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CONTROL OF INTESTINAL COCCIDIOSIS IN CHAMOIS AND OTHER WILD RUMINANTS USING MONENSIN

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Introduction

Intestinal coccidiosis, a contagious enteritis caused mainly by infection with the protozoan parasite *Eimeria* spp., occurs universally, affecting both domesticated and wild mammals. Overt disease with diarrhea, dysentery and even death, or chronic infection with symptoms of malnourishment, or subclinical infection with diminished weight gain, may be present within a group of affected animals. The disease is most important where animals are housed or confined in small areas—the situation found in large scale management systems and in zoological collections.

Overt disease caused by *Eimeria spp.* was repeatedly diagnosed at Tierpark Hellabrunn in many species of wild ruminants. As previous methods of therapeutic treatment of the affected cases did little to reduce the overall occurrence of disease, and initial trials to reduce oocyst excretion by prophylactic use of amprolium in a dosage of 40 mg/kg body weight were not satisfactory,[22] a study of the prophylactic effects of monensin was undertaken in the following field trial.

The anticoccidial compound monensin is an ionophore antibiotic produced as a fermentation product of *Streptomyces cinnamonensis*[10]. It has been proven to be effective against enteric coccidiosis in poultry[19], cattle,[6,13] and sheep.[1,7,11,12,14] Monensin affects the coccidian life cycle at the first generation schizont stage.[19] In mammals, monensin causes the reduction or complete cessation of oocyst production at various levels. For prophylactic use the following dose levels are recommended.

Lambs: 10-20 mg/kg sheep fattening ration resulting in approximately 0.8-1.6 mg/kg body weight.[2,3,7,8,14,21]

Cattle: 1 mg/kg body weight.[6,13]

In some species problems occurred with unpalatability if monensin was included in the ration at too high a level.[3,6] Levels of monensin of over 150 mg/kg medicated pellets, was refused by chamois, mouflon and ibex but accepted by some antelope and gazelle species.

There have been reports of toxicity of monensin in horses, lambs, cattle and deer. Equine species are more sensitive to monensin than are ruminants, showing toxic effects on the mitochondria of the liver and heart. Death has occurred in lambs given monensin at a dosage rate of 8 mg/kg body weight and the LD_{50} of monensin in cattle is reported as 26.6 mg/kg body weight.[1,4,5,9,15,16,18,20]

Materials and Methods

During 1980-1982 fecal samples from wild ruminants were collected every week in Tierpark Hellabrunn and examined for coccidia oocysts.

The following groups of animals were subject to strict parasitological supervision:

12 Chamois *Rupicapra rupicapra*
14 Markhor *Capra falconeri*
7 Dorcas gazelle *Gazella dorcas*
9 Springbok *Antidorcas marsupialis*

Temporarily included in the parasitological examinations were fecal samples of:

16 European mouflon *Ovis ammon musimon*
16 Alpine ibex *Capra ibex ibex*
11 Nubian ibex *Capra ibex nubiana*
12 Mountain gazelle *Gazella gazella*
4 Impala *Aepyceros melampus*

