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TREATMENT OF OVINE FOOTROT WITH ZINC SULFATE/SODIUM LAURYL SULFATE FOOTBATHS

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Seven groups of sheep, with a total of 365 animals were used to determine the efficacy of treating ovine footrot by footbathing in aqueous zinc sulfate solution (20% w/v) or aqueous zinc sulfate solution (20% w/v) with added sodium lauryl sulfate (2% w/v).

The average percentage of cured ovine feet in all trial groups ranged from 86,11 to 96.61% of the number of affected feet. The cure rates were 94.71% for sheep that were foothathed in 20% zinc sulfate solution, and 96.61% for those footbathed in 20% zinc sulfate solution with added 2% sodium lauryl sulfate, when treatment was for 10 minutes every day for 14 days. When 45 minute footbathings, given three times at intervals of 4 days were examined, the cure rates were 91.27% for sheep treated in 20% zinc sulfate solution, and 92.85% for those footbathed in 20% zinc sulfate solution with 2% sodium lauryl sulfate. Treatment of sheep, involving 30 minute footbathings with 20% zinc sulfate solution, four times, intervals of 3 days, resulted in 88.64% cures. Fully healed feet were obtained in 86.11% of sheep stood for 1 hour in a footbath containing 20% zinc sulfate solution with 2% sodium lauryl sulfate, and the treatment was repeated after 5 days.

Surgical treatment did not have any significant effect on the percentage of cured feet compared with routine horn paring in the affected hooves. In cured sheep no reinfection was recorded for the next 30 days after therapy termination. The results obtained for curing affected sheep as well as the coparative advantages over other therapeutic agents, suggest that zinc sulfate and zinc sulfate with sodium lauryl sulfate are the means of choice for treating ovine footrot.

Key words: ovine footrot, zinc sulfate/sodium lauryl sulfate, footbathing

INTRODUCTION

Footrot is a specific infectious disease of the feet of sheep and is widespread throughout the world. The disease is characterized by inflammation of the skin at the coronary band, underrunning the hooves, and inflammation of the sensitive laminae of the foot, as well as severe lameness. Lesions are commonly present in more than one foot and the disease significantly affected productivity of sheep (Marsh, 1965, Marshall et al., 1991, Anojčić et al., 1997)

There are numerous reports on effective surface administration of a variety of disinfectants and antibiotics for treatment of ovine infectious footrot. However, footrot control, and eradication in particular, is a serious problem because the effects of the agents applied are evident only when there is prior thorough surgical treatment of the affected hooves, which is not usually done in an adequate way in practice. Therefore, altempts were made to achieve effectiveness with parenteral administration of drugs, for in that case surgical treatment could be reduced to a routine hoof paring. In this way, antibiotic administration produced very good results in the treatment of affected sheep (Harriss, 1958, Gradin and Schmits, 1983, Radostits et al., 1994), but due to their high cost and reinfection occurrence, antibiotics have not become extensively used yet.

Surface administration of therapeutic agents, an alternative to the parenteral route, demonstrates a pronounced ability of penetration into the ovine hoof and they may act effectively on the footrot causal agent. Considering the expenience of others (Demertzis et al., 1978, Prietz and Mauske, 1981; Malecki, 1982; Malecki et al. 1983, Skerman et al., 1983, Casey and Martin, 1988), zinc sulfate meets the required criteria, particularly in regard to its ability of penetrating into the ovine hoof. Namely, most researchers have achieved, on average, acure rate of 90% for sheep by surgical treatment of affected hoofs followed by treatment with 10-20% zinc sulfate solution (Cross and Parker, 1981; Glynn, 1993). However, Malecki et al., (1983) and Malecki and Coffey, (1987) achieved nearly identical percentages of sheep cured by treatment in zinc sulfate solution for both unpared and surgically treated hoofs.

