THE USE OF PROFTRIL® BOLUSES IN WEANER RED DEER HINDS (*Cervus elaphus*)

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ABSTRACT

Three groups of weaner red deer hinds were treated with oral albendazole solution at either 35 daily intervals (Control) or 21 daily intervals (Albezol) or with an albendazole-based sustained release bolus (Proftril). The Proftril group had significantly higher weight gains (11 4 kg ± 2 8, group mean ± standard deviation) compared with the Control or Albezol group (7 9 kg ± 2.9 and 8.1 kg ± 4.3 respectively). The Proftril group had nil faecal larval lungworm counts (FLC) between 14 and 91 days post-treatment while the other groups had mean FLCs up to 483 larvae per gram. At slaughter 91 days post-treatment, there was no significant difference in the numbers of lungworms (adults and immatures) recovered from the 3 groups. The Albezol group had significantly ($P<0.05$) fewer adult abomasal worms, and the Proftril group had significantly ($P<0.01$) higher numbers of *Ostertagia*-type fourth stage larvae recovered from abomasal digests

INTRODUCTION

Lungworms (*Dictyocaulus eckerti*, also classified as *D viviparus*) are recognised as important production-limiting parasites of young farmed deer in New Zealand, especially in their first autumn-early winter period (1). Recognition of parasitism by gastrointestinal nematodes as a production-limiting factor is emerging (2), and autumn is the season in which ingested larvae of the *Ostertagia*-type nematodes become hypobiotic or inhibited in the abomasum of ruminants, including deer (3) With benzimidazole anthelmintics (white drenches), it is recommended to treat young deer at 21 day intervals for the most efficient control of lungworm infection (1). Albendazole is a benzimidazole derivative, the liquid oral formulation (Albezol DC®, SmithKline Beecham Animal Health) of which is licensed for use in farmed deer in New Zealand. Albendazole has recently been formulated in a sustained-release intraruminal bolus for sheep (Proftril®, SmithKline Beecham Animal Health). In sheep, the Proftril bolus is formulated to last 100 days. It is effective against established adult gastrointestinal nematodes and also is effective against incoming L_3 larvae (4). The potential advantages of a sustained-release bolus would include persistent protection of stock against parasites leading to greater production and reduction of stress and potential injury by a lessened need for yarding and handling An initial trial using Proftril in red deer weaners showed decreased larval shedding and increased liveweight gain in treated deer compared with untreated or orally drenched deer over a 103 day period (5). This research is part of a longer term study on the effect of Proftril as a parasiticide in young deer This work compares the growth rates, serum biochemistry and faecal larval output of weaned red deer hinds treated with either Albezol DC or Proftril for a 91 day period and the total number of lungworms and abomasal worms recovered at necropsy

METHODS AND MATERIALS

In mid-March 1992, 60 weaned female red deer were randomly allocated to 3 different groups which were run together at all times Group 1 (Control) consisted of 10 deer in which moderate parasitic infections were maintained Past experience at Invermay has shown that untreated weaned deer often develop very severe parasitic disease For humane reasons to prevent

debilitating infections over the extended time frame of this study, these animals were routinely drenched on a 35 day schedule instead of 21 days. These animals were randomly allocated into 5 pairs at the start of the trial, and one pair was drenched each week on a rotating schedule. In addition to the collection of reference data from these animals, they were intended to provide sufficient pasture contamination for an adequate parasite challenge to the other groups. Group 2 (Albezol) consisted of 25 animals which were orally drenched at 21 day intervals with Albezol DC at the rate suggested by the manufacturer (based on a minimum dose rate of 10 mg/kg liveweight, the actual dose was 5 ml of Albezol DC if less than 51 kg liveweight and 10 ml of Albezol DC if greater than 51 kg liveweight). Treatment dosage was based on the previous (7 days prior) liveweight of the individual animal Group 3 (Proftril) consisted of 25 animals which were dosed with a single Proftril bolus on day 0.

Liveweights and faecal samples (for faecal larval counts) were taken at 7 day intervals. Blood samples were taken for serum from all animals at day 0 and then at 21 day intervals for analysis of total serum protein, serum albumin, serum pepsinogen and SGOT (serum glutamic oxalacetic transaminase). All animals were vaccinated with Yersiniavax^{R} and a multivalent clostridial vaccine and were treated with a 4 gm capsule of copper oxide wire particles (Copper Needles^{R}, Bayer New Zealand Ltd) on day 0. Selenium supplementation was given monthly by oral solution at the rate of approximately 1 mg/10 kg liveweight.

