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Short communication

Efficacy of treatment of elevated coccidial oocyst counts in goats using amprolium versus ponazuril

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ABSTRACT

Coccidiosis is an important disease of young goats leading to weight loss, diarrhea, and death. In the USA, both ionophores and decoquinate are labeled for prevention of coccidia in goats. However, there are no drugs approved for treatment of clinical cases of coccidiosis in this species. Amprolium is labeled for treatment of coccidiosis in calves while ponazuril, a metabolite of toltrazuril, is labeled for treatment of equine protozoal myeloencephalitis. In this study, 150 young goats housed on concrete lots had fecal samples collected and McMaster fecal oocyst per gram counts performed at 0, 7, 14, and 21 days post-processing. Goats were randomly assigned to receive either amprolium (50 mg/kg once a day for 5 days by mouth) or ponazuril (10 mg/kg by mouth once) if they had fecal oocyst counts >5,000 per gram. Fecal samples were obtained and oocyst counts performed at days 7, 14, 21, and 28 after the cessation of treatment. Goats were weighed on days 0 and 21 post-processing. Seven goats were enrolled into the amprolium group and 8 into the ponazuril group. Both treatments resulted in decreased oocyst counts post-treatment compared to before treatment. There was no significant difference between fecal coccidian oocyst counts between goats in each group. There was no significant difference in body weight between goats in each group. This study showed that both amprolium and ponazuril were effective in decreasing fecal coccidia oocyst counts in this group of goats. Use of both drugs is currently extra-label in the USA.

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1. Introduction

Coccidiosis, caused by *Eimeria* species, is a common cause of diarrhea, weight loss, and ill thrift in 2–4 month old goats worldwide. The most common species encountered in the USA are *Eimeria arloingi, Eimeria christenseni, Eimeria ninakohlyakimovae*, and *Eimeria alijevi* (Chartier and Paraud, 2012; Foreyt, 1990). Clinical coccidiosis occurs as a result of ingestion of large numbers of sporulated oocysts and/or asexual multiplication in the host as a result of decreased resistance of the animal (Chartier and Paraud, 2012). High stocking rates, poor hygiene, and stress from weaning, feeding, weather, and transport can all contribute to decreased disease resistance (Foreyt, 1990). Coccidiostats, both ionophores and decoquinate, are approved in the USA for prevention and control of coccidia in goats when pre-mixed in feed. There are, however, no drugs approved for treatment of coccidia in goats.

Amprolium, which is effective against the later stages of infection (Chartier and Paraud, 2012), has been previously investigated in goats (Iqbal et al., 2013; Young et al., 2011). A dosage of 50 mg/kg orally for 5 days resulted in a significant decrease in fecal oocyst counts and improved clinical appearance (Young et al., 2011) compared to a 10 mg/kg dosage. Toxic levels of amprolium (600 mg/kg) (Horino et al., 1994) have induced cerebrocortical necrosis in sheep (Foreyt, 1990) and cattle (Horino et al., 1994).

Triazinones are approved in other countries for the treatment of coccidiosis in sheep and cattle. These drugs act on all stages of the parasite life cycle and only require a single treatment, thereby, improving client compliance and decreasing handling stress on the animals. Diclazuril was shown to decrease oocyst counts and increase growth rates in goats at both 1 and 2 mg/kg when given once at 3 weeks or at 3 and 5 weeks of age (Ruiz et al., 2012). Toltrazuril has been shown to be more effective and provided

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a longer duration of action against *Eimeria* oocysts compared to diclazuril when used therapeutically or metaphylactically in sheep field type trials (Mundt et al., 2009; Diaferia et al., 2013). Toltrazuril resulted in a complete reduction in fecal oocyst counts by 7 days after treatment compared with 21 days for amprolium treatment for coccidia in goats (Iqbal et al., 2013).

Ponazuril is a metabolite of toltrazuril (Dirikolu et al., 2008) and is approved in the USA as Marquis™ (Bayer, Shawnee Mission, KS). Ponazuril is labelled for the treatment of equine protozoal myeloencephalitis (EPM) in equines and has been shown to have good oral bioavailabilty when administered at 5 mg/kg for the purpose of treating *Neospora caninum* in cattle (Dirikolu et al., 2008). The use of ponazuril in goats is extra label in the USA. The aim of this study was to evaluate the efficacy of a single dose of ponazuril as a treatment for coccidiosis in goats compared to 5 days of treatment with amprolium.

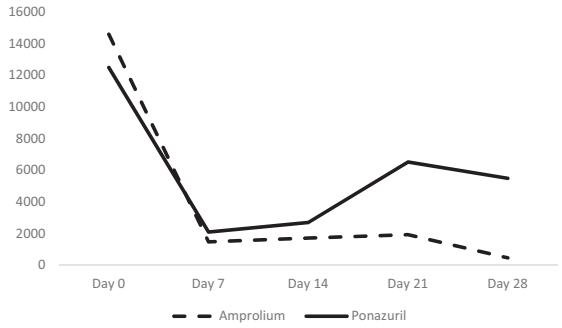
2. Materials and methods

Meat type 2–4 month old goats (150 total) were obtained from a sale barn. The goats were housed on concrete lots with shelter at Texas A&M University in 3 groups of 50 animals. They were fed coastal Bermudagrass hay and a non-medicated pelleted goat feed starting at 0.25 lb per head and increasing to 0.5 lb per head after 2 weeks. Water was available at all times.

