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USE OF ALBENDAZOLE IN FEED TO CONTROL *FASCIOLOIDES MAGNA* INFECTIONS IN CAPTIVE WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*)

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ABSTRACT: Thirty-six adult white-tailed deer (*Odocoileus virginianus*) naturally infected with *Fascioloides magna* were captured and randomly assigned to four groups. Each group was fed pelleted feed coated with albendazole for each of seven consecutive days to deliver the drug at a dose rate of approximately 0.0, 5.0, 8.5, or 16.5 mg/kg bodyweight/day. At 7 wk posttreatment, each animal was euthanized and necropsied. Effects of albendazole treatment included significant reduction ($P < 0.05$) in parasite egg count per gram of feces and increase in serum albumin concentration ($P < 0.05$). Smaller parasites or remains of dead parasites were seen at the end of migratory tracks in the treated groups. Efficacy of the drug was 82 to 84%.

Key words: Albendazole, fascioloidiasis, *Fascioloides magna*, white-tailed deer, *Odocoileus virginianus*, parasitology, anthelmintic, treatment.

INTRODUCTION

Previous studies conducted on the Welder Wildlife Refuge (San Patricio County, Tesax, USA) have indicated a high prevalence of *Fascioloides magna* (Platyhelminthes: Digenea) in white-tailed deer (*Odocoileus virginianus*) along the Gulf Coast of Texas (Glazner and Knowlton, 1967; Samuel, 1969; Scholl, 1973). The parasite causes economic losses because of condemnations of infected bovine livers at slaughter (Foreyt and Todd, 1976a) and because of fatal infections in sheep (Foreyt and Todd, 1976b) and goats (Foreyt and Leathers, 1980). White-tailed deer (*Odocoileus virginianus*) are definitive hosts, and cattle and sheep are dead end hosts (Foreyt and Todd, 1976b). White-tailed deer generally are adapted to infections with *F. magna*. However, a large proportion of white-tailed deer that died during severe winters in New York had *F. magna* infections, and it was believed that such infections reduced winter survival of deer (Cheatum, 1951).

Treating free-ranging white-tailed deer with a suitable fasciolicide could disrupt the life cycle of *F. magna*, reduce pasture contamination with eggs, and decrease transmission to other deer and cattle. Several drugs have fasciolicidal activity but most are toxic to the host and have long withdrawal periods. Albendazole at a rate of 11 to 54 mg/kg bodyweight was found to have 99% efficacy against intestinal nematodes and 38% efficacy against mature and immature *F. magna* in white-tailed deer (Foreyt and Drawe, 1978). Albendazole used to control *F. hepatica* in sheep was 100% effective at 5 mg/kg bodyweight/day, 98% at 3 mg/kg bodyweight/day and 42% at 1 mg/kg bodyweight/day when administered in feed for 35 days (Rew and Knight, 1980). In some situations free-ranging deer could be treated with albendazole in supplementary feed or bait. This study evaluated the efficacy of pelleted feed coated with albendazole premix in treating deer with naturally acquired infections of *F. magna*.

MATERIALS AND METHODS

Thirty-six adult white-tailed deer naturally infected with *F. magna*, as determined by a postcapture fecal flotation examination, were captured by drop-net trap on the Welder Refuge (Sinton, San Patricio County, Texas, USA;

28°06'N, 97°25'W). They were transported to a wildlife holding facility at Texas A&I University (Kingsville, Kleberg County, Texas, USA; 27°30'N, 97°52'W), and maintained on a pelleted diet containing at least 16% crude protein (Purina Chow, Purina Mills, Inc., St. Louis, Missouri 63166, USA). They were randomly assigned to four groups of eight, nine, nine, and 10 animals containing three, three, two and four male deer, respectively. A postcapture adjustment period of no less than 1 wk was allowed to acclimate the deer to the pens. Each group of deer was then given the medicated feed for a period of 1 wk.