MATERIAL AND METHODS

The experiment included 7 groups of sheep (groups A-F and a control), with a total of 365 animals. The sheep in trial groups A and B were treated with 20% zinc sulfate solution and 20% zinc sulfate with added 2% sodium lauryl sulfate, respectively, for 10 minute footbathings, every day during 14 days. The affected sheep in trial group C were treated four times at intervals of 3 days. Each treatment in this group of sheep consisted of 30 minute footbathings with 20% zinc sulfate solution. The sheep in trial groups D and E were three times subjected to 45 minute footbathings, with 20% zinc sulfate solution or 20% zinc sulfate plus 2% sodium lauryl sulfate solution, respectively, given at intervals of 4 days. The treatment of sheep in trial group F consisted

of two one hour footbathings with 20% zinc sulfate plus 2% sodium lauryl sulfate solution, given at an interval of 5 days.

Prior to treatment, the sheep in group A had undergone hoof surgical treatment whereas those in groups B, C, D, E and F passed only a routine hoof paring. After each footbath treated sheep were placed in a clean paddock. Control sheep were held in one similar paddock throughout the 14 day duration of the field trials. In all field trials normal stocking rates and management practices prevailed as far as possible.

The effectiveness of zinc sulfate solution and zinc sulfate with 2% sodium lauryl sulfate solution was checked after 14 days and 30 days from the beginning of treatments. The extent of marked footrot, apperance of the hoof and skin between the hooves was used to assess the cure rate of the affected feet.

RESULTS

The localization and character of pathomorphological changes on the affected feet of the sheep are given in Table 1.

Table 1. Localisation and character of pathomorphological changes

Group	Number of sheep/feet		Number of affected feet		Interdigital dermatitis		Inflammation of stratum corneum		Inflammation with separation of hoofn	
			n	%	n	%	n	%	n	%
Control	30	120	101	84.17	23	22.77	74	73.27	4	3.96
A	107	428	359	83.88	28	7.80	234	65.18	97	27.02
B	45	180	118	65.56	14	11.86	81	68.64	23	19.49
C	43	172	132	76.74	24	18.18	88	66.67	20	15.15
D	75	300	172	57.33	32	18.60	121	70.35	19	11.05
E	60	240	140	58.33	18	12.86	95	67.86	27	19.28
F	35	140	72	51.43	15	20.83	51	70.83	6	8.33
Total A-F	365	1460	993	68.01	131	13.19	670	67.47	192	19.33

The groups were not homogenous concerning the clinically affected feet and the degree of pathological changes on the hooves. Interdigital dermatitis showed prevalence from 7,80% to 20,83%, inflammation of the stratum corneum from 65,18% to 70,83% and inflammation with separation of hard horn from 8.33% to 27.02% of the total affected feet. Also, the results in Table 1 indicate that the number of affected feet at the initiation of the trial was not uniform in all groups and ranged from 51.43% (group F) to 83.88% (group A). The relative number of affected feet in the control group was 84.17%.

The results of the efficiacy of 20% zinc sulfate solution and zinc sulfate with 2% sodium laaryl sulfate in the treatments of affected sheep are given in Table 2.

After 14 days treatment the percentage of affected feet substantially decreased in all treated groups (Table 2). Thus, fully healed feet in all treated groups ranged from 86.11% (group F) to 96.61% (group B), improvement without lameness from 0.27 (group A) to 8.33% (group F), improvement with lameness from 0.85% (group B) to 4.73% (group A) and feet without improvement from 0.27% (group A)to 2.77% (group F), while in the control group the percentage of affected feet remained largely unchanged (91.09% without improvement and only 8.91% showing slight improvement with lameness persisting.

Table 2. The results of zinc sulfate use in footrot treatment

Group	Number of sheep/feet		Number of afected feet		Fully healed		Improvement without lameness		Improvement with lameness		Without improvement	
			n	%	n	%	n	%	n	%	n	%
Control	30	120	101	84.17	0	0.00	0	0.00	9	8.91	92	91.09
A	107	428	359	83.88	340	94.71	1	0.27	17	4.73	1	0.27
B	45	180	118	65.56	114	96.61	2	1.69	1	0.85	1	0.85
C	43	172	132	76.74	117	88.64	10	7.57	4	3.03	1	0.76
D	75	300	172	57.33	157	91.27	9	5.23	4	2.32	2	1.16
E	60	240	140	58.33	130	92.85	6	4.28	3	2.14	1	0.71
F	35	140	72	51.43	62	86.11	6	8.33	2	2.78	2	2.77
Total A-F	365	1460	993	68.01	920	92.65	34	3.42	31	3.12	8	0.80