The samples were processed by the

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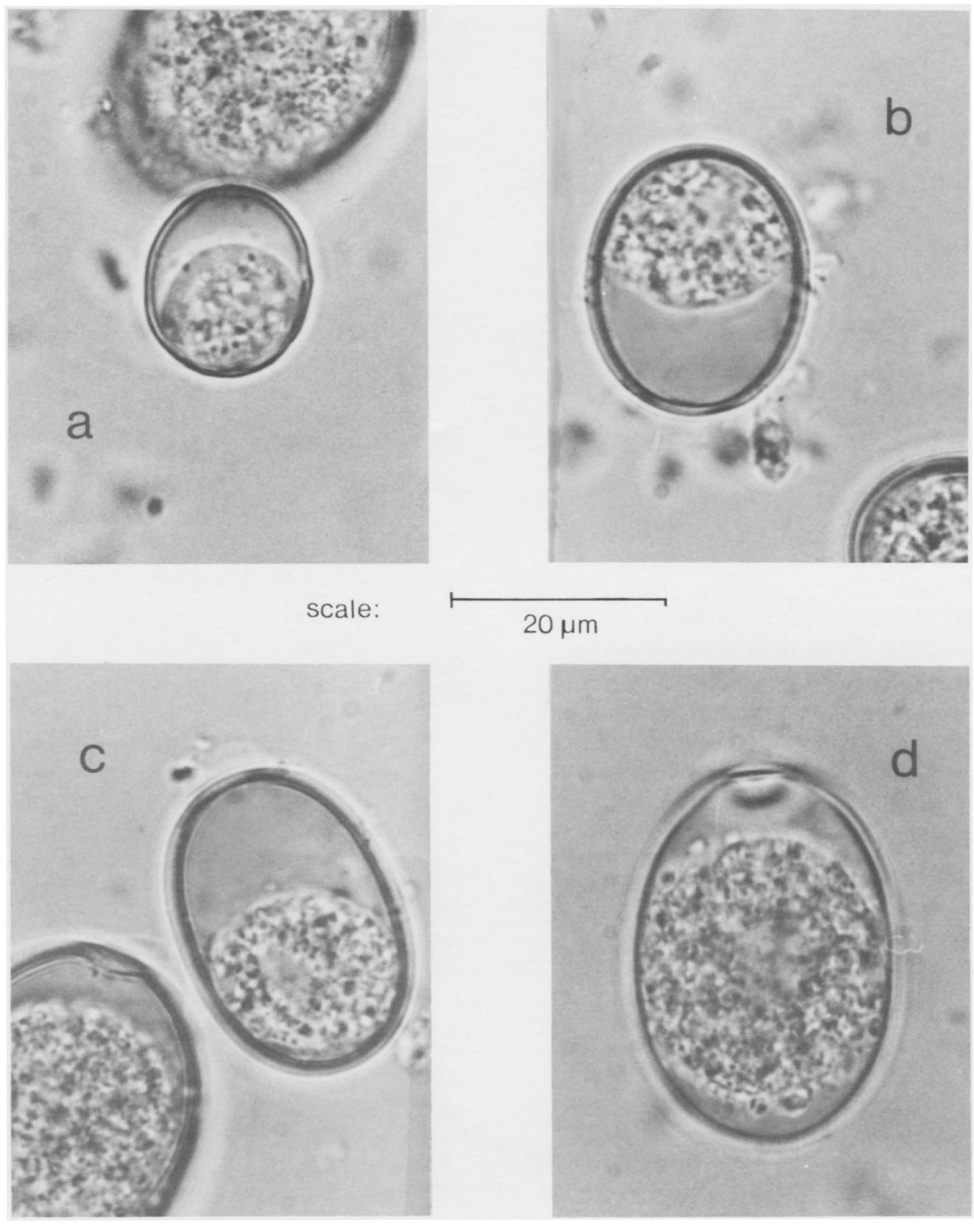


Figure 1. Fresh not sporulated *Eimeria* oocysts shed by chamois
a = *E. alpina*
b = *E. riedmuelleri*
c = *E. rupicaprae*
d = *E. yakimoff-matschoulskyi*

$ZnCl_2$-NaCl flotation technique (specific gravity: 1.3 g/cm³). One loop of the fluid surface was covered with a 18x18 mm coverglass and one line through the center was examined for coccidia with 160-fold magnification. A semiquantitative counting technique was applied using the following key:

0	: no oocysts
+	: oocysts hard to find (<10)
+ +	: oocysts easy to find (11-30)
+ + +	oocysts in every microscopial view (>30)

Eimeria spp. of chamois were differentiated according to morphological characteristics.[17] Coccidia of other species could not be differentiated, as most of them are not described in the literature and their specificity has not been investigated. Furthermore, transmission of coccidia species from one species of ruminant to another could not be excluded.

The anticoccidial antibiotic monensin was mixed into pelleted food in concentrations of 75, 100 and 150 mg/kg. The medicated pellets were fed at a level of approximately 100g/10kg body weight, resulting in an effective dosage of 0.75, 1.0 and 1.5 monensin/kg body weight. Besides medicated pellets, hay and green forage was fed ad lib. Additionally, according to season, leafed branches, vegetables, fruit, silage, brewers grains and a mixture of concentrated foods without medication were offered.

Results

All species of ruminants from which fecal samples were collected, showed infection with *Eimeria* spp. before monensin-medicated pellets were fed. The coccidia of chamois were identified as: *Eimeria alpina* (Fig. 1a), *E. riedmuellerie* (Fig. 1b), *E. rupicapra* (Fig. 1c) and *E.yakimoff-matschoulskyi* (Fig. 1d).