After an average of 91 days, 5 control (1 randomly chosen from each pair), 10 Albezol treated (randomly chosen) and 10 Proftril treated animals (randomly chosen) were humanely slaughtered. The remaining 35 animals (5 Control, 15 Albezol and 15 Proftril) will be monitored for a further 4 months to investigate longer term consequences of the 3 regimes Due to a limited capacity to process all the samples, 7 animals were killed at 90 days, 7 were killed at 91 days and 11 were killed at 92 days. The abomasum was isolated, tied and removed as quickly as possible after slaughter. The respiratory tract was removed, and the abomasum and respiratory tract were processed for adult and 5th stage larval nematode parasites (6). The abomasal mucosa was removed and processed (by acidic enzymatic digestion) for the recovery of 4th stage *Ostertagia*-type larvae (6) The pH of the abomasal contents was analyzed with an electronic pH meter Liver sections from each animal were analysed for copper and selenium concentrations. Statistical analysis was done by ANOVA using Genstat 5 (2 2) (copyright 1990) Statistical analysis of worms recovered was done with log transformation of one plus the actual number counted.

RESULTS

Changes in liveweight: Figure 1 shows the pattern of weekly liveweight of the 3 groups over the 91 day evaluation Over this period the Proftril group gained 11.4 kg which was significantly more than the 7 9 kg gain (SED 1.1; $p<0.01$) of the Control group or the 8.1 kg gain (SED 0.8, $p<0.001$) of the Albezol group It is noteworthy that between days 40 and 70 (during May) both the Control (5 weekly Albezol) and the Albezol (3 weekly) groups declined in weight compared with a steady rise in the Proftril group

Serum biochemistry: The mean serum pepsinogen values for the control and Albezol groups were not statistically different at any time (see Table 1) The Proftril group however had a significantly elevated mean value on day 0 due to 3 animals which had values of over 12 There was no significant difference among the mean serum pepsinogen values of the 3 groups on day 21, or day 42. However, on day 63 the Proftril group was significantly higher than the Albezol group ($p<0.05$) On day 84, the serum pepsinogen value for the Proftril group was significantly elevated in comparison to the other groups ($p<0.01$)

Figure 1. Changes in mean group liveweight in weaner red deer hinds on different anthelmintic regimes from March to June

