The Effect of HOOFMAX Acid Concentrate on the Viability of Bacteria Responsible for Foot Rot and Foot Warts in Dairy Cattle

Introduction

Traditionally high levels of copper sulfate (50 lbs per 50 gallons of water) have been used to control foot rot and foot warts in dairy cattle. While this practice is effective, there is considerable concern about copper buildup in soil, its detrimental effect on lagoons, and the high cost of copper sulfate. HOOFMAX represents a safe and effective means of acidifying a footbath which allows for much lower addition rates of copper sulfate addition (5 or 10 lbs per 50 gallons of water). The effectiveness of copper is increased through acidification of the bath. The initial pH of a typical footbath treated with HOOFMAX is approximately 1.75 compared to 3.75 for copper sulfate alone. Acidification serves two purposes: 1) creates a very low initial pH (100X more acidic than a conventional bath) which kills bacteria and also resists pH change as manure (natural buffer) is introduced into the bath and 2) allows for complete dissolution of the copper sulfate which assures maximum killing power.

Objective

The objective of this study was to compare the bactericidal properties of HOOFMAX acid concentrate plus low levels of copper sulfate to a traditional level of copper sulfate alone on the *in vitro* viability of the major bacteria that cause foot rot and foot warts in dairy cattle.

Materials and Methods

An *in vitro* system was used to simulate actual on-farm conditions. All bacterial strains were obtained from the American Type Culture Collection and were as follows: *Fusobacterium necrophorum ,Prevotella melaninogenica, Treponema medium, Treponema denticola, and Treponema vincentii.* There were five treatments:
1) HOOFMAX added at the equivalent rate of 64 ounces per 50 gallons of water,
2) HOOFMAX, same as 1) plus equivalent of 5 lbs copper sulfate per 50 gallons of water, 3) HOOFMAX, same as 1) plus equivalent of 10 lbs copper sulfate per 50 gallons of water, 4) copper sulfate added at the equivalent rate of 50 lbs copper sulfate per 50 gallons of water, and 5) no additive.

Results

The results for *Fusobacterium* and *Prevotella* are shown in Tables 1 and 2, respectively.

Table 1. The effect of HOOFMAX and/or copper sulfate on the viability of *Fusobacterium*

	30 seconds	60 seconds	300 seconds
Treatment 1 (HOOFMAX)	0	0	0
Treatment 2 (HOOFMAX + 5 lbs $CuSO_4$)	0	0	0
Treatment 3 (HOOFMAX + 10 lbs $CuSO_4$)	0	0	0
Treatment 4 (50 lbs $CuSO_4$)	0	0	0
Treatment 5 (no additive)	1.98E+08	1.33E+08	1.23E+08

Table 2. The effect of HOOFMAX and/or copper sulfate on the viability of *Prevotella*

	30 seconds	60 seconds	300 seconds
Treatment 1 (HOOFMAX)	0	0	0
Treatment 2 (HOOFMAX + 5 lbs $CuSO_4$)	0	0	0
Treatment 3 (HOOFMAX + 10 lbs $CuSO_4$)	0	0	0
Treatment 4 (50 lbs $CuSO_4$)	0	0	0
Treatment 5 (no additive)	5.25E+07	6.10+07	6.80E+07

Exposure of these bacteria to HOOFMAX, HOOFMAX plus copper sulfate, or copper sulfate alone yielded 100% kill after as little as 30 seconds of exposure. Treatment 5 (no additive) showed high levels of bacterial growth for both organisms which documents that the bacterial cultures were viable.

The effect of HOOFMAX and/or copper sulfate on the growth of the three species of *Treponema* is shown in Table 3. Growth of *Treponema* was evaluated on a scale of 1-5 with 5 being the greatest. After 20 minutes of exposure of *Treponema* to the various treatments, none were completely effective in eliminating growth for all three species. Addition of copper sulfate to

the HOOFMAX treatment increased its killing power. There was no difference between HOOFMAX plus 10 lbs copper sulfate and 50 lbs of copper sulfate except for the *vincentii* strain which seemed a bit more sensitive to a high level of copper sulfate. Growth of all three species of *Treponema* in media that contained no additive was very good and indicated that the cultures were viable.

Table 3. The effect of HOOFMAX and/or copper sulfate on the viability of *Treponema*

		T. denticola	*T. medium*	*T. vincentii*
20 minutes	Treatment 1 (HOOFMAX)	3	3	3
	Treatment 2 (HOOFMAX + 5 lbs $CuSO_4$)	2	2	3
	Treatment 3 (HOOFMAX + 10 lbs $CuSO_4$)	2	2	2
	Treatment 4 (50 lbs $CuSO_4$)	2	2	1
	Treatment 5 (no additive)	5	5	5

Discussion

The bacteria that cause foot rot (*Prevotella and Fusobacterium)* are completely susceptible to either HOOFMAX plus low levels of copper sulfate (5 or 10 lbs) or a high level (50 lbs) of copper sulfate alone. As experience on the farm would indicate, the bacteria that cause foot warts are more difficult to eliminate. HOOFMAX plus 10 lbs of copper sulfate was as effective as 50 lbs of copper sulfate. One aspect of on-farm conditions that this test did not take into account is manure loading of the bath. Because of the low initial pH of 1.75 for the HOOFMAX treatment compared to 3.75 for copper sulfate alone, HOOFMAX is less affected by manure loading and maintains its low pH for a much longer period of time compare to copper sulfate alone. Once the pH of the footbath rises to around 4.2, the killing action of the bath is greatly reduced. Field experience with HOOFMAX indicates that 600 cows may be effectively treated before pH rises above 4.2 compared to approximately 300 cows with copper sulfate alone.

Conclusions

HOOFMAX plus 5 or 10 lbs of copper sulfate is as effective as 50 lbs of copper sulfate for controlling the bacteria that cause foot rot and foot warts in dairy cattle. The low level of copper sulfate used in conjunction with HOOFMAX greatly reduces the concern of copper buildup in the soil and its detrimental effect on lagoons.

Implications

The high cost of copper sulfate, its susceptibility to manure loading when used by itself, and the number of cows it will effectively treat (300) makes HOOFMAX plus low levels of copper sulfate an excellent alternative. Coupled with its ease of application (64 oz per 50 gallon of footbath capacity) and double the number of cows treated per footbath (600), HOOFMAX reduces the cost per treated cow by over 50%.