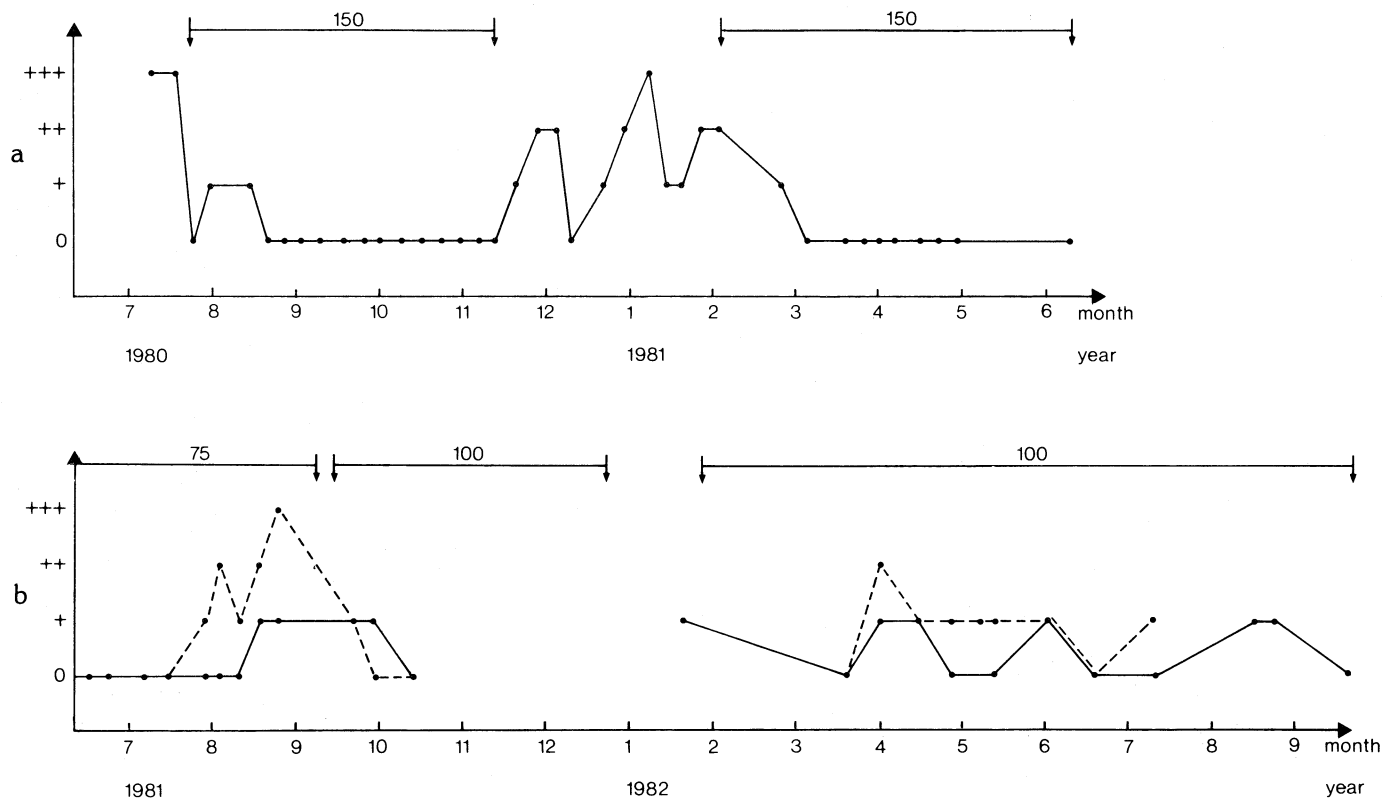
The percentage of *E. alpina* oocysts was high in feces of chamois with clinical symptoms. High losses of 4-6 month old animals as a result of intestinal coccidiosis were observed in chamois. The animals showed inappetence, dull appearance, diarrhea with soiling of the hindquarters and, in some cases, edema of the throat region (Fig. 2).

The herd of chamois was kept on an 4,240 m² area and therefore individual therapy with sulfanomides was not always possible. To avoid further losses in the summer of 1980 monensin as given at a dosage rate of 150 mg/kg pelleted food, resulting in an effective dosage rate of 1.5 mg/kg body weight. In spite of individual variation in the consumption of the medicated food, the number of expelled oocysts decreased and after four weeks, all fecal samples were negative for coccidia (Fig. 3a). In Nov. of 1980, the medication of the pelleted food was terminated and immediately an increasing number of oocysts was observed in the feces. The young stock showed clinical symptoms of coccidiosis and required chemotherapy (Fig. 3a).

