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Garlic as an Alternative Anthelmintic in Sheep

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ABSTRACT

An increase in the anthelmintic resistance of parasites in small ruminants and a push towards non-chemical farming has lead researchers to search for alternative forms of anthelmintics. The efficacy of treating sheep by using natural garlic extract with respect to changes in weight, fecal egg counts (FEC), and packed cell volume (PCV) was investigated. Sheep were treated every 4 weeks for 8 weeks with saline (control), Ivermectin, or natural garlic extract and samples were collected weekly to determine FEC and PCV. Sheep were weighed at the time of sample collection to determine weight change. There were no significant differences between the Ivermectin and natural garlic extract treated sheep with respect to weight changes, FEC or PCV. The Ivermectin and natural garlic extract treated sheep had significantly greater ($P < 0.05$) weight changes and PCV compared to the control. The control sheep had a significantly higher ($P < 0.05$) FEC compared to the Ivermectin and natural garlic extract treated sheep. Administering natural garlic extract as anthelmintic is a variable alternative to Ivermectin.

INTRODUCTION

Small ruminant gastrointestinal nematodes potentially reduce production and cause profit loss throughout the sheep industry (Perry and Randolph, 1999). Traditionally, producers have used commercially available anthelmintics (benzimidazoles, imidazothiazoles-tetrahydropyrimidines, and avermectins-milbemycins) to control parasites. However, an increase in the anthelmintic resistance of parasites is currently a serious threat and research is being done to find alternative forms of anthelmintics (Larson, 2006). The societal push towards non-chemical (eco-friendly, green, organic) farming has also hastened the search for viable alternatives to chemical anthelmintics (Waller and Thamsborg, 2004).

Haemonchus Contortus, often referred to as the "barber pole" worm, punctures the lining of the abomasum, causing blood plasma and protein loss in sheep. Since it is usually the most prevalent nematode parasite in sheep and causes the most destruction, a majority of the research in alternative forms of anthelmintics has been targeting *H. Contortus*. Copper oxide wire particles administered to sheep have been shown to reduce the number of *H. Contortus* strongyle eggs shed in lambs (Burke et al., 2004) as well as pregnant ewes (Burke et al., 2005). Developing vaccinations against parasites is becoming a reality with the use of recombinant protein-based vaccines (Knox, 2000), however the economical availability of such vaccines to producers is

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currently not a possibility.

Additional research has shown that feeding forages high in tannin content reduces the fecal egg counts (FEC) and number of worms in goats (Shaik et al., 2006). Strong evidence suggests that using chlamydospores (nematode ingesting fungi) as an anthelmintic in sheep is very successful (Fontenot et al., 2004) however it has not been shown to target *H. Contortus*. Although not an alternative treatment, research indicates that breeding and selecting for ewes with higher genetic merit for growth as lambs, and lambs with higher genetic merit for body weight, were all more resistant to infection as adults (Vanimisetti et al., 2004).

Any novel treatment needs to easily be incorporated into a producers flock management and be economically feasible (van Wyk et al., 2006). The current techniques available to test the efficacy of any treatment are serology testing, the FAMACHA chart based on the color of the eye membrane mucosa (measures relative levels of anemia) (van Wyk and Bath, 2002), and FEC (Cringoli et al., 2004). Novel treatments and management systems should be able to be evaluated using the above techniques.

Therefore, the objectives of this study were to compare the use of natural garlic extract to Ivermectin as an anthelmintic for sheep with respect to, 1) change in body weight (BW), 2) FEC, and 3) packed cell volume (PCV) based on serology analysis.

MATERIALS AND METHODS

Experimental Site and Treatment Groups

This study was carried out at the Ferrum College Agriculture Center in Ferrum, Virginia (36º92'N), between May and September 2009. The experimental site was at an altitude of 430 m and consisted of a 0.5 ha plot containing a clean fescue and orchard grass mix. Free access to unlimited water was available throughout the study.

A total of 14, 90-d sheep (American black-faced) ranging from 18 to 32 kg (average = 26 kg) were randomly assigned to receive orally either saline (control), natural garlic extract (Garlic Barrier, Glendale CA, 1 teaspoon/head), or Ivermectin (Merial Ivomec, Atlanta GA, 42 mg/kg bodyweight). All sheep were treated on week 0 and week 4 of the 9 week study. Samples were collected each week for analysis.

Body Weight Measurements

Sheep were weighed weekly using an electronic scale (A and A Scales LLC, Prospect Park, NJ, USA) to monitor changes in BW.

Fecal Egg Counts

Feces were taken rectally using the gloved hand method and stored at 4˚ C until analysis. All FEC were performed using the McMaster method (Cringoli et al., 2004). Briefly, approximately 4.0 g fecal material was placed in a 50 mL graduated cylinder and Sodium Nitrate (1.2 – 1.25 specific gravity) was added to bring to final volume to 26 mL. The solution was homogenized, filtered through 2 layers of cheesecloth, and immediately 1.0 mL of resulting solution was placed on a McMaster slide. The slide was incubated at room temperature for 5 min to allow the eggs to float to the top of the solution and strongyle eggs were counted at 100X using a compound light microscope.