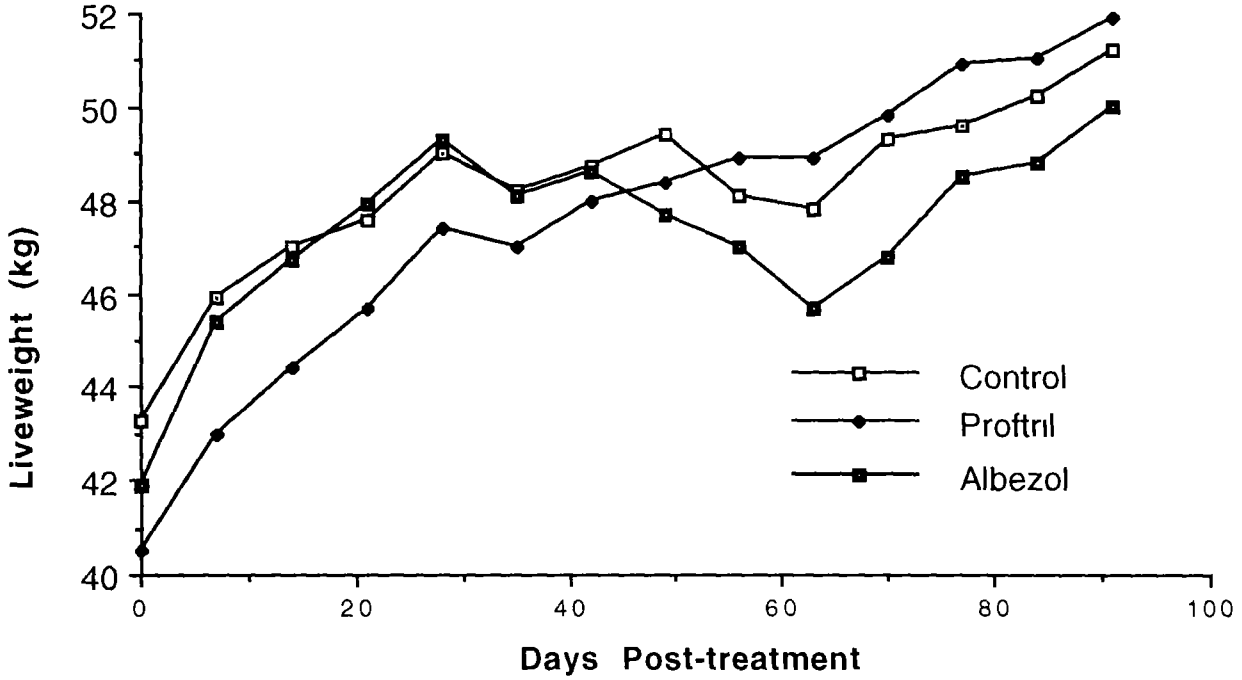

Figure 2. Mean group faecal larval counts for weaner red deer hinds on different anthelmintic regimes from March to June

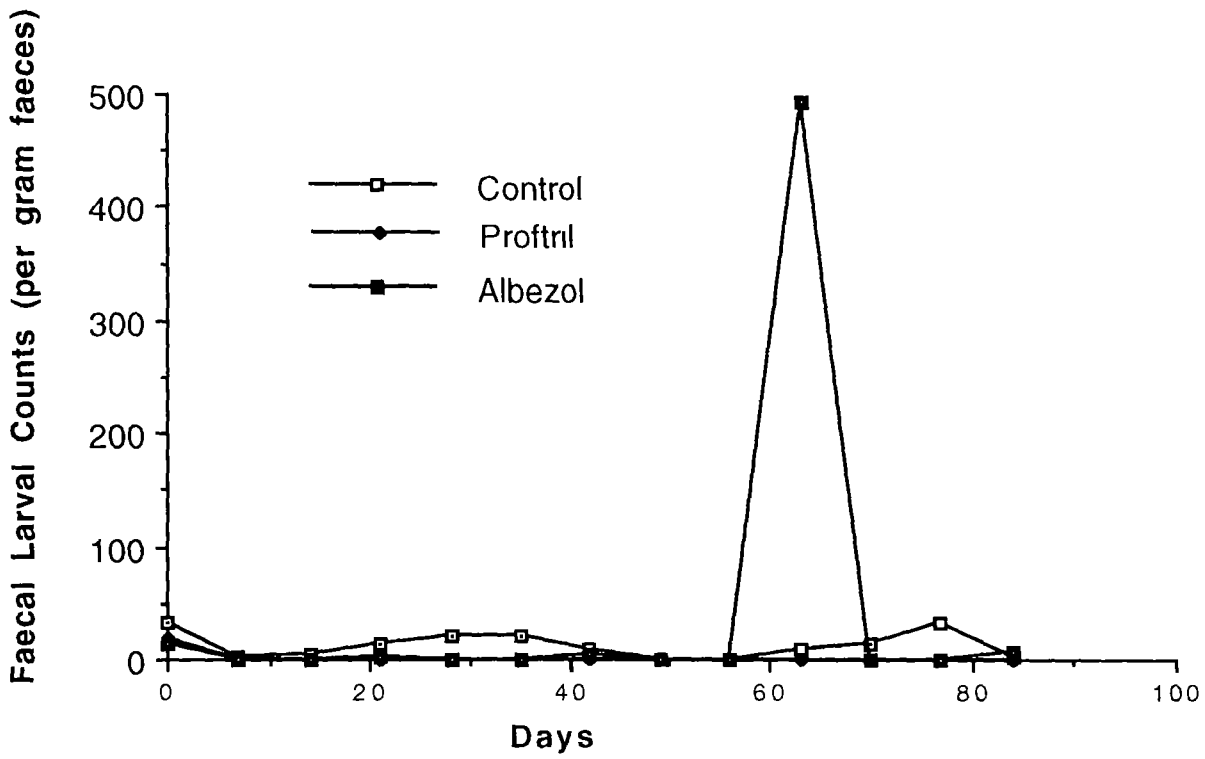

TABLE 1. Mean serum pepsinogen values (Units/litre) for weaner red deer hinds at 21 day intervals on different anthelmintic regimes over 91 days (± s.d.).