The percentage of cured ovine feet in the treated groups ranged from 86.11% to 96.61% of the number of affected feet at trial initiation. The cure rates were 94.71% for sheep that were footbathed in 20% zinc sulfate solution (group A) and 96.61% for those footbathed in zinc sulfate/sodium lauryl sulfate (group B), for 10 minutes, during 14 days. When 45 minute footbathings were used, at an interval of 4 days, the cure rates were 91.27% for sheep that were footbathed in 20% zinc sulfate solution (group D) and 92.85% for those footbathed in 20% zinc sulfate and 2% sodium lauryl sulfate solution (group E). Sheep treated four times with 30 minute footbaths in 20% zinc sulfate solution at intervals of 3 days, resulted in 88.64% cured feet (group C). Fully healed feet were registered in 86.11% cases when sheep were stood for 1 hour in a footbath containing 20% zinc sulfate solution with 2% sodium lauryl sulfate, and the treatment was repeated after 5 days (group F).

Surgical treatment (group A) compared with routine hoof paring of affected hooves did not have any significant effect on the percentage of cured feet at trial termination (other groups). In cured sheep no reinfection was recorded for the next 30 days after therapy termination, although the sheep were held on contaminated ground together with those remaining infected.

DISCUSSION

Ovine footrot has doubtless been treated superficially since it was first recognized some 200 years ago (Beveridge, 1941, Barber, 1979). It is well known that the site of the infection in ovine footrot is the major impediment to effective surface treatment. Namely, Dichelobacter nodosus can survive for long periods and grow slowly in isolated pockets under the horn (Malecki et al., 1983, Radostits et al., 1994).

The usual approach to surface treatment is to expose all infected areas by removing overlying tissue by footparing. This approach has been used successfully for treatment, control and eradication. However, it requires extensive paring of affected feet that is labor intensive, time consuming and distressing both to the operator and to the sheep. Usually this is a very laborious procedure that has not proved completely effective, particularly when large flocks of sheep are being treated (Malecki et al., 1983, Malecki and Coffey, 1987).

An alternative vould be to use a therapeutic agent that can penetrate the hoof (stratum corneum) of the foot. However, the hoof is composed of keratin proteins arranged in fibres and embedded in a matrix. Keratins and particularly the matrix proteins are characterized by a high content of disulfide bonds that provide considerable strength, flexibility and imperviousness to the hoof (Radostits et al., 1994).

Surface treatment of footrot in sheep with zinc sulfate solution was first reported to be an effective therapy by Beveridge, (1941). Subsequently Cross and Parker, (1981), Malecki et al., (1983), Skerman et al., (1983) and Hristov et al., (1998) have shown that footbathing in zinc sulfate is one of the most effective surface treatments. Zinc sulfate was found to penetrate into hoof horn well (0.06 to 0.58 mm per hour), and its penetration rate was greatly enhanced (up to 10 times) by addition of sodium lauryl sulfate. The effects of sodium lauryl sulfate are due to its specific reaction with the keratin molecule (Malecki and McCausland, 1982).

There are data that zinc sulfate incorporated into sheep hoof agar would stop Dichelobacter nodosus growth at zinc ion levels as low as 10 ppm. However, zinc ion levels in treated hoof needed to exceed 400 ppm to prevent growth when incorporated in sheep hoof agar. These high levels were attained when the hooves were exposed to the zinc sulfate and sodium laury sulfate compound for one hour. Absorption of zinc from solutions containing 10 per cent zinc sulfate gave hoof tissue concentrations of zinc from 0.22 to 0.88 zinc ions per g tissue (10 to 20 times that found in normal hoof samples) and most of this zinc was retained after the hooves were washed continuously in running water for 24 hours. It was concluded that most of the zinc in hoof tissue is protein bound, and only a small amount is available for bactericidal action (Malecki and McCausland, 1982, Malecki et al., 1983).

Our treatments of sheep with severe footrot by footbathing with zinc sulfate and zinc sulfate plus sodium lauryl sulfate solution was very effective.