Medicated feed was prepared by coating the pelleted ration with a suspension of insoluble albendazole premix (SmithKline Animal Health Products, West Chester, Pennsylvania 19380, USA) in corn syrup. This was achieved by mixing 50 ml suspension of corn syrup and albendazole premix (20% W/V) in a concrete mixer containing 22.3 kg of feed for 5 min to coat the pellets with the suspension. Weights of albendazole premix used for 22.3 kg of feed were 65, 33, 20, and 0 g for groups one to four, respectively, assuming deer weighed 35 kg each and ate 1 kg of feed per day. The feed provided albendazole at 16.6, 8.5, 5.1 and 0.0 mg/kg bodyweight/day as an average dose per animal, respectively, to each group.

Treatment effects were monitored by examining fecal samples, whole blood, and serum from each animal before treatment and every 2 wk thereafter. Fecal samples collected from the rectum were examined to obtain a parasite egg count expressed as eggs per gram of feces. A modified flotation technique was used (Sewell and Hammonds, 1972). Blood samples were obtained from the jugular vein after manual restraint. Whole blood in ethylenediamine tetraacetate (EDTA) and sera were sent to the Texas Veterinary Medical Diagnostic Laboratory (College Station, Texas 77843, USA) for hematological and biochemical analysis. Differential blood counts and serum chemistry were determined. The data were compared to reference values established by Seal et al. (1981). Seven wk posttreatment, deer were euthanized by single rifle shot and a complete necropsy performed. At necropsy, viscera were examined for ectopic *F. magna*. Livers were examined by slicing in 10 mm serial sections. All live, affected, and dead adult parasites were recovered. Parasites found in cysts were defined as adults while those migrating in the liver as immature. Affected *F. magna* were defined as those that had undergone changes in morphology, color, texture, and consistency as described by Lang et al. (1980). Parasites recovered from cysts were washed in water and placed on a metal tray. Length and width of each parasite was measured using a vernier caliper. Efficacy of the drug was calculated by counting only unaffected parasites. The following formula was used: % efficacy = [(mean number of parasites in control − mean number of parasites in treatment)/(mean number of parasites in control)] × 100 (Powers et al., 1982). Data were analyzed by a two × four factorial analysis of variance (ANOVA) test, and Tukey's test using a 95% level of significance.

RESULTS

Egg production of *F. magna* declined significantly in the albendazole treated groups. At the start of the experiment, the mean parasite egg count/g of feces of the four groups ranged from 30.3 ± 10.4 to 126.8 ± 82.4. Four wk later, mean parasite egg count of treated groups was 0.5 ± 0.3 to 0.89 ± 0.5, while it was 67.0 ± 23.7 for the control group. At necropsy the counts for the treated groups ranged from 0.0 to 2.4 ± 2.3 and 33.1 ± 15.7 for the control group. These differences were significant between the control and the three albendazole treated groups, but differences among the three treatment groups were not significant (Fig. 1).

Eosinophilia was observed in all deer throughout the experiment. The number of eosinophils ranged from 250 to 877/μl (normal values <100/μl, Seal et al., 1981), but, analysis of eosinophil count did not show significant differences between groups during the study. Other white blood cell counts were within normal ranges.

Serum albumin levels remained within normal range (2.5 to 4.2 g/dl) through the duration of the experiment (Fig. 2). At the seventh week the serum albumin concentration in the three albendazole treated groups was significantly higher than in the controls. Also, this concentration increased significantly in the three albendazole treated groups but not in the control groups. Throughout the experiment the values of alkaline phosphatase (39 to 126 IU) and aspartate aminotransferase (170 to 244 IU) were above the normal values, creatine phosphokinase (289 to 1,243 IU) was also

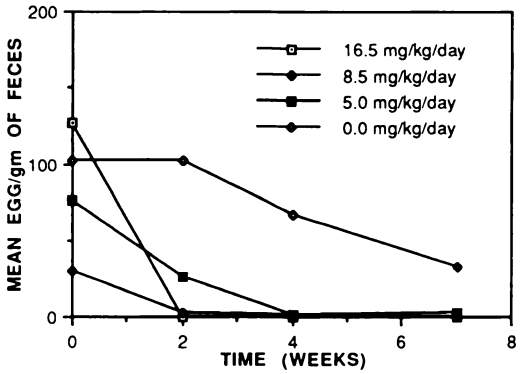

FIGURE 1. Effects of albendazole on mean *Fascioloides magna* egg counts/gram feces in four treatment groups of whie-tailed deer.