Good results were obtained with parenteral application of Theracanzan[a] (100ml contains 33.4g Sulfadimethoxin) 1-2ml/10kg body weight and simultaneous oral application of Socatyl[b] (100g contains 50g Formo-Sulfathiazol) at a dosage rate of 4g/10kg body weight over a period of 3-5 days. Again monensin medicated pellets were fed at the same concentration, and the shedding of oocysts ceased.

Some animals ate less medicated food when monensin was added at the rate of 150 mg/kg pellets, resulting in reduced weight gain. To increase the palatability of the medicated food, the concentration of monensin was reduced to 75 mg/kg pellets in the summer of 1981. All the animals accepted the offered ration, but again oocyst counts in the feces increased and after two months diarrhea occurred, caused by intestinal coccidiosis requiring individual chemotherapy (Fig. 3b). Increasing the percentage of monensin in the pellets to 100 mg/kg caused a sharp reduction in the oocyst counts and clinical symptoms disappeared. Although monensin was fed

Figure 2. Young chamois suffering from intestinal coccidiosis showing eduma of the throat region.



0 = no oocysts
\+ = oocysts hard to find (<10)
\+ + = oocysts easy to find (11-30)
\+ + + = oocysts in every view (>30)
↓ = application of monensin
---------- = oocyst counts in young stock

Figure 3. Influence of monensin (150, 75, 100 mg/kg pellets) on oocyst shedding of chamois.

continuously in the ration, in the springtime of 1982 the number of oocysts shed by the young stock increased, but neither maximal oocyst counts nor clinical symptoms were observed, nor was any chemotherapy necessary (Fig. 3b).

Similar results were seen in the other species of ruminants fed with monensin-medicated rations, i.e. palatability of 150 mg/kg medicated food was lessened, but oocyst excretion terminated. Mouflon and ibex were especially resistant to the medicated pellets, whereas antelopes and gazelles accepted the medicated ration. The use of monensin at the rate of 75 mg/kg pellets resulted again in increased oocyst counts, whilst 100 mg/kg medicated pellets resulted in good effects, both in regard to palatability and to coccidiostatic efficiency. During the 3-year period of using monensin, no losses by intoxication or secondary effects, or reduced fertility could be observed.

Discussion

Data described in the literature concerning the prophylactic use of monensin in ruminants cannot be compared with our results without reservation. According to our experience, feeding monensin at the rate of 1 mg/kg body weight, given over periods up to 10 months is effective in controlling coccidisis of wild ruminants under certain conditions in zoological gardens. This dosage approaches the 0.8-1.6 mg/kg body weight recommended for monensin in lambs and 1.0 mg/kg in calves.[2,3,6,7,8,13,14,21] In contrast to the experience in lambs and cattle, unpalatability of the medicated ration must be considered in many species of zoo ruminants. The best results were obtained by offering the medicated ration at a rate of 100 mg/kg pellets. It should be noted that individually in all species, intake of the medicated feed could not be controlled, particularly if animals were kept in groups in large enclosures. It therefore cannot be discounted that some of the animals had a higher intake of monensin than the average of 1 mg/kg body weight, although no losses by monensin toxicity, nor secondary effects, nor reduced fertility could be observed during the 3-year period.

Of the five species of coccidia to affect wild chamois in the alpine region, four species were identified in our stock.[17] This can be explained by the fact that the breeding stock of the herd was captured in the wild.

The fact that even three years of permanent use of monensin could not eliminate coccidia in the ruminants may be desirable because it results in minor infection of the stock, aiding in developing immunity without clinical symptoms, as is well known in poultry.[17] The drug monensin proved to be suitable for control of coccidiosis in various species of ruminants kept in Tierpark Hellabrunn. Development of resistance—as observed in many other coccidiostatic compounds—is not reported for monensin so far. This problem could be avoided by changing the coccidiostatic drug from time to time.

Summary

Intestinal coccidiosis of wild ruminants in Tierpark Hellabrunn caused frequent losses of young stock, particularly in chamois. Individual chemotherapy with sulfonamides was successful, but could not solve the problem in groups of animals, kept on large areas.

The pelleted food was medicated with monensin at three levels, 75, 100 and 150 mg/kg, and was offered over periods of 5-10 months in effective doses of about 0.75, 1.0 and 1.5 mg monensin/kg body weight. Satisfactory results were obtained when feeding 1 mg/kg body weight in nine species of wild ruminants, with regard to coccidiostatic effect and palatability of the medicated food. During three years of use of monensin, no toxicities nor symptoms of incompatability were observed.

Acknowledgement

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Products Mentioned in Text

a. Theracanzan—Therapogen, MSD
b. Socatyl—Ciba-Geigy

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