Foot Problems in Dairy Cows
Literature review and preliminary trials with drySTART™ footbath

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Introduction:

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According to researchers from the Department of Veterinary Preventive Medicine of The Ohio State University¹: “Lameness is common on U.S. dairy farms, with a prevalence of 22% of cows affected. In the mid 1990’s, it was estimated that 47% of herds experienced digital dermatitis (a.k.a. hairy heel warts, papillomatous digital dermatitis) and that 11.9% of the dairy cow population was affected with DD (USDA, 1997). More recent reports suggest that prevalence of digital dermatitis has increased (USDA, 2002).”

The Pennsylvania State University on its Extension Bulletin “Prevention and Control of Foot Problems in Dairy Cows”² also refers that “Foot health and lameness are major issues facing dairy producers because of their common occurrence and the tremendous economic losses incurred. Early detection and prompt treatment can minimize the loss, improve recovery, and reduce animal suffering. Economic loss is mostly due to the foot problems per se, not the treatment costs. Losses are often subtle, however, depending on the severity, the following components can be identified: body weight loss and decreased milk production, dry matter intake, herd longevity, and reproductive efficiency. The economic implications associated with foot problems can be a minimum of $90 to $100 per case. Depending on the problem and the severity this cost can be higher.”

A publication from Manitoba Agriculture indicates that Canada has an incidence of 35% of lameness³.

Types of lameness

Typically, lameness is categorized into two types: infectious and non-infectious³.

<table>
<thead>
<tr>
<th>Infectious</th>
<th>Non-Infectious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heel warts</td>
<td>Laminitis</td>
</tr>
<tr>
<td>Digital and interdigital dermatitis</td>
<td>White line disease</td>
</tr>
<tr>
<td>Foot rot</td>
<td>Sole ulcers</td>
</tr>
<tr>
<td></td>
<td>Joint and upper leg trauma/deformity</td>
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</table>

According to the Penn State publication² there are several types of foot problems. Some of them are clearly related to moisture conditions:

- **Hard and Soft feet** – “Foot infections, abscesses or sole ulcers may stem from cracks that result when feet are too soft or hard. Excessively Soft Feet are more apt to occur in free stall systems from standing in manure and urine. This may result in heel and sole cracks allowing ulcers, abscesses or infections to occur.”

- **Foot rot** – “A smelly infection of the foot, which generally occurs high between the claws or toes, is referred to as foot rot. Control of foot rot is important to minimize the economic impact of this contagious disease to the herd. This results mainly from an infection caused by the bacterium, Fusiformis necrophorus. The organism may build-up in barnyards, exercise lots, mud-holes, and pastures. Researchers from the University of Florida and Tennessee also associate environmental conditions to this problem: “Environmental factors associated with these disorders may include housing conditions which require cows to walk through or stand in manure slurry for extended periods. Since the causative organisms are believed to originate from the gastrointestinal tract of the cow it would be reasonable to expect that manure management would be helpful to reducing the occurrence of the disease. Removing extraneous debris from walkways and alleyways to avoid interdigital skin lesions and keeping cattle habitat as dry as possible are believed to major considerations in the prevention of foot rot problems.”

Hoof-Care Treatments

Treatments can consist of hoof trimming, foot baths, and/or topical applications. Footbaths are the most commonly used form of prevention/treatment. The proper use of footbaths can help reduce the incidence of infectious lameness disease such as foot rot and digital dermatitis or heel warts. A footbath used with a suitable chemical performs two functions³:

1. Kills disease causing bacteria
2. Hardens hoof horn making it less easily damaged

According to Bill Epperson and Lowell Midla¹ “Footbaths can clean debris from feet and/or apply a disinfectant (or antibiotic) to the feet. In the U.S., footbaths are used largely in a preventive strategy and feature disinfectants. The most common disinfectants are formalin (2 to 5% concentration) and copper sulfate (5 to 10% concentration). On the other hand “Copper sulfate has commonly been favored as a footbath disinfectant due to availability and ease of use, and it appears effective in reducing Digital Dermatitis lesions. Copper sulfate is bacteriostatic by reaction of Cu⁺ with protein thiol groups in target organisms.”

Researchers at The Pennsylvania State University besides normal footbaths, also recommend the use of dry footbaths⁵: “If feet are too soft, avoid having cows stand in moist sod for extended periods of time. Allow cows to stand in dry soil or sand, even if it means piling it on concrete for cows to stand on. Routinely use a dry mineral mixture in a walk-through foot box. Barn lime or superphosphate can be used on walkways.” They also recommend several things for Foot rot control, amongst them “Affected animals should be separated from the herd and confined to prevent the spread of the organism. Isolating individual cows, rigid sanitation in high-density areas, and use of a foot bath has
The foot bath should contain five-percent copper sulfate. The depth of the solution should be at least four inches. The foot bath should be located where cattle must pass through it several times a day. An alternative to the foot bath is a dry bath containing one part copper sulfate to nine parts hydrated lime.

