Foot disinfection (foot bathing) - Clinically Appraised Topic

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For full article see: Bell et al 2014 <https://www.magonlinelibrary.com/doi/abs/10.12968/live.2014.19.1.6>

Twelve papers describing foot bathing intervention studies evaluating biocidal agents for the control of digital dermatitis in dairy cattle

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| ***Author (date), country*** | ***Study population*** | ***Study design*** | ***Outcomes*** | ***Key results*** | ***Study weaknesses*** |
| 1. Laven and Hunt ([2002](#_ENREF_10)), UK
 | 187 Holstein-Friesian cows from a group of 369 cubicle housed lactating cows in a herd of 550 milking cows (8500 litres average milk yield) | Randomised positive-control trial: 2 days of 2.1g/litre Erythromycin (positive control) comparison with 7 consecutive days of 6% formalin, 2% copper sulphate or 1% peraectic acid | Improvement in lesion score over 21 days for all treatments (no significant difference between treatments over time) | Percentage of hindlimbs with lesions following 21 days: Copper sulphate approximately25%, formalin approximately 35%, peracetic acid approximately 50% and erythromycin approximately 50% | Short (21 day) evaluation of lesions. No preventative outcome measure i.e. lesion-free cows not acquiring digital dermatitis. Housing and slurry scraping not identical for all groups. Lesion score involved both depth and grade, but current understanding is that grade (M stage as described by Dopfer et al 1997) is not a chronological scale of lesion progression. |
| 1. Manske et al ([2002](#_ENREF_13)) , Sweden
 | 43 Swedish Red and 15 Swedish Holsteins in one herd | Split-leg footbath design for within cow negative control (water). Five periods of foot bathing for a median of 10 days with a gap between bouts of median 5.5 days. Comparison of 0.6% ionized copper (Hoofpro+, SSI, Julesberg, CO) with water as a negative control. | Acidified water significantly better at curing digital dermatitis lesions than water but there was no difference in lesion prevention. No difference detected for lesions in front feet. | Cure rates:Acidified copper 20 out of 24 animals vs. 12 out of 24 animals for water | Six point nominal lesion score scale used not consistent with current concepts in lesion transitions. Small herd size and variations in management means replication of this trial would be difficult. For example, refreshing of solutions occurred if the baths were perceived to be dirty. No comments on the limitations of split footbath design in terms of cows placing all feet in one foot well or contamination of chemical from one footwell affecting the other side. |
| 1. Silva et al ([2005](#_ENREF_17)), Brazil
 | 120 Holsteins from two herds | Randomised field trial with no control and the following four groups:1. Hypochlorite 1% solution in footbath twice daily for 30 days AND intravenous oxytetracycline 10mg/kg q48hrs repeated 4 times
2. Hypochlorite 1% solution in footbath twice daily for 30 days
3. Intravenous oxytetracycline 10mg/kg q48hrs repeated 4 times
4. Commercial topical ointment
 | Recovery was best with a combination of systemic antibiotic and foot bathing, with foot bathing appearing to be most beneficial. | Reported recovery rates were as follows:Gp1 86.67%Gp2 73.33%Gp3 56.67%Gp4 50% | All lesions were surgically debrided prior to the trial. |
| 1. Holzhauer et al ([2008](#_ENREF_8)), The Netherlands
 | 140 lactating dairy cows (95% Holstein-Friesians) | Randomised control trial:Control=1 once per week through 4% formalinGp 1=twice on one day, every other week, 4% formalinGp 2=on days 7,28 and 90 water sprayed clean and bathed with commercial compoundGp 3= once per week commercial compoundGp 4= once per week 3% sodium carbonate solution | The reference group (4% formalin) achieved the lowest and most consistent control of M2 lesions | By the end of the study each group had achieved the following prevalence of M2 lesions:Reference gp<5%Gp2 5-10%Gp3 ~40%Gp4 outbreak period 12Gp5 outbreak period 9-13 | No cross-over and conditions not identical between groups |
| 1. Thomsen et al ([2008](#_ENREF_21)), Denmark
 | Four herds per product;100 randomly selected cows from each farm; Danish breeds | Split leg footbath design with negative control. Three products tested: 1. 1.5% Virocid (glutaraldehyde, didecylmethylammoniumchloride, and alkyldimethylammoniumchloride; Cid Lines, Ieper, Belgium)
2. 2% Hoofcare DA(quaternary ammonium compounds; DeLaval, Drongen, Belgium)
3. 1% Kickstart 2 (hydrogen peroxide, acetic acid, and peracetic acid; Cid Lines)

Cows walked through foot bathing solutions 2 days per week for 8 weeks. | No significance difference compared to the negative control |  | Split-leg footbath design (disadvantages as outlined above) |
| 1. Speijers et al ([2010](#_ENREF_18)), Northern Ireland
 | 118 lactating Holstein-Friesians (95%) | Three biocides tested:1. Copper sulphate pentahydrate (2% and 5%)
2. Sodium hypochlorite (2%)
3. Sodium chloride (10%)

