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Clinical efficacy of fenbendazole against gastrointestinal parasites in llamas

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Abstract

Llamas or South American Camelids (SACs) are increasingly popular in the United States, as a source of fiber, livestock guard, and pack animals. Gastrointestinal parasites have been identified as a major health problems in all classes of livestock including llamas. Currently there are no approved anthelmintics available for use in llamas. In this study, *fenbendazole* was evaluated for its clinical efficacy in the control of gastrointestinal parasitism in llamas. Twelve, healthy, young adult llamas of both sexes naturally infested with *Nematodirus*, *Strongyloides*, *Trichuris*, and *Capillaria* were randomly divided into two groups. One group received a single oral dose of *fenbendazole paste* at 5 mg/kg. The second group received a comparable dose of water as a placebo. Fecal samples were obtained per rectum from each animal prior to administration of either the drug or placebo treatment and weekly thereafter. These samples were analyzed for total fecal egg burden using a modified Wisconsin sugar floatation technique. The *fenbendazole* treated group had a significant reductions in total fecal egg counts of 95%, 84%, 89% and 76%, respectively, for each week of the four-week sampling period. *Nematodirus*, *Strongyloides*, and *Trichuris* all had significant reductions in egg counts during the study period. All animals were observed twice daily during the experiment. All animals remained healthy and showed no adverse effects related to treatment. These results indicate that fenbendazole is a safe and an effective anthelmintic for the treatment of naturally occurring gastrointestinal parasite infestations of *Nematodirus*, *Strongyloides*, and *Trichuris* in llamas. © 2000 Published by Elsevier Science B.V. All rights reserved.

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1. Introduction

Intestinal parasites are a major health problem in the livestock industry. Although there are significant numbers of “minor species” animals including sheep,

goats, Llamas, and alpacas raised in this country for food, fiber, and companion purposes, there is lack of legal drugs approved for use in these animals by the center for Veterinary Medicine of the Food and Drug Administration. There are over 100 000 llamas, and 10 000 alpacas with a smaller numbers of guanacos and vicunas in the United States by current estimates of the Llama Breeders Association (personal communication). All members of the genus *Llama* have the

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same number of chromosomes; therefore the physiology of these animals will be the same. In Oklahoma alone there are 45 breeding farms that are members of the Oklahoma Llama Breeders Association, with numerous others that are not registered with the association (Breeder and Service Directory, 1998). Although little is known concerning the incidence of intestinal parasitic diseases and their impact on the health of South American Camelids (SACs), there is a significant need for identifying anthelmintic agents that are clinically effective and safe for use in these animals (Fowler, 1998). Fenbendazole is a member of the benzimidazole group of anthelmintics, and has a broad spectrum of activity against gastrointestinal parasites, lungworms, and some tapeworms. This drug is currently approved and widely used in horses, dogs, pigs and cattle (Roberson, 1988).

Fenbendazole has been studied extensively in sheep and goats, and is currently being recommended and used as an extra label anthelmintic in llamas, alpacas

and other SACs (Fowler, 1998; Cheney and Allen, 1989). However, there are no reports available concerning the efficacy and safety profiles of this drug in SACs.

Fenbendazole (Safe Guard[®]), at a dose of 5 mg/kg, produces a reduction in egg production of *Nematodirus*, *Trichuris*, *Strongyloides*, and *Capillaria* species, by fecal egg counts in llamas (Cheney and Allen, 1989). Therefore, the major objective of this study was to characterize clinical efficacy profiles of orally administered *fenbendazole* in SACs with naturally occurring gastrointestinal parasite infestations.

2. Materials and methods

2.1. Animals

Twelve, healthy, young adult llamas of both sexes selected from an Oklahoma farm, were used in this

Fig. 1. Mean combined fecal egg counts of *Nematodius*, *Trichuris*, *Strongyloides*, and *Capillaria* in llamas over four weeks following oral administration of placebo ($n = 6$) and *fenbendazole* paste ($n = 6$, a single dose of 5 mg/kg). Error bars represent SEM.

study. These animals were vaccinated against clostridial diseases and rabies. They had a significant number of parasite eggs in their feces and were not treated for parasites during the four months prior to this investigation. These animals were randomly assigned to two groups of six animals each.

Animals in this study were allowed to freely graze on 50 acres of native pasture and supplemented with cracked corn and alfalfa hay once a day. They were allowed access to three sided sheds for shelter from inclement weather. The individual animal within a group was restrained with a halter and lead rope during treatment and collection of fecal samples.

2.2. Experimental method

Fenbendazole 10% paste (Safe-Guard[®] Hoechst Roussel Agri Vet, Sommerville, NJ), was used in the study. A single dose of 5 mg/kg, to the nearest 20 kg body weight was administered orally to indi-

dual llamas within the treatment group, using the cattle dispensing gun designed for this product (Hoechst Roussel Agri-Vet, Sommerville, NJ). An individual animal in the control group received an amount of water equal to the volume of the drug as a placebo. This was orally administered with a dosing syringe. The llamas were monitored individually twice a day for any changes in appetite, posture, attitude, respiration, activity, temperature, urination, and defecation, every 12 h for four weeks following administration of either *fenbendazole* or water.

2.3. Collection of fecal samples

A minimum of 3 g of feces was collected immediately prior to administration of the drug or placebo from each animal in the study, and on every seventh day thereafter for the next four weeks. All fecal samples were obtained per rectum with a lubricated, gloved hand. These samples were stored in labeled

Fig. 2. Mean fecal egg counts of *Nematodirus* in llamas over four weeks following oral administration of placebo ($n = 6$) and *fenbendazole* paste ($n = 6$, a single dose of 5 mg/kg). Error bars represent SEM.

plastic bags and refrigerated at 5°C until further analysis.