Two days after arrival (Day 0) feces were collected from the rectum, ocular mucus membrane color was assessed using the FAMACHA scoring system, and the goats were ear tagged and weighed. The goats were also given tulathromycin as a prophylactic antimicrobial against respiratory pathogens (Draxxin™, Zoetis, Kalamazoo, MI), administered fenbendazole (Panacur™, Intervet, Madison, NJ) orally at 10 mg/kg, and vaccinated with *Clostridium perfringens* Types C and D and *Clostridium tetani* toxoid vaccine subcutaneously. A McMaster quantifiable egg per gram count was performed on all fecal samples and the number of strongyle type eggs and coccidia oocysts per gram were calculated. Briefly, the McMaster count was performed by adding 2 g of feces to 28 ml of standard commercially available floatation solution (Feca-Med™, VetOne, MWI, Boise, ID). The fecal pellets were disrupted dispersing oocysts into the solution and an aliquot pipetted onto a grid slide (Chalex Corporation, Portland, OR) where the number of oocysts were counted. Counts in excess of 20,000 oocysts per gram of feces were recorded as >20,000. The fecal consistency was recorded as pelleted (score = 1), soft to pasty (score = 2), or liquid diarrhea (score = 3).

Additional fecal sampling was conducted on day 7, 14, and 21 post-processing for goats not already enrolled in the study. Goats were enrolled in the study if the fecal coccidia oocyst per gram count was >5,000 at processing (day 0) or at day 7, 14 or 21 post-processing. They could also be enrolled if they developed diarrhea between fecal collection days and the coccidia count was >5,000. Goats enrolled based on fecal oocyst count (FOC) at processing (day 0) were randomly assigned to either the amprolium (A) or ponazuril (P) group using a random number generator. Goats that were enrolled on subsequent days were enrolled alternately into the A or P group.

The goats in group A were given 50 mg/kg of amprolium (Corid™ 9.6%, Merial, Duluth, GA) administered orally once daily for 5 days. Goats in group P were given 10 mg/kg ponazuril (Marquis™ 150 mg/ml, Bayer, Shawnee Mission, KS) orally. Treatment was administered as soon as the goats were enrolled based on FOC. Fecal samples were collected from the rectum 7, 14, 21, and 28 days following cessation of treatment for each enrolled goat. Goats in Group A had fecal samples collected starting 7 days after the last dose. If feces could not be obtained, collection was attempted the following 2 days. Fecal scoring and McMaster oocyst per gram counts were performed on the fecal samples. At day 21 post-processing, a pooled fecal sample was obtained from the goats and kept at room temperature for 5 days to allow for oocyst sporulation and speciation. The proportion of each coccidia species was not determined. Goats enrolled in the treatment groups were weighed again at 21 days post-processing. This study was approved by the Institutional Animal Care and Use Committee at Texas A&M University.



		Day 0	Day 7	Day 14	Day 21	Day 28
Amprolium	mean	14579	1467	1709	1919	460
	SD	5724	1842	1615	2826	867
Ponazuril	mean	12478	2089	2694	6511	5479
	SD	6232	2209	3195	8018	6992

Fig. 1. Mean coccidia (±SD) oocyst count per gram for goats treated with amprolium or ponazuril before treatment (Day 0) and every 7 days following cessation of treatment.

Statistical analyses were performed using Intercooled STATA v12. Fecal oocyst counts recorded as >20,000 were capped at 20,000 for analysis purposes. The Shapiro–Wilk test was performed to assess normality for fecal oocyst counts ($p > 0.05$) and weights ($p > 0.05$). Differences in fecal oocyst counts were assessed using a repeated measure ANOVA, which allowed for the evaluation of oocyst counts between groups and between time points. Differences in weights between the two groups were assessed upon enrollment and at 21 days post-processing using a two-tailed *t*-test. Significance testing was set at $p < 0.05$.

3. Results

Fourteen goats were originally enrolled in each group. Seven were then excluded from Group A and 5 from Group P due to inaccurate oocyst counts or problems with sample labeling. In the amprolium group, 4 animals were enrolled based on fecal oocyst counts >5,000 at the first collection and 4 enrolled based on counts >5,000 on day 7 post-processing. In the ponazuril group, 5 animals were enrolled at day 0 (first collection), 2 at day 7, 1 at day 14, and 1 developed diarrhea and had a fecal oocyst count of >5,000 between day 14 and day 21 collections. In total, 5 fecal samples (one from group A on day 7 and 2 each from group A and P on day 28) were unable to be collected.

The mean coccidia oocyst count for each group at each week of the study is displayed in Fig. 1. The oocyst counts at enrollment ranged from 6300 to >20,000 for Group A and from 5350 to >20,000 for goats in Group P. Goats in both treatment groups, with the exception of 1 goat in Group P, had fecal oocyst counts below 5000, 7 days after finishing treatment. Overall, there were decreased oocyst counts for both treatment groups over the course of the study ($p < 0.001$). However, there was no significant difference in fecal oocyst counts between Groups A and P ($p = 0.1571$), with the treatment by-time interaction also not significant ($p = 0.2930$).

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