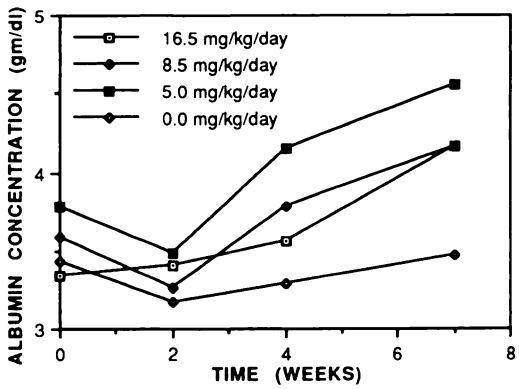

FIGURE 2. Effects of albendazole on mean serum albumin levels in four treatment groups of white-tailed deer.

above the normal values except on the second week while alanine aminotransferase (71 to 109 IU) remained within the normal range.

Livers from deer in treated groups had areas of fibrosis and regeneration. The black pigment pathognomonic of *F. magna* infections was observed along migratory tracts and in areas of liver necrosis. Some cysts associated with the parasite had thick fibrous capsules, scar tissue, and contained dead or disintegrated parasites. Some affected parasites and apparently healthy parasites were recovered. Livers from the untreated control group did not have extensive areas of fibrosis and regeneration. Three immature parasites were collected from deer in the control group. The total number of parasites found were 8, 9, 10 and 56 in groups one to four, respectively. Mean length and width of parasites from the control group were 37 mm and 25 mm; from the treated group mean length and width were 31 mm and 16 mm. Parasites collected from the control group were significantly larger than those from the three albendazole treated groups. There were no differences in size of the parasites among the three treatment groups. Efficacy of the medicated feed was calculated as 84% for group one, 84% for group two, and 82% for group three (Table 1).

DISCUSSION

Variations of blood values appear to be related to the method of restraint (Kocan et al., 1981). Therefore, most blood values were not useful in evaluating the effects of albendazole treatment. Only the serum albumin levels showed changes related to the effects of albendazole treatment. Although the serum albumin values were within the normal range of 2.5 to 4.2 g/dl (Seal et al., 1981), they showed a gradual increase over time in the albendazole treated groups but not in the controls. Al-

TABLE 1. Summary of the number of live *Fascioloides magna* recovered of weeks posttreatment and calculated efficacy of albendazole at each dose.

	Group number (dose mg/kg bodyweight/day)			
	1 (15.0)	2 (7.5)	3 (5.0)	4 (0.0)
Number of deer	8	9	9	10
Total parasites	8	9	10	56
Mean (parasites/deer)	1.0	1.0	1.1	6.2
Efficacy %	84	84	82	NA

bumin is also a non-specific indicator of liver damage. The liver is the sole producer of albumin (Finlayson et al., 1977) and levels of this protein often decrease in liver disease. Hypoalbuminemia occurs if more than 80% of the liver is damaged (Duncan and Prasse, 1977). None of the livers seen at necropsy had such extensive gross damage, but, at necropsy all livers had clinical signs of *F. magna* infection. Albumin levels may increase also following recovery of infection of intestinal helminths. In this study, the effect of albendazole on intestinal helminths was not evaluated.

Parasite egg counts in feces are not a reliable indicator of intensity of infection but they are of diagnostic value. A large variation of parasite egg counts per gram of feces was observed at the initiation of the experiment, but albendazole was highly effective in reducing egg production of the parasite regardless of the initial egg count.

At necropsy, all livers had clinical signs of *F. magna* infection. In the albendazole treated group stunted, dead and disintegrated parasites were recovered. Hence, the use of albendazole in feed to administer a therapeutic dose was highly effective against natural infections of *F. magna* in white-tailed deer.

An increasing number of ranchers in Texas are using commercial deer feeds. Baiting is also an important tool in intensive wildlife management. Treatment of the reservoir host, the white-tailed deer, using supplementary feed or bait would be another practical and logical method of controlling *F. magna*. This study showed that albendazole medicated feed effectively inhibited parasite egg production and caused the death of parasites with an efficacy in the range of 82–84%.

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