Cost-benefit of Anthelmintic Protocols in Naturally Infected Sheep

Alexandre Balzan¹, Chrystian Jassana Cazarotto¹, Gustavo Machado², Rhayana Kharyna Grosskopf³, Flavio José Simioni², Lenita Moura Stefani¹ & Aleksandro Schafer Da Silva¹

ABSTRACT

Background: Gastrointestinal nematode infections are a major problem for sheep production, leading to large economic losses as a result of the high costs for prevention and treatment. In helminthiasis, the most common clinical signs are weight loss, submandibular edema, diarrhea, and anemia. Among the many nematodes, stands out in the Brazilian states Haemonchus contortus and Trichostrongylus colubriformis, as well as these parasites have developed a number of anthelminthic resistance. Therefore, the aim of this study was to evaluate the cost-benefit of different antihelminthic protocols in naturally infected sheep.

Material, Methods & Results: The study was conducted for one year in a sheep farm located in Southern Brazil. Three groups (A, B and C) with 10 adult sheep each were used. The group A was treated without drug rotation, and levamisole hydrochloride was used at intervals of 60 days. The group B was treated with levamisole hydrochloride at months 2, 4, 8 and 12 and albendazole at month 6 (antiparasitic treatment with pharmacological rotation). Animals from the group C were treated after selection by the Famacha method, which is based on the degree of anemia of their mucous ocular membranes. The results showed that the animals of the group C had lower values of eggs per gram of feces (EPG), and thus, they were treated more efficiently. The main genera of the Trichostrongylidae family observed in this study were Haemonchus, Trichostrongylus, and Teladorsagia, but were no difference between groups related to the percentage of helminths the Trichostrongylidae family. Furthermore, it was found that the cost of anthelmintic protocols used for groups B and C was 7.4 and 49.6% less than the cost of the methods used in the group A, respectively. We have noted that if all the animals were treated based on the Famacha method with levels 4 and 5, only 20 (group A) and 22 (group B) animals would have received treatment, which characterizes an unnecessary cost of 66.6 and 63.3% for group A and B, respectively. The group C showed the lowest number of eggs per gram of feces, indicating greater treatment efficiency when compared to group A.

Discussion: Some methods are used to control nematodes including Famacha, which is related to hematophagous helminths and its most significant advantage is the reduction of the number of treatments needed, reducing the chances of helminthic resistance, as observed in the current study. In this research it was found that the EPG counts were reduced after treatment, but it was not zero in most animals, which indicates a degree of resistance. The resistance can be defined as the decrease in the efficacy of a drug against the parasite population that is generally susceptible, an evident fact in this study for H. contortus and Trichostrongylus sp. According to researchers, resistant parasites are probably in a lower number, but the selection pressure exerted by a given drug may favor the increase of resistant on individuals in the same population of parasites that were originally susceptible to the treatment. Therefore, the existence of an anthelmintic treatment program is important in a herd, in order to delay the occurrence of resistance and for better production performance. The Famacha method minimizes the use of antihelmithics and in addition, it mitigates the possibility of drug residues on meat, milk and the environment. Therefore, it is possible to conclude that the Famacha method showed the best cost-benefit response, with lower treatment costs to producers, and consequently, it minimized the chances of drug residues in animal products and in the environment.

Keywords: nematodes, Famacha method, cost-effective.
INTRODUCTION

Brazil has approximately 13.8 million sheep, and the state of Santa Catarina has approximately 203,000 animals primarily related to meat production [3]. Gastrointestinal helminths constitute a major problem for sheep production, resulting in economic impact due to high costs to prevent and to treat infected animals, which may reach 1.4 billion a year, without considering costs with mortality, especially of young animals [1].

The hemonchosis is caused by *Haemonchus contortus*, a hematophagous parasite that leads to high mortality in sheep [4,6]. However, other species of helminthes are commonly found in mixed infections such as: *Trichostrongylus colubriformis*, *Cooperia* spp., and *Oesophagostomum* spp. [6,7]. In helminthiasis, the most common clinical signs are weight loss, submandibular edema, diarrhea, and anemia [7,10]. These pathological changes in sheep can be controlled by anthelmintics through different therapeutic protocols. However in most farms, sheep are treated only when presenting clinical signs of the disease and many may have died by then, since the parasitic resistance is a constant problem [4]. Alternative methods for the control of helminths are used in many Brazilian farms, like the Famacha method [8].

