminary caring and trimming of hooves. In all experiments, the character of limb support, the shape and condition of the hoof as a whole and its individual parts, sole and digital torus were visually determined. Particular attention was paid to the presence of wounds, ulcers, fistulas, or swelling on the corolla. Also, during the clinical examination, attention was paid to the condition of the hoof wall, in particular to its slope, the presence of defects, and the nature of annulation. The presence or absence of pain was assessed using test forceps.

The sole of the hoof, the digital torus and the heel area were especially carefully examined, paying attention to the shape and concavity of the sole, the state of the white line, the color of the sole horn (red, yellow spots with bruises and inflamed sores), and the presence of foreign bodies.

1% solution of "Hoofex" (LLC "Nuvikhim", St. Petersburg, Russian Federation) was used as a test antiseptic agent for foot baths. When choosing the concentration of the solution for application in foot baths, the manufacturer's instructions were followed. The preparation contains quaternary ammonium salts, nonionic surfactants, copper sulfate and isopropanol. As one can see, based on the composition, most of the components of the drug have proven antiseptic and / or disinfectant activity. In turn, production trials of the efficiency of new combinations, both in vivo and in vitro, are an important stage in preliminary testing.

For a comparison, the most often used drug in livestock farms - a 10% solution of copper sulfate (copper sulfate) was used. For a comparative assessment of the efficiency of the drug, 3 groups of animal analogues were formed, 10 animals each (control - baths with pure water; reference drug - baths with 10% copper sulfate; experiment - baths with 1% Hoofex solution.

To assess the bactericidal activity of the tested solutions, microbiological research methods were used. Washings for bacterial cultures were carried out before and after the application of the preparations, that is, before and after passing through the hoof baths. The washing was taken using a sterile Citoswab probe in the fornix of the interdigital cleft. Bacteriological studies were carried out at Ryazan Regional Veterinary Laboratory. For the purpose of a comparative assessment of the efficiency of disinfection using various technologies for treating hooves, the total microbial count (QMAFAnM) and *Escherichia coli* group bacteria (CGB) in washings from the fornix of the interdigital cleft were determined.

To indicate *E. coli*, inoculations were carried out in test tubes with CODA medium. The inoculations were kept in a thermostat at a temperature of 37-38° C for 12-18 hours. A change in the lilac-red color of the medium to a green or light green color with turbidity of the media and gas formation indicated the presence of *E. coli* growth. After that, the washings from the interdigital fissure were inoculated onto Endo medium. Based on the methodology, other color changes (yellowish, pink, grayish) observed with the growth of microorganisms of other species were not considered.

The digital data obtained during the studies were subjected to statistical processing. Due to the small number of groups, the Mann-Whitney test of nonparametric statistics was used to assess the intergroup difference. The difference in digital data was considered significant at a significance level of differences less than or equal to 0.05.

### **3 Results and discussion**

Data on the analysis of the frequency of registration and the nature of hoof pathology at LLC "Agrocapital" for 2017-2019 showed that, in general, this category of pathologies was not often recorded at the farm. So, out of 475 heads that underwent a thorough clinical examination, 17.3% of animals (82 heads) had signs of lameness expressed to one degree or another. At the same time, analyzing the conditions of animal management, the degree of cleanliness in premises for rest, cattle driving corridors and milking parlors, we gave the farm as a whole a high positive assessment. The diet of animals was balanced in terms of basic nutrients, the balance of the diet changed in accordance with the needs of animals, based on a specific technological group.

In turn, the picture of walking disturbance allowed to classify animals into groups depending on the severity of pathology (Table 1).

**Table 1.** Classification of the cows examined according to the severity of walking disorders

| Assessment criterion   | Number of points | Conclusion      | Number of animals, heads | Number of animals, % |
|--|------------------|-----------------|--------------------------|----------------------|
| Stands and walks with a straight back  | 1                | healthy animal  | 361                      | 76                   |
| Back arched while walking  | 2                | slight lameness | 15                       | 3.2                  |
| The back is always arched, the step on the opposite side of the sore limb is shortened | 3                | medium lameness | 23                       | 4.8                  |
| The back is always arched, the cow does not step on the sore limb when walking         | 4                | severe lameness | 27                       | 5.7                  |
| A cow shows an inability to step on a sore leg in any situation                        | 5                | acute lameness  | 17                       | 3.6                  |

Based on this division, it can be seen that, despite the relatively low overall percentage of morbidity, there is a fairly pronounced lameness in the structure, characterized by significant pain, and, accordingly, leading to a more intense stress reaction and a decrease in productivity. Almost half of the cows with a pathological process in the distal limb had severe and acute lameness.

When analyzing by nosological units, it was found that the most frequently recorded diseases were Rustergoltz ulcer (specific ulcer of the sole), presented in Figure 1A with 29 heads (6.1%), digital dermatitis (Mortellaro disease, Figure 1B) with 21 heads (4.4%), aseptic forms of laminitis and pododermatitis with 13 heads (2.7%). Purulent pododermatitis and abscesses in the area of the corolla were less frequently recorded with 7 heads each (1.5%), respectively. Only 4 heads (0.8%) had tylome (limax) and 1 head (0.2%) had phlegmon of the corolla).