In another publication from Pennsylvania State University, the author refers to the control of Foot Rot in sheep, and the use of a Dry Footbath: “Zinc sulfate (dry) can be placed in a box in an area sheep must walk through. This will not treat infected animals, but will help decrease the spread of the disease. Lime, disinfectants, or drying agents may be used around feed or water troughs to reduce moisture and decrease the spread of the disease.”

**Typical footbaths and environmental and hazardous concerns**

According to Cornell University, commonly used foot baths to prevent lameness in dairy cows “may not only reduce crop yields but also contribute to the copper load in farm fields.” “Copper sulfate is the most cost-effective treatment for controlling hairy heel warts that cause lameness in dairy cows. However, much of the copper sulfate used in the cow’s foot baths is disposed of in manure slurry applied to farm fields. A William H. Miner Agricultural Research Institute survey of New York and Vermont farms estimates that 4 to 16 pounds of copper sulfate is applied per acre per year to some fields. Since the New York State Department of Environmental Conservation has set a lifetime load limit for copper at 74 pounds per acre, a field could reach its maximum load of copper in 4.5 to 19 years.”

Bill Epperson refers that “Typically, copper sulfate solution is considered effective for 150 to 300 cow passes. Used solution is mixed with manure waste and ultimately disposed by land application. Regulators in several states have expressed concern that soil copper could be increased to an unhealthy level by this practice and have established maximum (lifetime) loading rates of copper. An 8 ft x 2.5 ft x 5 inch footbath will contain approximately 62 US gallons of water and 26 pounds of copper sulfate (charged at the 5% concentration). Since copper sulfate is 25% copper, each time the footbath is dumped, 6.5 pounds of copper is added to the disposal burden. The environmental effect of this copper depends on the volume of footbath solution disposed (a function of cow number and intensity of footbath use), concentration of copper sulfate, and the land area of application. Without careful attention, maximum soil copper loading rates may be exceeded by dairy producers in relatively short times (5 to 30 years). Plants require very little copper, so annual removal rates are less that 0.5 lb/acre for typical grain and forage crops.”

Formaldehyde, although considered a strong disinfectant, also poses some concerns, especially to the user. Again Bill Epperson refers that “Formaldehyde is a respiratory and contact irritant, and is considered a potential carcinogen. The main objection to formalin is the potential health hazard to farm workers, most of which is posed by the concentrated solution.”

Sometimes antibiotics are used in footbaths. They are used to cure, not to prevent. Although they are generally efficacious, they present several causes of concern: they are costly, it’s always an extra label use, there is potential for bacteria to develop resistance and they are most efficacious when mixed with distilled water. There is also the concern expressed on a University of Minnesota paper on the reasons why sometimes antibiotic contamination occurs in bulk tank milk, that: “Cows drank from a medicated footbath.”

**On Farm Trials**

*(Luci Rosca, Livestock Specialist)*

**Material and methods:**

A trial was conducted at two dairy farms using drySTART in a footbath. These trials were meant to be preliminary tests to:

- determine the best size of the footbath box,
- determine the amount of drySTART required
- gauge the overall perception by the farmer of the effectiveness of drySTART footbaths, as this was the first time the product was used for this purpose.

It was considered a good coverage of the feet if the coronary band was covered with the product.

To reduce the amount of product usage and to increase the volume of the product in the foot bath, drySTART was mixed with wood shavings at 1:2 or 1:1 ratios.

**FIRST BARN**

This is a 98 milking cow’s dairy barn. It has two footbaths installed on each side of the exit from the milk parlor. The dimensions of the footbaths are 6 feet (1.8 m) long, 32 inches (81 cm) wide, and 6 inches (15 cm) deep.

In this particularly dairy barn, a footbath is not used on a regular basis as a prevention or treatment of lameness. The owner considers foot bathing with antibiotics unsafe because cows could drink the prepared solution and have milk residues. On the other hand, the prepared solution is expensive and due to its fast contamination with manure it has to be changed often. This added cost makes this alternative an expensive one. They also don't want to use Formaldehyde or Copper Sulfate in the footbath because of hazardous and environmental concerns. Usually they spray the affected feet with Linco-Spectinomycin solution on an as-needed basis.
drySTART trial – FIRST BARN

For each dry footbath two bags of fine wood shavings, with 0.046 m$^3$ (1.63 ft$^3$) (this is the volume of the compressed bag), were mixed with one 25 kg (55 lbs) drySTART bag. The dry bath should last for one day passing (morning and afternoon) and for the next two days another half of drySTART bag was used to complete the wastage.