No footbath was used as a control.Three foot bathing regimes tested:1. Four consecutive milkings every week (X4/W1)
2. Four consecutive milkings every other week (X4/W2)
3. Alternating weeks of X4 copper and X4 salt
 | 5% copper sulphate 4X/1W was found to be the most effective foot bathing agent, significantly more effective than sodium hypochlorite and control. Sodium hypochlorite was no different to the control. There is no benefit to using 10% salt water alternated each week with copper sulphate. | Prevalence M1,M2 and M4 lesions for:5% Cu X4/W1=7%2% Cu X4/W1=21% | Result potentially confounded by re-allocation of cows to new treatment groups for welfare reasons. |
| 1. Teixeira et al ([2010](#_ENREF_20)), USA
 | 406 lactating Holsteins in a 2800 herd | A commercial biocide tested using formalin and copper as positive controls in twice weekly foot bathing regimes:1. Dragonhyde 5%
2. Formalin 5%
3. Copper sulphate 5% and 10%
 | Dragonhyde performed better than formalin but was no different to copper sulphate. | Cows had 1.36 greater odds of having a lesion if in the formalin group compared to the Dragonhyde group (30% BDD lesions vs 23%). Copper had 0.88 the odds of having a BDD lesion (26% BDD lesions vs 31%). | Only twice weekly regimes tested. Solutions were replaced every 45 cows. |
| 1. Holzhauer et al ([2012](#_ENREF_7)), The Netherlands
 | 120 Holsteins | A 4 month, split-leg footbath trial comparing 4% formalin (1 day per week) with acidified, ionized copper sulphate (5 days per week) | Cows were 3 times less likely to develop an ulcerative lesion on the copper-based regime. The was no difference in curative rates between treatments. | Prevalence of M2 lesions in the two groups:Formalin=20 new case and 19 curedCopper=7 new cases and 17 cured | Formalin only used 1 day per week (compared with 5 days per week for copper). Split-leg footbath design (disadvantages as outlined above). |
| 1. Logue et al ([2012](#_ENREF_12)), Scotland
 | 408 Holstein-Friesians | Split-leg footbath design with 5% copper sulphate as a positive control compared with a commercial heavy metal product. Foot bathing twice daily for 3 consecutive days over 103 days in total. Some herds treated with footbaths in serial (4.4m), some with single baths (2.2m). | Copper sulphate performed significantly better than the commercial product.  | 4.4m footbaths (2x2.2m baths in series) had significantly lower prevalence than the single 2.2m baths | Opportunity for one or two baths in series was determined by the layout of the exit race. Details about the commercial product not revealed. Split-leg footbath design (disadvantages as outlined above). |
| 1. Relun et al ([2012](#_ENREF_15)), France
 | 4677 lactating dairy cows on 52 farms | 6 month quasi-randomised trial with negative control (no foot bathing and individual treatment of cases) compared with:1. Footbath four consecutive milkings every 4 weeks (FB/4W)
2. Four consecutive milkings every 2 weeks (FB/2W)
3. Collective spraying for two milkings every 2 weeks (CS/2W)

Chelated copper (3.5g/litre) and zinc (0.5g/litre) was used in the footbath. A stronger solution was used in the spray (20g/litre for both chelated copper and zinc). | A walk through FB every 4 weeks alone is not sufficient to control BDD alone. Rate of healing was influenced by grazing, foot cleanliness, size of initial lesion and addition of topical treatment. | Cure rates for each group:Cx=58%FB/4W=55%FB/2W=76%CS/2W=76% | Quasi randomized trial, with a focus on cure rates rather than daily disinfection. |
| 1. Speijers et al ([2012](#_ENREF_19)), Northern Ireland
 | Experiment 1: 70 lactating Holstein-Friesian cows with BDD lesionsExperiment 2: 64 Holstein-Friesians without BDD lesions | Experiment 1 involved 14 weeks of foot bathing using:1. 5% copper sulphate every week, 4 consecutive milkings
2. 5% copper sulphate every two weeks, 4 consecutive milkings

Experiment 2 involved 14 weeks of foot bathing using:1. 5% copper sulphate every two weeks, 4 consecutive milkings
2. 5% copper sulphate every four weeks, 4 consecutive milkings
 | Increasing the interval between copper sulphate footbaths was not recommended as a means of reducing copper sulphate usage.  | Experiment 1 – no active (M1, M2) lesions found in either group.Experiment 2 – significantly fewer cows with BDD lesions with fortnightly vs monthly foot bathing.  | The protective effect of 5% copper sulphate foot bathing was not evaluated. No M4 lesions were observed (unusual). |
| 1. Relun et al ([2013](#_ENREF_16)), France
 | 4678 dairy cows on 52 farms (80% Holsteins, 20% Normande breed) | Farms allocated to treatments by minimization. Farms allocated to either:1. Footbath vs collective spraying
2. 2 days every 2 weeks vs 2 days every 4 weeks

Chelated copper and zinc solutions were used in the footbath (5% Hoofit solution, Intracare, The Netherlands) and spray solution (50% Hoofit liquid, Intracare, The Netherlands) | Compared with individual cow treatment alone, collective treatments were better only if used every 2 weeks | 88.2% of feet were free of lesions at the start of the study. | No reporting of cure rates throughout the study. |

Conclusions:

1. Very little evidence supporting the common practice of daily formalin foot bathing
2. The evidence supporting the use of copper (or any disinfectant) for treatment is not conclusive
3. More frequent bathing is beneficial