Influence of timing of endectocidic antiparasitic treatment on its efficacy in overwintering reindeer

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Abstract: To find out if timing of endectocidic antiparasitic treatment is crirical for its efficacy in overwintering reindeer, 72 hinds of the Kaamanen Experimental Reindeer Herd were randomly allocated to four groups. Three groups received ivermecrin mixture orally once ar a dose of 200 µg/kg, either in September, December, or February, and one group was left untreated. Antiparasitic efficacy was evaluated by counting *Hypoderma tarandi* and *Cephenemyia trompe* larvae in April, and by faecal examination for trichostrongylid nematode eggs in March and April. Production efficacy consequences were assessed by comparing animal weight development from November to April, and calf birth weights. No difference could be seen in the antiparasitic efficacy of the treatments; all were 100 % efficient against *H. tarandi* larvae (warbles) and *C. trompe* larvae (throat bors), and reduced the trichostrongylid egg output by 62 to 74 %. Weight gains of the groups were not significantly different, however the calf birrh weights differed nearly significanrly (P = 0.057). On average, smallest calves were produced by the untreated group.

Key words: ivermectin, avermectin, warbles, throat bots, trichostrongylids, *Hypoderma tarandi, Cephenemyia trompe, Rangifer tarandus.*

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Introduction

Endectocidic antiparasitic treatment (efficacy against both some endo- and ectoparasites) has become a routine in Finnish reindeer husbandry (Anon., 1993). The goal is to help animals to survive the critical winter period and increase their fitness, thereby aiding them to produce healthy offspring. From the endectocidic avermectins and milbemycins produced, the only one so far in commercial use in reindeer is ivermectin. Injectable ivermectin at a dose of 200 µg/kg has high efficacy against warbles, *Hypoderma tarandi* (Diptera: Oestridae), and throat bots, *Cephenemyia trompe* (Diptera: Oestridae), the «sinus worm» *Linguatula arctica* (Pentastomida), and many nematodes parasitizing reindeer (Nordkvist *et al.*, 1983, 1984; Haugerud *et al* , 1993). Oral ivermectin at the same dose given in December was also highly effective against warbles and throat bots, but its nematocidal efficacy was lower than that of the injection (Oksanen *et al.*, 1992a, 1993).

It has been observed that different developmental stages of parasitic nematodes have different susceptibilities to antiparasitics. In general, hypobiotic (inhibited) larvae with minimal metabolism are regarded as those most resistant (Soulsby, 1982). Whereas in examination 50 days later it was found that all abomasal nematodes had been killed after ivermectin injection on 23 February (Nordkvist *et al.*, 1983), no efficacy was seen after injection given on 25 November, as measured 147 days post treatment (Nordkvist *et al.*, 1984). While the apparent lack of efficacy might also have been caused by reinfection during the winter, the authors considered seasonally inhibited development of the nematodes to be the most probable reason. Different stages of insect parasites may also have variable susceptibility to antiparasitics; first instars of *Oestrus ovis* (Diptera: Oestridae) of sheep were less susceptible to moxidectin (another endectocide) than were 2nd and 3rd instars (Puccini *et al.*, 1994).

As antiparasitic treatment of reindeer is in practice only possible in connection with the separation of animals to live over winter from those to be slaughtered, the treatments are sometimes spread throughout the slaughter season from September up to February, whenever weather and snow conditions allow the flock to be rounded up. Therefore, the oestrid fly parasites can be either 1st or 2nd instars during the treatment (Bergman, 1917; Nilssen & Haugerud, 1995), and the seasonal hypobiosis of nematodes can be either early, intermediate, or late.

According to earlier studies (Oksanen *et al.*, 1992a, 1993), differences in nematocidal efficacy only become evident in spring when hypobiotic gastointestinal nematode larvae mature and the infections become patent. Faecal examinations are therefore to be performed in the spring. The aim of the present study was to examine if timing of the endectocidic treatment has influence on its efficacy.

Materials and methods

On 26 September, 1995, 72 hinds of the Kaamanen Experimental Reindeer Herd (69°09' N, 27°00' E) were randomly allocated according to age to four similar groups of 18 animals each. Group 1 was left untreated as controls, and the groups 2 to 4 received ivermectin (Ivomec® vet. 0.8 mg/ml mixt., Merck Sharp & Dohme B. V., Holland) orally at a dose of 200 µg/kg once on 26 September, 19 December, or 16 February. Due to not finding all the animals allocated to the specified group at the time of the scheduled treatment or later, the final group sizes were: 16 hinds in groups 1 and 2, 17 in group 3, and 18 in group 4, respectively.

Warbles were counted visually and by digital palpation on 24 April, and throat bots at the same time using a human fibre-optic bronchoscope according to the method described earlier (Oksanen *et al.*, 1992b). When the number of warbles exceeded 30, the count was done at tens, as adjacent warbles might blend together and prevent exact enumeration. Likewise, the number of throat bots seen was estimated to the nearest five when exceeding 25. Rectal faecal samples were collected on 16 February, 25 March, and 23 April. They were examined according to a modified McMaster method, each egg representing 20 eggs per gram (epg). The animals were weighed (to the nearest kg) on 26 September, 02 November, 23 April, and immediately before treatment using a digital scale based on "The Poldenvale Lambway" (Precision Weighers, Reading, England). New-born calves were weighed within 24 hours after birth (0.1 kg precision).