The Santa Catarina state it was reported that sheep farms had serious problems of parasite resistance [4]. The use of inadequate methods and drugs in combating worms has generated unnecessary burden to producer, which can be minimized with a good antiparasitic treatment program. Therefore, the objective of this study was to evaluate the cost-benefit of antiparasitic protocols in naturally infected sheep.

MATERIALS AND METHODS

Animals

The study was conducted in a sheep farm located in Chapecó (Southern Brazil) for one year, beginning in January (defined as month 1) and finalized in December 2013 (defined as month 12). Three groups (A, B and C) with 10 adult sheep each received anthelmintic treatment [Albendazole (Albendathor 10®), 5.0 mg kg⁻¹] two days before starting the experiment after stool examinations. The animals of all groups were monitored at 30 day intervals, as described below.

Experimental groups

For animals in the group A we followed an anthelmintic protocol commonly used in Santa Catarina state, i.e. herd treatment without drug rotation in a pre-established period with intervals of 60 days. The drug used was levamisole hydrochloride (Ripercol®) by the oral route at a dose recommended by the manufacturer (5.0 mg kg⁻¹).

The sheep that formed the group B were treated with an antiparasitic protocol with drug rotation and treatment of all animals at pre-established intervals, similarly to the group A. The anthelmintics levamisole hydrochloride (months 2, 4, 8 and 12) and albendazole (month 6) were used orally at a dose of 5.0 mg kg⁻¹ each.

The anthelmintic treatment of the group C was based on the Famacha method using a well-known methodology [8]. Animals from this group were treated with levamisole hydrochloride at a dose of 5.0 mg kg⁻¹ when showed anemia level of 4 and 5 in the Famacha card. Animals with level 3 were also evaluated according to their body condition score, and since all showed good or excellent body condition they were not treated.

Sample analysis

All animals in this experiment had fecal samples collected at intervals of 30 days (months 1-12), and at this day they were examined by the Famacha method [8], in order to verify their health condition, mainly looking for signs of anemia. The results of the Famacha method were tabulated and used in the statistical analysis to determine how many times the animals in the groups A and B were treated unnecessarily, and thus define how much could have been saved with treatments. Fecal analyses were performed by the McMaster technique, which determines the number of eggs per gram of feces (EPG) in each animal. From each group, a larval culture was performed to identify the genera of parasites involved in the study, and also to evaluate the occurrence of parasitic resistance.

Cost-benefit analysis

The economic evaluation of different protocols for anthelmintic control was performed by considering the costs of each treatment (number of doses and dose value) associated with the results obtained from parasite control (EPG values, degree of anemia (Famacha), and anti-drug resistance), and thus, identify the relation of the anthelmintic efficacy protocol, and treatment costs.
Statistical analysis

Initially, a descriptive analysis was performed to measure the distribution of the variables in the study. The data distribution was checked for normality, through of a histogram, and thereafter by Shapiro-Wilk hypothesis, and homoscedasticity by Levene’s test. In case of violation of normality the data was transformed by log(x) in order to meet the assumptions of parametric data. In order to compare the variation on EPG results throughout the year between the studied factors such as months of the year, treatment criteria used, and treatment efficiency, the analysis of variance (ANOVA) for repeated measures was performed in blocks (groups A, B, and C). In addition, any EPG result equal to zero was replaced by the mean value for the respective group. Finally, a post hoc test was conducted to evaluate pair statistical differences between groups using the statistical program R, v.2.15.2 (R Development Core Team, 2012).

RESULTS

Considering the experimental period of one year, it can be observed by analysis of variance for repeated measures, statistical differences on treatment efficiency for each animal in its group (F:8.73, df:1, \( P = 0.003 \)), i.e., treated animals showed reduced EPG counts (Figure 1). Differences were observed between groups B and C when taken into account their score according to the Famacha method (Figure 2-A) (F: 3.07, df: 2, \( P = 0.04 \)), as well as difference on EPG counts among related groups selected by the Famacha method (F:7.20, df: 2, \( P < 0.001 \)) (Figure 2-A). At the same time, there was significant differences in EPG counts throughout the year (F:5.31, df:11, \( P < 0.001 \)). In addition, post hoc analyses showed differences between groups A and B (\( P = 0.04 \)), as well as between groups A and C (\( P < 0.001 \)). However, there were no differences between groups B and C (\( P = 0.09 \)) (Figure 2-B). On this study we were able to verify statistically (\( P = 0.02 \)) which animals were correctly treated due to a need proved by high EPG counts (Figure 2-B).