Immune Response

Whole blood was obtained via jugular venipuncture (BD Vacutainer, 12 mg EDTA, Franklin Lakes, NJ) at stored at 4˚C until analysis. The PCV was determined using microfuge hematocrit tubes.

Statistical Analysis

The experiments were set up as complete randomized designs and the data were analyzed using the general linear model (GLM) procedure in SAS (SAS Institute, Cary, NC, USA). The effects included in the model were treatment and time. There was no significant effect for time and it was dropped from the final model. Significance between treatments was analyzed using the least-square means (LSMEANS) statement with the possible probability values (PDIFF) options. In all analyses, $P < 0.05$ was considered significant. Results are expressed as the least-squares mean ± s.e.m.

RESULTS

Body Weight Measurements

There was no significant difference between the change in BW of the natural garlic extract treated sheep (0.23 ± 0.17 kg) when compared to the Ivermectin treated sheep (0.36 ± 0.15 kg). The natural garlic extract and Ivermectin treated sheep were significantly heavier ($P < 0.05$) than the control sheep (-0.26 ± 0.17 kg) (Figure 1).

Fecal Egg Counts

There was no significant difference between any of the treatment groups at the first week, prior to treatment administration. Throughout the remainder of the study, there was no significant difference in the FEC of the natural garlic extract treated sheep (1805.0 ± 613.0 eggs/g feces) when compared to the Ivermectin treated sheep (863.0 ± 548.0 eggs/g feces). The control sheep had significantly higher ($P < 0.05$) FEC (4993.0 ± 613.0 eggs/g feces) than the natural garlic extract and Ivermectin treated sheep (Figure 2).

Immune Response

There was no significant difference in the PCV between any of the treatment groups at the first or second week of the study. Throughout the remainder of the study, there was no significant difference in the PCV of the natural garlic extract treated sheep (25.5 ± 1.1 %) when compared to the Ivermectin treated sheep (27.5 ± 1.0 %). The natural garlic extract and Ivermectin treated sheep had significantly higher ($P < 0.05$) PCV than the control sheep (18.9 ± 1.1 %) (Figure 3).

DISCUSSION

The results presented in this paper compare the use of a commercially available anthelmintic (Ivermectin) to the use of a non-chemical alternative (natural garlic extract) in the parasite management of sheep. As sheep producers continue to see an increase in anthelmintic resistant parasites in their flocks, there is an increased demand to find alternatives to the current practices (Larson, 2006). Our results indicate that by administering natural garlic extract (Garlic Barrier) orally using the same time guidelines as the commercial anthelmintics there were no significant differences in BW, FEC, and PCV compared the commercially treated sheep.

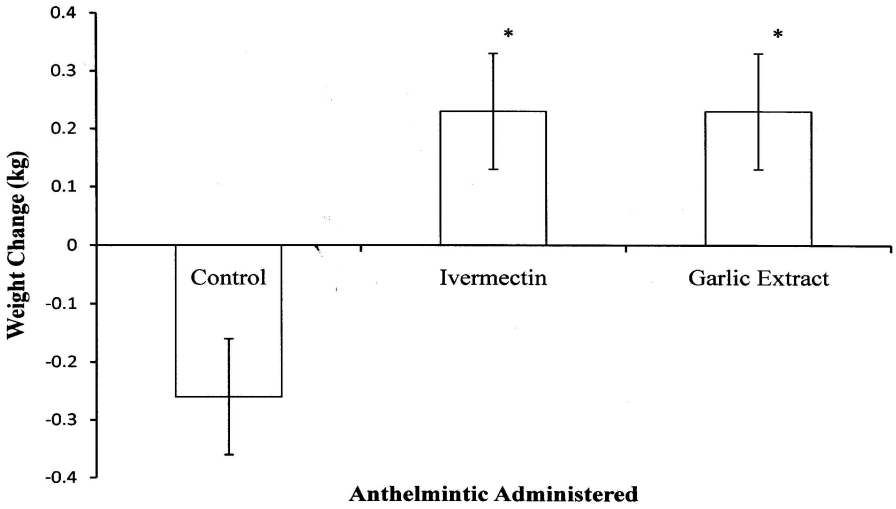

FIGURE 1. Effect of anthelmintic administered every 4 weeks on weight change (kg) after 8 weeks. Data are expressed as mean ± SEM. *Means with different superscripts differ at least $P < 0.05$.