For statistical analysis of trichostrongylid nematode egg counts, differences were assessed by calculating individual arithmetic means (Faecal Egg Count Mean, FECM) of the egg counts during the spring (25 March and 23 April). The FECMs were compared between the groups by one way analysis of variance. Individual weight gains (from November to April) and calf birth weights were similarly compared. The statistical analyses were performed using the Statistix® 4.1 software package (Analytical Software, 1994). Treatment efficacy was calculated from the trichostrongylid FECMs according to the following formula (modified from Wood *et al.*, 1995):

Treatment efficacy of group i =

$$\frac{\text{geometric mean of FECM in group 1} - \text{geometric mean of FECM in group i}}{\text{geometric mean of FECM in group 1}} \times 100\ \%$$

Corresponding formula was used to calculate treatment efficacy against warbles and throat bots.

Results

All of the untreated animals (group 1) harboured *H. tarandi* larvae. Most of them (12 out of 16) were also infected by *C. trompe* larvae (Table 1) None of the ivermectin treated reindeer (groups 2 to 4) had any of these parasites, so the efficacy of all the treatments was 100 % against oestrid fly larvae. On 16 February, the trichostrongylid nematode egg count was zero in all others, but one animal of the untreated group excreted a small number of eggs (20 epg). Subsequently, the nematode FECM of the untreated group (group 1) was highest, but the difference between the groups was not significant (P = 0.12). The FECMs of the treated groups were closely similar (Table 1).

Table 1. Warbles (*Hypoderma tarandi* larvae) and throat bots (*Cephenemyia trompe* larvae), trichostrongylid nematode faecal egg count means, start weights, weight gains, and calf birth weights of the groups of reindeer hinds, treated orally with ivermectin at 200 µg/kg at different times, or untreated.

Group	1	2	3	4
	untreated	treated Sep 26	treated Dec 19	treated Feb 16
n	16	16	17	18
H. tarandi[a]	52.9 (36.0)	0	0	0
- treatment efficacy		100 %	100 %	100 %
C. trompe[a]	14.9 (12.4)	0	0	0
- treatment efficacy		100 %	100 %	100 %
FECM[b]	12.9	4.8	4.0	3.3
- treatment efficacy		62 %	69 %	74 %
Start weight[c]	79.0 (13.1)	80.1 (10.0)	78.9 (10.9)	80.0 (10.1)
Weight gain[d]	-0.1 (5.6)	-0.2 (5.4)	1.6 (4.8)	-2.6 (4.7)
Calf birth weight[e]	5.7 (0.9), 14	6.2 (1.0), 13	6.6 (0.8), 13	6.4 (1.0), 13

[a] mean number (standard deviation).
[b] geometric mean of individual Faecal Egg Count Means (25 March and 23 April), epg.
[c] weight 02 November (srandard deviation), kg .
[d] weight 23 April - weight 02 November (standard deviation), kg.
[e] birth weight (standard deviation), kg, *n*.

Weight gain/loss of the groups of hinds varied between a loss of 2.6 kg and a gain of 1.6 kg. The differences were not statistically significant (P = 0.14). Difference in birth weights was nearly significant (P = 0.057), and the calves born to the untreated group were on average smallest.

Discussion

Due to the 100 % efficacy against both warbles and throat bots, the present results cannot suggest if different developmental stages are equally susceptible or not. The efficacy of all the treatments against trichostrongylid egg production was higher than expected for orally administered ivermectin from earlier studies. In the study of Oksanen *et al.* (1993), the efficacy of oral treatment against FECM at the corresponding time was 47 %, while that of injection treatment at the same dose was 86 % (data not shown). Although the difference in egg output between the groups in the present study was not significant, the nevertheless substantial efficacy raises the question, if the oral mixture designed for sheep used in this study might be better absorbed than the equine paste used in the earlier studies. In sheep, it has been observed that the bioavailability of intra-abomasally administered ivermectin is vastly higher than that of the drug placed intraruminally (Prichard *et al.*, 1985). In case some of the oral mixture passes on directly into the abomasum, its bioavailability could be consequently higher than that of the equine paste that is probably being mixed in the ruminal contents. This point deserves further pharmacokinetic studies.

Decrease in faecal egg counts does not definitively prove a proportional change in worm burdens, as nematode egg production is affected by many factors. Also ivermectin treatment is shown to suppress the fecundity of surviving nematodes (McKellar *et al.*, 1988). However, that suppression was documented 7 and 14 days after treatment, when measurable ivermectin concentrations still exist in animal tissues (Bogan & McKellar, 1988). In the present study, the time between treatment and the start of the FECM examination was 5 weeks (group 4) to 25 weeks (group 2). In case the reduction of fecundity caused by ivermectin is temporary, it might already have subsided before the FECM examination.

Trichostrongylid egg production has earlier been observed to be discontinued for the winter period (Oksanen *et al.*, 1992a, 1993). This was seen also in the present study in the mostly zero egg counts on 16 February, and is most probably caused by the seasonal hypobiosis of the worms.

The weight development figures shown are based on weighing in November, as many animals were missing from the September weighing. No difference was seen in the weight development (of those present in September) from September to November between the groups (data not shown).

From the practical point of view it appears that parasites can be effectively treated anytime during the winter. The statistically nonsignificant and small differences in weight gain/loss and in birth weights indicate, assuming comparable parasite fauna and good winter pastures, that the timing of endectocide treatment of reindeer hinds is not very critical. Although not quite significant, the average birth weight of the calves of the untreated group was lowest, which is concomitant with earlier observations (Nieminen, 1989), supporting the assumption of the benefit of treatment.

If first quality hides are desired, it must be noticed that warbles can cause damage already in October-November (Nieminen, 1992). Even though the larvae were subsequently killed, the damage may persist during subsequent years in the form of scars. Therefore, early treatment might be preferable.

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