Sheep treated with the combination of zinc sulfate and sodium lauryl sulfate were completely cured of footrot and all lameness had disappeared 14 days after treatment. In group F a complete cure of severe footrot was achieved by using two one hour footbathing treatments with the combination given at an interval of five days. Recovery from lameness occurred in that group in less than 7 days. Sheep treated with zinc sulfate and sodium lauryl sulfate in combination appeared to suffer no discomfort while standing in the footbath.

Apart from the high percentage of cured sheep, zinc sulfate is considerably better suited for practical use then formalin and copper sulfate, because it is without any smell, not iritating or toxic, easy to prepare, and the curing solution is more stable (Skerman, 1983, Radostits et al., 1994).

Our results obtained for sheep that had undergone prior surgical treatment of hooves are in accordance with those of Cross and Parker, (1981), and Prietz and Mauske, (1981). It is also evident that surgical treatment relative to paring of affected hooves did not have any substantial effect on the percentage of cured sheep. These results are in agreement with those obtained by Cassey and Martin, (!983) and Malecki and Coffey, (1987). The authors suggested that unpared hoofs had a greater capacity for zinc binding than pared hooves.

Reinfections in cured sheep were not recorded for 30 days after trial termination, even though they were held in a stable together with infected sheep after the treatments.

The favourable results achieved in curing affected sheep, particularly sheep with umpared hooves, indicate that zinc sulfate solution has a marked ability of penetrating into hoof horn, especially with detergent addition to the curing solution (Malecki and Coffey, 1987). In addition, zinc sulfate slows down the proteolytic activity of B. nodosus, and improves hoof horn and skin epidermis quality and resistance. It has been shown that zinc has an immunostimulating role and is important for sustaining immunity. Some authors have found that concurrent vaccination and peroral administration of zinc and vitamin A produced considerably more stable immunity compared with sheep that received the vaccination alone (Katić et al., 1986).

The results obtained for cure rate and the comparative advanteges over other agens indicate that zinc sulfate/sodium lauryl sulfate solutions could be recommended as the means of choice for treatment and control of bovine footrot. In addition, to achieve optimal efficacy and rational use of zinc sulfate in sheep curing, it is important to establish the period of time for which zinc sulfate should be used without compromising the conducted treatment.

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LEČENJE ŠEPAVOSTI OVACA CINK SULFATOM I NATRIJUMOM LAURIL SULFATOM U BAZENIMA

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SADRŽAJ

Za ogled je korišćeno 365 ovaca podeljenih u 7 grupa radi utvrđivanja efikasnosti lečenja šepavosti u bazenima sa 20% vodenim rastvorom cink sulfata ili 20% rastvorom cink sulfata uz dodatak 2% rastvora natrijum lauril sulfata.

Prosečan broj izlečenih mogu imajući u vidu sve ogledne grupe ovaca kretao se od 86,11 do 96,61%. Stopa izlečenja je iznosila 94,71% kod tretiranih ovaca u 20% rastvoru cink sulfata i 96,61% kod ovaca koje su tretirane u kombinovanom 20% rastvoru cink sulfata i 2% natrijum lauril sulfatu, svakodnevno po 10 minuta, u toku 14 dana. Kada je primenjeno trokratno tretiranje cink sulfatom u bazenima, u trajanju od 45 minuta, svakog 4. dana, stopa izlečenja nogu je iznosila 91,27%. Kombinacija cink sulfata i natrijum lauril sulfata primenjena na isti način dovela je do izlečenja 92,85% nogu. Kod četvorokratnog tretiranja 20% rastvorom cink sulfata, u trajanju od 30 minuta, svakog 3. dana, postignuto je 88,64% izlečenja nogu. Potpuno izlečenje kod 86,11% nogu ostvareno je kod ovaca koje su boravile dva puta po 1 čas u 20% rastvoru cink sulfata i 2% rastvoru natrijum lauril sulfata, u razmaku od 5 dana.

Hirurško tretiranje u poređenju sa rutinskim obrezivanjem obolelih papaka nije ispoljilo značajan uticaj na procenat izlečenih nogu. U izlečenih ovaca nije ustanovljena pojava reinfekcije 30 dana posle završetka terapije. Dobijeni rezultati, kao i komparativne prednosti u odnosu na druga terapijska sredstva, potvrđuju da su cink sulfat i cink sulfat sa natrijum lauril sulfatom sredstva izbora u lečenju šepavosti ovaca.