Group (n)	Day 0	Day 21	Day 42	Day 63	Day 84
Control (10)	0.75	0.78	0.57	0.54	0.68**
Albezol (25)	0 80*	0.77	0.46	0.38*	0.59**
Proftril (25)	3.31*	1.01	0.54	0.63*	0.95**
SED Control vs Albezol & Proftril	1.40	0.17	0.07	0.12	0.08
SED Albezol vs Proftril	1.06	0.12	0 05	0.09	0.06

* p<0.05; ** p<0.01

The mean total serum protein values were not statistically different among the 3 groups at any time during the 91 day evaluation but ranged from 61 to 71 g/ℓ. However, the Albezol group had a significantly lower mean serum albumin value than the Proltril group on day 84 (p<0.05), and over the period from day 0 to 84 the mean serum albumin value for the Proftril group declined significantly less than that of the Albezol group (p<0.001) and the Control group (p<0.05) (see Table 2).

The serum SGOT levels were within the normal range for all animals in all groups for the entire 91 day period.

TABLE 2. Mean serum albumin (g/l) levels for weaner red deer hinds at 21 day intervals for different anthelmintic regimes over 91 days and the difference between day 0 and day 84

Group (n)	Day 0	Day 21	Day 42	Day 63	Day 84	Day 84-Day 0
Control (10)	34.6	30.6	29.7	27.1	30.6	-4.0*
Albezol (25)	33.6	30.9	29 0	25.4	28.5***	-5.1***
Proftril (25)	33.6	31 6	30.8	29.4	32 2***	-1 4***
SED Control vs Albezol & Proftril	1.2	0.9	0.9	0.9	1.1	1.3
SED Albezol vs Proftril	0.9	0.7	0.7	0.7	0.8	1.0

* p<0.05, *** p<0.001

Parasitology: The faecal larval counts (FLC) of the Control and Albezol groups fluctuated relative to their anthelmintic treatment (see Figure 2). The Proftril group had nil FLCs by 14 days post-treatment, and remained at nil throughout the 91 day period Most group mean FLC remained below 50 L_1/g The exception was the Albezol group which had high counts on day

63 at the end of May. At necropsy, lungworms were recovered from animals from all 3 groups. The mean numbers of lungworm adults recovered were 2, 2 and 10 from the Control, Albezol and Proftril groups, respectively (not significantly different - NS). The mean numbers of immature lungworms recovered were 70, 30 and 70 from the Control, Albezol and Proftril groups respectively (NS). It was noted that some of the female lungworms recovered from Proftril-treated deer appeared patent at approximately half the normal adult female size (M. Taylor, pers comm.).

Ostertagia-type nematodes were the only abomasal parasites recovered The geometric means of abomasal worms recovered for each group are shown in Table 3. For adult *Ostertagia*-type worms all three groups were significantly different from each other ($p<0.05$) with Albezol the lowest (7) and Proftril the highest (553). There were no significant differences in the numbers of 5th stage larvae (L5) between groups However, all three groups had significantly different numbers of 4th stage larvae (L4) again with Albezol the lowest (444) and Proftril the highest (12,288) ($p<0.05$).

There was a significant correlation between the number of adult *Ostertagia*-type worms and the abomasal pH ($r=0.55$; $p<0.01$).

TABLE 3. Geometric means of abomasal *Ostertagia*-type nematodes recovered from three treatment groups of 8 month old red deer hinds at slaughter.

Group (n)	Adult worms	L5 larvae	L4 larvae
Control (5)	135*	38	1777*
Albezol (10)	7*	0	444*
Proftril (10)	553*	32	12288*
Std error ratios for Control v Albezol & Proftril	1.4	1.3	1.6
Std error ratios for Albezol v Proftril	1 4	1.2	1 5

* $p<0.05$

Other biochemistry: The mean abomasal pH values were 4.4 for the Control group, 3.8 for the Albezol group and 4.4 for the Proftril group (SED=0.5). The variance was high and there were no significant differences between groups.

