Evaluation of the bioequivalence of two formulations of deltamethrin for treatment of sheep with psoroptic mange

Marie-Christine Cadiergues, DVM, PhD; Caroline Laguerre, DVM; Martine Roques, Michel Franc, DVM, PhD

Objective—To evaluate efficacy of 2 deltamethrin emulsifiable concentrates that differed on the basis of vehicle (methyl glycol acetate [AMP] or 2-propylene glycol 1-methyl ether acetate [AMG]) for the treatment of sheep with mange.

Animals—30 ewes between 11 months and 7 years old that weighed 16 to 71 kg and were naturally infested with Psoroptes ovis.

Procedure—Sheep were randomly allocated into 3 groups (13 sheep in group AMP, 13 sheep in group AMG, and 4 negative-control sheep). Each sheep was dipped twice (10-day interval between dippings) in the assigned formulation. Assessment of efficacy was performed on days 3, 7, 14, 21, 28, 35, 42, 49, 56, and 63 after the first dipping. Efficacy was assessed by determining the number of eggs or live mites on those days, as well as regrowth of wool at the end of the study.

Results—Psoroptic mange infestation was maintained in the 4 control sheep throughout the study. We did not detect live Psoroptes mites in scrapings after day 7 (AMP group) or after day 14 (AMG group). No parasites were seen after day 14 in either treatment group. Therefore, efficacy was 100% for both treatment groups from days 14 to 63.

Conclusions and Clinical Relevance—The 2 formulations of deltamethrin were equally able to eradicate Psoroptes infestation of sheep after 2 dippings performed in accordance with the label recommendations. (Am J Vet Res 2004;65:151–154)
necessary. Sheep were fed hay and an additional commercial food. Drinking water was available ad libitum. The study was approved by an animal care and use committee.

Procedure—Sheep were allowed a 31-day acclimation period before the first treatment. Only female sheep confirmed to be infested with psoroptic mange were included in the study. All sheep had large numbers of *P. ovis* mites in skin scrapings obtained 7 days before onset of treatments.

Treatment—Sheep were treated with 1 of 2 formulations of deltamethrin (a formulation made with AMP [test treatment] and a formulation made with AMG [reference treatment]). Both were emulsifiable concentrates formulated for dilution with water and application by total immersion of sheep in a dipbath containing 5% (wt:vol) deltamethrin (ie, 50 mg/L). Each sheep was dipped twice (10-day interval between dippings) in the assigned formulation. Treatments were applied in an area in front of the animal pens by use of a mobile dip tank. Volume of the dip tank was 310 L, as calculated by use of a water flow meter.

Two fixed amounts of water were used in the dip tank. For medium-size sheep, 220 L of dipbath was used, whereas for large-size sheep, 250 L of dipbath was used. A glass cylinder was used to measure the appropriate amount of each formulation for the volume of dipbath. The formulation and water were mixed thoroughly with an electric stirrer before each sheep was dipped. Investigators were aware of the treatment applied to each sheep. Each sheep was dipped separately and kept in the dipbath for 1 minute; the head of each sheep was immersed briefly but completely 2 or 3 times. Sheep in the control group were not immersed in the tank.

After each sheep was dipped, the tank was emptied and filled with fresh water and deltamethrin prior to treatment of the next sheep. The tank was emptied and cleaned by use of a series of water rinses between treatment groups.

During each treatment procedure, the pens were cleaned, and existing straw and hay were removed. The pens and feed rack were washed by use of a high-pressure washer. Fresh straw and hay were then put into the pens prior to return of the sheep.

Efficacy and safety assessments—Assessment of safety was performed by daily observation of all sheep throughout the study. Assessment of efficacy was performed on days 3, 7, 14, 21, 28, 35, 42, 49, 56, and 63 after the first dipping for all sheep in the 2 treatment groups. Efficacy was determined on the basis of the number of eggs or live mites on wooled areas. Sheep that did not have any mites at the end of the study period were considered cured. When mites were still evident on a specific treatment day, that sheep was considered still infested on that day.

Our primary interest was to compare efficacy of the 2 treatment formulations. Treatment with the AMP formulation (test treatment) was regarded as efficacious when there was therapeutic equivalence of the cure rates for both treatments. When efficacy for either of the treatments was < 80%, testing would not be performed because the treatment would be regarded as ineffective and equivalence could not be proven. In the situation in which efficacy was 100% for both treatment groups, a test for therapeutic equivalence would not be necessary because therapeutic equivalence would be assumed. When efficacy for both treatment groups was > 80% but efficacy was < 100% in 1 or both treatment groups, a test on therapeutic equivalence of cure rates would be performed by use of a test procedure derived from the Fisher exact test with a continuity correction.