Cows were monitored at milking time by recording the number of cows that were lame. Pictures of their affected feet were taken to compare with pictures taken one month after using drySTART.

![Pictures before drySTART](image1)

![Pictures after drySTART](image2)

SECOND BARN

This is a 45 milking cow’s dairy barn. It has one footbath at the exit of the milking area. The dimensions of the box are 8 feet (2.44 m) long, 32 inches (81 cm) wide, and 8 inches (20.5 cm) deep. The farm has its own footbath protocol as follow:

<table>
<thead>
<tr>
<th>Week One</th>
<th># of days</th>
<th>Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>Formaldehyde</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Oxytetracycline</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Copper Sulfate</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week Two</th>
<th># of days</th>
<th>Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>Formaldehyde</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Copper Sulfate</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>None</td>
</tr>
</tbody>
</table>

The owners would like to try something different, more environmental friendly and less strenuous in the work of changing baths every other day.

drySTART trial – second barn

The regular protocol was stopped and the following procedure was implemented:

Mondays: a bath with degreasing soap and water

Tuesday: drySTART along with wood shavings.

For each dry footbath one bag of coarse wood shavings, 0.092 m$^3$ each (3.25 ft$^3$), were mixed with two bags of 25 kg (lbs) drySTART bags. The bath should last for one day passing (morning and afternoon). Cows were monitored at milking by recording the number of cows that were lame. Pictures of affected feet and the level of feet coverage were taken.
**Discussion**

**First barn**

At the first dairy barn, 15 cows were identified with an inflammation at the coronary band along with the interdigital space. Assuming it could be Digital Interdigital dermatitis, drySTART was expected to help by reducing the moisture which is the principal predisposal factor to these types of infections.

The footbath was prepared right before milking and cows walked through it after they were milked. The coverage of the hoof wasn't acceptable because of the dimensions of the bath. On the other hand, the hoofs were dirty and covered with manure. Results are not expected if drySTART can't get in direct contact with the hoof walls. Feet should be as clean as possible (must see wall) to maximize the contact of the footbath agents with skin and horn tissue. Adding a prebath with cleaning agents in it may be beneficial. We considered using a soap solution as a pre-bath to clean feet before the use of drySTART footbath, but the farmer decided just to wash the feet with water after each cow was milked. After this, the drySTART footbath was installed and used for one month. Cows walked through the drySTART footbath two consecutive days per week.

One month later, another set of pictures was taken and a significant improvement could be seen between before and after using drySTART. Only three cows were lame after one month of treatment.
The farmer decided to use drySTART on a weekly basis and also he started to sprinkle drySTART in stalls on the top of bedding every day by using one bag of product for 98 cows per month.

Second barn

The situation was different at the second dairy barn because only a few cows were lame as there was already a foot bath protocol in place. Also, the footbath box had different dimensions which give it more suitable coverage. As cows walked through the bath, their feet were covered with drySTART above and beyond the coronary band.

The farmer liked the new dry foot bath and implemented a new protocol as follows:

Mondays: a bath with soap and water, to clean the hoofs,

Tuesday: Two bags of drySTART along with wood shavings.

The trial will be in place for the next three months. The results will be monitored monthly.

Future Considerations

- General recommendation for the dimensions of footbath box is:
  8 feet (2.44 m) long, 32 inches (81 cm) wide, and 8 inches (20.5 cm) deep
- The amount of drySTART usage differs accordingly with the dimensions of the footbath and the number of cows that are passing through the bath. For a dry footbath with the dimensions mentioned above it would be necessary to use two 25 kg bags of drySTART along with one 19 kg bag of wood shavings (0.092 m$^3$ or 3.25 ft$^3$), and this bath should be enough for 150 cows for two treatments (morning and afternoon).
- Feet should be as clean as possible (must see wall) to maximize the contact of dry footbath with skin and horn tissue. Adding a pre-bath with soap and water may be beneficial. If pre-bath is not available, consider cleaning the feet with normal pressure water hose after each cow is milked and then use the drySTART footbath.
- Routine use of drySTART in a walk-through footbath box is needed to evaluate the further impact it may have on productivity.

References:

4. “Lameness in Dairy Cattle” J.K. Shearer DVM, MS., Dairy Extension Veterinarian University of Florida and S. Van Amstel DVM, MS., Associate Professor University of Tennessee, Proceedings from 2000 Kentucky Dairy Conference
8. “J.K. Shearer DVM, MS, Dairy Extension Veterinarian, University of Florida, S. Van Amstel DVM, MS, Associate Professor, University of Tennessee- Lameness in Dairy cattle.”