The mean liver copper values were 284, 387 and 396 µmol/kg for the Control, Albezol and Proftril groups, respectively (SED=117; NS) The mean liver selenium values were 462, 960 and 757 nmol/kg for the Control, Albezol and Proftril groups, respectively (SED=69). The mean liver selenium level of the Control group was significantly lower than the other groups ($P<0.05$), and the Proftril is lower than the Albezol group ($P<0.05$).

Carcass weight and dressing percentage: At slaughter, there were no significant differences among the groups for carcass weight or dressing percentage

DISCUSSION

The results were similar to an earlier trial using Proltril in weaner red deer with respect to weight gain and faecal larval counts (4). The Proltril treated deer had significantly higher liveweight gains and had virtually no shedding of lungworm larvae during the trial period (91 days) Additional studies have indicated that shedding of lungworm larvae in Proltril-treated deer begins by day 112 (Waldrup, KA, unpublished data). The high FLC in the Albezol group (see Fig. 2) occurred at the end of May and in the previous 4-5 weeks both groups receiving Albezol drench had lost weight (see Fig. 1), compared with a rise in liveweight in the Proltril group This suggests that the entire group was heavily challenged by parasites over this period and Proltril prevented the uptake and development of parasite burdens, whereas the other groups developed burdens which were then cleared by periodic Albezol treatment. The difference in FLCs at day 63 between the 3 weekly Albezol group and the 5 weekly Albezol (Control) is probably due to the fact that the treatment in the control group was rotated so that only 2/5 of the group were at the same stage of treatment Thus, if by chance there was a particularly heavy challenge around the time of the previous Albezol treatment 3 weeks earlier all 25 animals would have developed burdens at the same time, compared with only 2 animals in the control group treated at that time The scheduled drench on day 63 brought a decrease in FLC and an increase in liveweight. It can therefore be inferred that the parasite challenge to the Proltril group was sufficient to have caused disease had the bolus not been functioning. The number of worms recovered from the Albezol-treated animals indicates that albendazole is an efficacious drug for the removal of lungworms and abomasal worms in deer. The number of lungworms and abomasal worms present in the Proltril-treated deer at slaughter is a matter of concern, as these numbers are equivalent to those previously reported to have caused loss of production in farmed red deer (2)

It is apparent that the Proltril treatment did not completely prevent the infection of the treated deer by parasitic nematodes for the entire 91 days, although it did seem to offer protection from the loss of liveweight and serum albumin as observed in the Control and Albezol groups However the increased serum pepsinogen level in the Proltril-treated deer could be indicative of a developing abomasal problem and was associated with much greater numbers of 4th stage *Ostertagia*-type larvae In spite of the differences in mean number of 4th stage larvae recovered from the abomasa of the 3 groups, there was no statistical difference in the mean abomasal pH Whether these numbers of 4th stage larvae are indicative of a recent massive challenge or whether the Proltril treatment had a suppressive effect on the larvae which promoted inhibition is still in question

The presence of adult lungworms in the Proltril group at slaughter with the prolonged absence of faecal larval shedding is intriguing. One possible explanation is that the bolus had not functioned for the entire 91 days and that the infection had not yet reached patency. If the bolus had completely prevented lungworm infection but had ceased functioning prior to the slaughter at 91 days, then the numbers of lungworms present could be indicative of a lack of immune resistance and the absence of faecal larvae would be due to inadequate time for patency of the infection. However as adult female lungworms recovered from the Proltril animals had developed ova in their uteri on day 91, larvae should have been recovered prior to day 112 if timing were the only consideration. Young deer develop immune resistance to lungworm infection upon exposure to the parasite (1). Another possible explanation is that the Proltril treatment did not completely prevent lungworm infection but had a suppressive effect on the development of disease and on the fecundity of the lungworms present. Since lungworm larvae (L_1) must survive a trip through the rumen to be shed with the faeces, it is possible that they are killed in the rumen by the action of the bolus The absence of faecal larval shedding could be an advantage if all the deer in the weaner mob were treated. Contamination of the grazing paddocks would be minimal, and transmission of lungworm would therefore be substantially

reduced. Whether this would have a negative effect on the development of immune resistance in these treated deer is still in question This trial will continue into the spring with the remaining animals of these groups to investigate any long term effects of the three treatments.

There was no statistical difference in the mean liver copper levels of the 3 groups, and all copper levels were considered adequate There was a difference in the mean liver selenium levels, but the relevance of this finding is unknown.

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