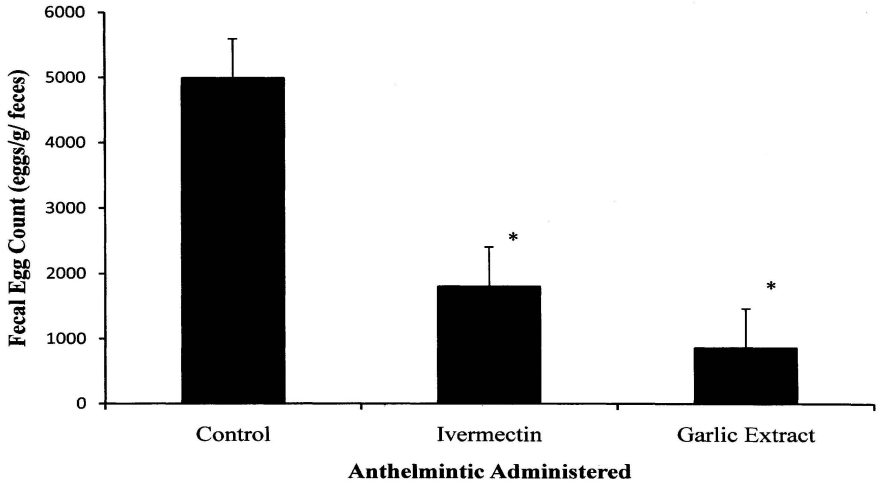

FIGURE 2. Effect of anthelmintic administered every 4 weeks on fecal egg count (FEC) (eggs/g feces) after 8 weeks. Data are expressed as mean ± SEM. *Means with different superscripts differ at least $P < 0.05$.

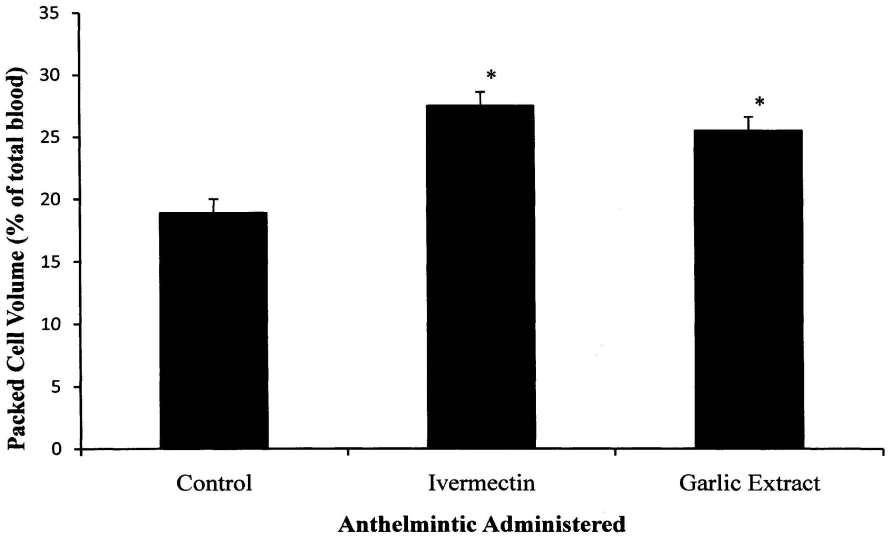

FIGURE 3. Effect of anthelmintic administered every 4 weeks on packed cell volume (PCV) (% of total blood volume) after 8 weeks. Data are expressed as mean ± SEM. *Means with different superscripts differ at least $P < 0.05$.

Throughout the experiment we observed that there was no significant change in BW between sheep that were administered natural garlic extract and those that were administered Ivermectin. The sheep that were not treated with an anthelmintic lost weight compared to the other treatment groups, most likely due to the increase in parasite load. This is advantageous to the producer because they could implement using only natural garlic extract instead of the commercially available anthelmintic (Ivermectin) and still achieve the same rates of production (Perry and Randolph, 1999).

We observed the same trend with the PCV in response to treatment groups. We believe that the low PCV in the untreated group was due to an immune response. Elevated levels of *H. Contortus* in the abomasums can cause a decreased immune response thus leading to a loss in blood plasma, serum protein, and decreased PCV (Scharenberg et al., 2008). Our results are in agreement with previous studies that show not treating sheep with anthelmintics causes a decrease in PCV and the symptoms can be eliminated by treating with commercially available anthelmintics (Yacob et al., 2009).

Little scientific research has been conducted on using garlic as an anthelmintic in sheep, but it is thought that garlic does not prevent the production of parasite eggs but rather the hatching of eggs into larvae (Bastidas, 1969). Our results are in agreement with this hypothesis, as we observed no difference in FEC between the garlic extract and commercially available anthelmintic treatment groups.

Our results indicate that using garlic extract as an oral anthelmintic in sheep is a viable option to commercially available chemicals. Further research still needs to be done to determine if there is a dose response and the most economical dose without losing its effect. A better understanding of the specific mechanism of action of garlic in the animal and the immune system could lead to future solutions to controlling anthelmintic resistant parasites in small ruminants.

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