The main genera of the Trichostrongylidae family observed in this study were *Haemonchus*, *Trichostrongylus*, and *Teladorsagia* (Figure 3). However, the genus *Haemonchus* was the most prevalent in all months, except in the winter (months 5 to 9 - May through September), when *Trichostrongylus* spp. was found in all groups (Figure 2), especially in the coldest month of the year (month 7 - July). There was no difference between groups related to the percentage of helminths the Trichostrongylidae family.

Animals from the groups A and B have received 60 doses of anthelmintic drugs on a two month interval compared to animals from the group C that have received only 29. Based only on the cost of the antiparasitic drugs we found that the treatment used on the group A was the most expensive. These analyses also showed that the anthelmintic protocols used to treat animals from groups B and C was 7.4 and 49.6% cheaper than the cost to treat animals of the group A, respectively.

We have noted that if all the animals were treated based on the Famacha method with levels 4 and 5, only 20 (group A) and 22 (group B) animals would have received treatment, which characterizes an unnecessary cost of 66.6 and 63.3% for group A and B, respectively. The group C showed the lowest number of eggs per gram of feces, indicating greater treatment efficiency when compared to group A (Figure 2-B).

**Figure 1.** Mean and standard error of the number of eggs per gram of feces (EPG) of sheep in the groups A, B and C throughout the experiment. Month zero (0) corresponds to the analysis performed prior to the study. There was no statistical difference (\( P > 0.05 \)) between groups on different months, however it was verified by analysis of variance for repeated measures that there was difference regarding the efficacy of treatment for each animal on its own group (F:8.73, df:1, \( P = 0.003 \)), i.e., treated animals reduced the EPG counts.
DISCUSSION

Some methods are used to control nematodes including Famacha, which is related to hematophagous helminths and its most significant advantage is the reduction of the number of treatments needed, reducing the chances of helmintic resistance [8], as observed in the current study. In this research it was found that the EPG counts were reduced after treatment, but it was not zero in most animals, which indicates a degree of resistance. The resistance can be defined as the decrease in the efficacy of a drug against the parasite population that is generally susceptible [9], an evident fact in this study for *H. contortus* and *Trichostrongylus* sp. According to researchers, resistant parasites are probably in a lower number, but the selection pressure exerted by a given drug may favor the increase of resistant on individuals in the same population of parasites that were originally susceptible to the treatment [5]. Therefore, the existence of an anthelmintic treatment program is important in a herd, in order to delay the occurrence of resistance and for better production performance.

The Famacha method minimizes the use of anthelmithics and in addition, it mitigates the possibility of drug residues on meat, milk and the environment [8]. These facts were confirmed in the present study since the group C had the lowest cost treatment (49.6%) followed by the group B (7.4%) compared to the group A, being the latest the most expensive. According to researchers the use of the Famacha method may save the use of anthelmintics, especially for those farmers that usually deworm 100% of the herd at fixed intervals of 30 or 60 days [2]. This study reinforces previous reports that the use of Famacha method indicates that only 35% of all doses (groups A and B) indeed needed to be administered. Therefore, it can be said that the groups A and B had unnecessary costs of approximately 65% compared to group C (Famacha method). A study found a reduction of 93.41% in the use of anthelmintics in sheep when the group was treated by the Famacha in comparison to other groups with treatments at every 30 to 60 days [11].

Figure 2. Relation between EPG values and the degree of anemia based on the Famacha method in different groups during the 12 months of the experiment (2-a). EPG distribution correlated to factor i.e. treated animals showed higher EPG values, and throughout experiment the mean in EPG counts of each group can be viewed (2-b).

Figure 3. Percentage of helminth of the Trichostrongylidae family (*Haemonchus* spp., *Trichostrongylus* spp., and *Teladorsagia* spp.) in each group throughout the experiment.
CONCLUSIONS

Therefore, we conclude that the Famacha method leads to significant savings to farmers by reducing the use of anthelmintic drugs. Furthermore, the animals subjected to this protocol showed lower EPG count, absence of clinical signs of disease, and the drug was not used unnecessarily. However, this protocol requires constant management by trained personnel to decrease errors, and consequently, death of animals between deworming intervals.

REFERENCES