Results

Clinical examination—None of the sheep had signs of poor health or adverse events during the study. *Psoroptes populations before treatment*—All sheep had large numbers of *P. ovis* mites in the skin scrapings obtained 7 days before treatments. Mean number of live *Psoroptes* mites was 76 *Psoroptes* mites/g in the control group, 251 *Psoroptes* mites/g in the treated group. Figure 1—Mean number of live *Psoroptes ovis* mites per gram of sample in 4 control sheep (triangle) and sheep treated with 1 of 2 formulations of deltamethrin (13 sheep/treatment group). Sheep in each treatment group were treated twice (days 0 [T1] and 10 [T2]) by immersion of sheep in a dipbath. The 2 treatment formulations were for deltamethrin in methyl glycol acetate carrier (circle) or deltamethrin in 2-propylene glycol 1-methyl ether acetate carrier (cross). Day 0 = Day of initial treatment.
for the AMG group, and 306 Psoroptes mites/g for the AMP group (Fig 1). Scores in nonwooled areas for the control, AMG, and AMP groups were 8.6, 9.9, and 9.7, respectively (Fig 2). Total scores (woooled and nonwooled areas) for the control, AMG, and AMP groups were 162.0, 349.5, and 402.8, respectively (Fig 3). Values for the variables did not differ significantly between the 2 treatment groups. Because the control group was used to verify maintenance of infestation, we did not make comparisons between values for the treatment groups and the control group.

Psoroptes populations after treatment—Psoroptic mange infestation was maintained in the 4 control sheep throughout the study. Mean number of live Psoroptes mites ranged from 22 (day 35) to 98 (day 14). Scores for nonwooled areas ranged from 7.3 (day 63) to 10.0 (day 7). Total scores ranged from 102.0 (day 35) to 195.8 (day 14). A unique difference between the control group and treatment groups was the relative surface area of the pen for each sheep (ie, by design, there were only 4 untreated sheep).

We did not detect live Psoroptes mites in skin scrapings obtained after day 7 for the AMP group and after day 14 for the AMG group. Parasites were not seen in scrapings obtained from nonwooled areas after day 14 for either treatment group. Therefore, total score was 0 for day 14 until the end of the study for both treatment groups, and efficacy was 100% from day 14 to day 63.

Discussion

Infestation of the control sheep did not change throughout the study; whereas the number of mites in sheep of the respective treatment groups decreased dramatically. All control sheep were still infested at the end of the study, despite a lower initial number of mites and a larger pen surface area for each sheep, compared with those of the treatment groups. However, sheep with a lower initial number of mites were assigned to the control group because we wanted to minimize the consequences of mange on their health.

We documented here that the 2 formulations were equally able to eradicate psoroptic infestation from sheep after 2 dippings performed in accordance with the commercial label recommendations. The efficacy was extremely good: we did not detect Psoroptes mites or eggs of mites after the second dipping. In addition, live parasites were not found in samples obtained 63 days after the first dipping (a period of approx 5 egg-to-egg cycles for psoroptic mange mites). Furthermore, the products were tolerated well by the sheep. We did not detect signs of irritation while handling the sheep during dipping or when monitoring the sheep thereafter.

Analysis of results of the study reported here also confirms the necessity of 2 dippings because live Psoroptes mites were still detected on day 7 after the first treatment for both formulations. We also confirmed the necessity of keeping sheep in the dip tank for 1 minute and immersing each sheep’s head briefly but completely 2 or 3 times. It is also essential to replenish the dip tank with the acaricidal product because of the lipophilic properties of the active ingredient, which affixes to the skin of the sheep.

Compared with other systemically administered treatments, dipping is an expensive method, but it is suitable for large flocks in which personnel want to avoid handling each sheep. Furthermore, the withdrawal period of deltamethrin administered via dipping (3 days for meat and offal; 0 days for milk) is reduced, compared with the withdrawal time after administration of injectable products such as ivermectin, moxidectin, or doramectin, which are not permitted for use
in lactating animals producing milk for human consumption and that have long withdrawal periods for meat and offal (21 days for ivermectin and 56 days for doramectin administered SC). Finally, dipping allows management of biting lice (Damalinia ovis) and chorioptic mange (Choriopites ovis) that are not reached by other systemically administered products.6-8

References