The obtained data allow saying that of the identified types of pathologies, the main part of cases (12.2%) is associated with a septic process, the prevention and treatment of which necessarily include the use of antiseptics and / or disinfectants.

In the future, the research was aimed at a comparative assessment of the efficiency of the use of modern environmentally friendly drug "Hoofex" (manufactured by LLC "Nuvikhim", St. Petersburg, Russian Federation) when used in the form of a 1% solution as a disinfectant for hoof baths.



**Fig. 1.** Clinical assessment of pathologies of cows' hooves at LLC "Agrocapital": A - digital dermatitis; B - specific ulcer of the sole

As can be seen from Table 2, the working solution of Hoofex at 1% concentration, when used in hoof baths, reduces microbial contamination of the skin of the interdigital fornix by 46.3% (QMAFAnM indicators) in comparison with the control group.

**Table 2.** Bactericidal effect of copper sulfate (10%) and "Hoofex" (1%) on the microflora of cow hoofs

| Drug  | Indicators | Average indicators of washings of cows' hoofs |
|---|------------|---|
| Experiment 1 (10% solution of copper sulfate) | QMAFAnM    | $(3.8 \pm 0.24) \times 10^2$ *                |
|   | CGB        | –   |
| Experiment 2 (1% solution of "Hoofex")        | QMAFAnM    | $(4.2 \pm 0.43) \times 10^2$ *                |
|   | CGB        | –   |
| Control (water)                               | QMAFAnM    | $(8.2 \pm 0.25) \times 10^2$                  |
|   | CGB        | +   |

Note: \* –  $p \leq 0.05$  – in comparison with the control group

There is also a bactericidal effect against *Escherichia coli* group bacteria (CGB - negative growth). A similar result with a slightly higher efficiency was obtained for a 10% solution of copper sulfate, the QMAFAnM index is lower than that in the control group by 51.2%, the bactericidal activity against CGB is also expressed (Table 2). The higher activity of a 10% copper sulfate solution is caused by the fact that due to its main chemical properties, this drug, when interacting with a microbial cell, actively interacts with water molecules, ultimately leading to denaturation of protein components. From the point of view of a similar effect on the tissues of the animal's body surface, on the one hand, this leads to the so-called "astringent" effect, reduces exudation, an inflammatory reaction, but this can also lead to excessive drying of the hoof and its fragility.

When assessing the growth rate of colonies obtained by direct inoculation on Endo medium, it was found that in washings obtained from animals treated with both 10% copper sulfate and 1% Hoofex solution, on average 50% of samples had either no growth or it was not significant (Table 3). It should be noted that, due to its complex chemical composition, this drug has a gentler action in relation to the external integuments of the animal's body simultaneously with a rather active bactericidal effect.

**Table 3.** Intensity of growth of colonies on the 4th day of cultivation in a thermostat at 37.0° C in all samples and groups

| Sample | Group                              |                             |                 |
|--------|------------------------------------|-----------------------------|-----------------|
|        | Comparison<br>(10% copper sulfate) | Experiment<br>(1% "Hoofex") | Control (water) |
| 1      | No growth                          | ++                          | +++             |
| 2      | No growth                          | +                           | +++             |
| 3      | ++                                 | No growth                   | +++             |
| 4      | +++                                | +                           | +++             |
| 5      | No growth                          | +++                         | +++             |
| 6      | ++                                 | ++                          | +++             |
| 7      | ++                                 | No growth                   | +++             |
| 8      | +                                  | +++                         | +++             |
| 9      | ++                                 | ++                          | +++             |
| 10     | No growth                          | No growth                   | +++             |

It is important to note that in the comparison group in one sample, and in the experimental group in two samples, the growth of microorganisms was present, which, in our opinion, may be due to the insufficient exposure time of the solution, as a result of the rapid passage of the animal through the bath. In turn, all samples of the control group had an active growth of colonies of microorganisms.

## 4 Conclusion

Among the diseases of cows' hoofs at the farm with a loose housing system, chosen as the basis for this study, pathologies of a septic nature prevail, namely digital dermatitis (Mortellaro's disease), purulent pododermatitis and septic complicated forms of specific ulcers of the sole (Rustergolz's ulcers).

When assessing the nature of animal locomotion, it was found that 3-5 point's lameness prevails in LLC "Agrocapital", which is a sign of insufficient management in this direction and is a signal for specialists responsible for herd health to take active therapeutic and prophylactic actions.

As a result of testing the efficiency of the new Hoofex product (manufactured by LLC "Nuvikhim", St. Petersburg, Russian Federation) when used in the form of a 1% solution as a disinfectant for hoof baths, it was found that it has a pronounced antimicrobial activity.

A solution at 1.0% concentration reduces microbial contamination by 96.1% and CGB were not found.

In addition, the fact that we could not establish a statistically significant difference in QMAFAnM values between the experimental group (1% Hoofex solution) and the comparison group (10% copper sulfate) ( $p = 0.253$ ) allows to assert that the funds have comparatively identical efficiency.

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