2.4. Determination of fecal egg counts

The numbers of eggs per gram of feces were determined using a modified Wisconsin sugar floatation technique (Jordan et al., 1988). The total egg counts and standard error of the mean (SEM) were calculated for individual llamas within both the placebo and treatment groups. The eggs belonging to the specific parasite groups were identified in accordance with the microscopic morphological characteristic features.

2.5. Statistical analysis of the data

SPPS[®] statistical software was used to perform statistical tests (SPPS for Windows Release 8.0, SPPS, Chicago, IL). A *t*-statistic for independent samples

was calculated to determine if the mean fecal egg count values were significantly different between the two groups prior to treatment. A paired *t*-test was used to compare the average of the four post-treatment fecal egg counts to the initial, pre-treatment counts for both of the treatment groups. A non-parametric Mann-Whitney test was used to determine if significant changes occurred in mean weekly fecal egg counts between the fenbendazole and placebo groups for each of the four different parasite groups (Shott, 1990). A value of $P \leq 0.05$ was considered to be significant for statistical tests.

3. Results and discussion

Oral administration of fenbendazole as a paste at a single dose of 5 mg/kg body weight, did not produce any adverse effects including changes in appetite, posture, attitude, respiration, physical activity, tem-

Fig. 3. Mean fecal egg counts of *Trichuris* in llamas over four weeks following oral administration of placebo ($n = 6$) and fenbendazole paste ($n = 6$, a single dose of 5 mg/kg). Error bars represent SEM.

perature, urination, and defecation in llamas for the duration of the experiment. These findings are consistent with the long history of safe use of fenbendazole and other benzimidazole analogs in other domestic ruminant species (Kennedy and Todd, 1975; Anderson, 1977; Gregory et al., 1985). Microscopic examination of the visual appearance of eggs present in the fecal material of both placebo and fenbendazole treated llamas confirmed the presence of *Nematodirus*, *Trichuris*, *Capillaria* and *Strongyloides* groups of nematodes in the gastrointestinal system of the llamas. These findings are in total agreement with those of the previous studies in llamas (Cheney and Allen, 1989; Fowler, 1998). Additionally, these groups of internal parasites have been commonly associated with gastrointestinal parasitism in domestic ruminants of the North American continent (Kennedy and Todd, 1975; Anderson, 1977).

The average fecal egg count per animal of all four groups of parasites including *Nematodirus*, *Trichuris*, *Capillaria* and *Strongyloides* in treatment and placebo groups was 54.2 ± 15.8 and 37.1 ± 11.7 , respectively, prior to either fenbendazole or placebo treatment ($p > 0.40$). Oral administration of a single dose of fenbendazole paste at 5 mg/kg body weight, produced a significant ($p < 0.04$) reduction in total fecal egg count of all four groups of gastrointestinal parasites during an observation period of four weeks (Fig. 1). This result agreed with our observation that high plasma concentrations of fenbendazole could be achieved and maintained for a four-week period following oral administration of a single dose at 5 mg/kg (unpublished data). Concurrently, placebo administration failed to produce any significant ($p > 0.08$) effects on the total fecal egg count (Fig. 1).

Based upon the analysis of fecal egg count of specific parasites, *Trichuris*, *Nematodirus*, and *Stron-*

Fig. 4. Mean fecal egg counts of *Strongyloides* in llamas over four weeks following oral administration of placebo ($n = 6$) and fenbendazole paste ($n = 6$, a single dose of 5 mg/kg). Error bars represent SEM.

Fig. 5. Mean fecal egg counts of *Capillaria* in llamas over four weeks following oral administration of placebo ($n = 6$) and fenbendazole paste ($n = 6$, a single dose of 5 mg/kg). Error bars represent SEM.

gyloides, fenbendazole had a significant ($p < 0.03$) effect in reducing the number of eggs produced by these parasites (Figs. 2–4). However, the total number of *Capillaria* eggs was not reduced significantly by the oral administration of fenbendazole (Fig. 5). This might be due to the possibility that *Capillaria* species in these llamas could have developed resistance to fenbendazole (Fowler, 1998). The results of this study compare favorably with other studies of fenbendazole in domestic ruminant species (Kennedy and Todd, 1975; Anderson, 1977). Various methods, including total fecal egg counts, larval culture, pasture larval counts, necropsy evaluation and clinical trials, have been used to determine the clinical efficacy of an anthelmintic in domestic animals (Uhlinger, 1996; Searson and Doughty, 1977; Anderson, 1977; Sutherland et al., 1997). The technique of total fecal egg counts was used in this study, because it was a simple, cheap, and noninvasive method for determining the

clinical efficacy of fenbendazole against gastrointestinal parasites in llamas.

4. Conclusion

Using fecal egg counts, this study was the first attempt to characterize the clinical efficacy of fenbendazole in llamas. The results of this study, although limited in scope, demonstrated that fenbendazole when administered orally in paste form at a single dose was effective in significantly reducing the total fecal egg burden of *Trichuris*, *Nematodirus* and *Strongyloides* in llamas for a four-week period. This is consistent with the oral pharmacokinetic parameters of fenbendazole. Additionally with the cash values of llamas ranging from \$800.00 to \$50 000.00 and alpacas even higher (personal communication), the use of a safe and efficacious anthelmintic like fenbendazole

will improve their health as well as the economic values of these animals. More extensive studies using larval culture and necropsy evaluation methods will be necessary to further characterize *fenbendazole* as a safe and effective anthelmintic for llamas and other SACs.

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