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Efficacy of Neem Extract and Cydectin Used as Treatments for the Control of Gastrointestinal Parasites in Sheep

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Abstract

Small ruminants, such as sheep in The Caribbean, are affected by an incidence of gastrointestinal (GI) parasites. Many such parasites negatively affect sheep's productivity and significantly reduce the economic viability of livestock. Parasite control, commonly by anthelmintic medication (such as Cydectin), is limited by the cost of treatment. Additionally, some herds have been infected with helminths resistant to multiple drugs. Therefore, smaller-scale livestock farmers require an alternative treatment form to control GI parasites. This research was carried out on the farmland of the livestock farm of The Bahamas Agricultural and Marine Science Institute (BAMSI) in North Andros, Bahamas. In this region, Neem (*Azedarach indica*) is a part of the natural flora. For the present study, ten sheep testing positive for helminth eggs in their feces were chosen and split evenly into two groups (A and B). Groups A and B were treated with neem extract at 0.5mL·kg^{-1} and Cydectin drench at 0.2 mL·kg^{-1} body weight, respectively. The egg count was determined using the modified McMaster technique. Results of the experiment show that neem extract showed significant ($p < 0.05$) reduction in EPG by day 55 and Cydectin found significant ($p < 0.05$) reduction on days 28 and 55. Although not statistically different ($p < 0.05$), Cydectin demonstrated higher efficacy (88.2%) than neem (74.2%) at day 55. Findings from this study suggest that Neem could be an alternative means of effective control treatment against helminths in sheep.

Keywords

Anthelmintic, Caribbean, Neem, Helminth, Gastrointestinal

1. Introduction

Small livestock farms in The Caribbean are affected by an incidence of gastrointestinal (GI) parasites. These farms make up most of the production within the Caribbean livestock industry. Unfortunately, parasitism and parasitosis constitute serious animal health problems that predispose them to other, more serious health conditions [1]. GI nematodes are responsible for economic losses in large ruminants and are characterized by reduced milk production, decreased working efficiency, and even death [2]. Such conditions can reduce their productivity and marketability, reducing their economic values [1]. When needing to treat hundreds or even thousands of heads of cattle, a livestock farmer can quickly expect to spend thousands of dollars on treatment. With most herds, specific helminths such as Oesophagostomum and Trichostrongylus are particularly resistant to multiple drugs [3]. Such resistance requires higher dosages of conventional medicine to be administered to ruminants to suppress helminth reproduction. Therefore, additional medication must be purchased to compensate for poorly affected parasites. Considering these factors, the cost of decreasing the incidence of intestinal parasites can negatively affect the finances of livestock farmers.

Productivity losses cause economic problems for the farmers and weaken the meat production industry [4]. Part of The Bahamas' commitment to the United Nations (UN) small island developing states agenda, its Sustainable Development Goals (SDGs), and 2030 Agenda for Sustainable Development is food security and seeing a drastic reduction in this country's "growing" $1.1 billion food import bill [5]. Therefore, the health of livestock animals used to produce milk, and meat is crucial not only to the farmers' income but also to the sustainability of the country's economy.

In large quantities, medicine (Cydectin in the case of this experiment) can become costly. Therefore, to reduce production costs and practice sustainability, small farmers need a less expensive and effective treatment for controlling GI parasites in livestock animals. The drawbacks of conventional anthelmintics have peaked scientific interest in the use of botanicals to address helminth infestations [6]-[8].

The anthelmintic properties of Azadirachta indica have been observed across journals of parasitology. Typically, administration is in the form of a powder [9]-[12] or oral drench [13]—anthelmintic efficacies of neem range from 34% to roughly 99% [11] [13]. Neem grows naturally in the Bahamas, where this study was done, and in other parts of the Caribbean. These factors make Neem a promising, inexpensive supplement to the anthelmintic regiments of livestock farmers.

2. Materials & Methods

2.1. Site

This research was conducted on the farmland of the livestock section of the Farm of The Bahamas Agricultural and Marine Science Institute (BAMSI), which provides tertiary-level education to its students. BAMSI is located on the Northern portion of Andros Island in The Bahamas and is situated on a settlement 13 minutes away from the capital island of Nassau by plane. The 400-acre Farm integrates both crop and animal production. The animal portion is on approximately 5 acres of land at latitude 24.96394772, longitude −78.0319395. The Farm is home to small ruminants such as sheep and goats, and it utilizes a semi-intensive production system, with small ruminant animals being held in night folds and allowed to graze on 15 pastures in rotation. Neem trees line the central roadways of the Farm.

2.2. Sample

Sheep were chosen as the target ruminants of the experiment. The population comprises sheep dwelling on BAMSI's Farm's livestock section. Sixteen 4-5-month-old male sheep positive for evidence of helminth eggs were chosen as the sample in this experiment. A random subsample of 5 sheep was selected by number tag to be treated with Azadirachta (group A). Another random sample of 5 sheep was selected to be treated with Cydectin (group B).

2.3. Leaf Collection and Preparation

The Neem leaves were gathered from a mature Neem tree and hung in bunches to air-dry for 7 days. The air-dried leaves were grounded using a Hamilton blender and sifted through a 1mm sieve. The ground air-dried leaves were stored in a plastic zip-lock bag.

2.4. Water Extraction

Two hundred fifty milliliters of distilled water were measured using a measuring cylinder placed into an electric kettle and brought to a boil. Then, the kettle was switched off, and 80 g of ground air-dried leaves were immediately added to the heated distilled water and allowed to steep for 5 hours. After 5 hours, the extract of Neem leaves and distilled water was filtered through a 1mm sieve into a plastic bottle rinsed with distilled water. The extract was stored in a lightless refrigerator until further use.

2.5. Flotation Solution

400 g of NaCl and 500 g of cane sugar were measured using an electric kitchen scale and poured into a 2000 mL beaker. One thousand milliliters of distilled water were measured using a measuring cylinder, added to the beaker containing the salt and sugar, and stirred until all the solids dissolved.

2.6. Fecal Collection and Analysis

Fecal samples were collected directly from the rectum of sheep by inducing egestion using a standard technique. The egg count was determined using the modified McMaster technique: Briefly, 56 mL of salt-sugar flotation medium was poured into a beaker containing the fecal sample using a measuring cylinder. The fecal mixture is stirred with a fork to break up the feces. The fecal mixture was filtered into another beaker through a 1mm sieve strainer. Then, the filtrate was stirred using a Pasteur pipette and drawn whilst stirring with the same pipette. The fluid was stirred within the pipette and pipetted into the first chamber of the McMaster slide. Stirring and drawing of the fecal solution was repeated to fill the second chamber of the McMaster slide. The McMaster slide was allowed to stand for at least 5 minutes before examining the chambers of the slide under a compound microscope at 10 × 10 magnification. The eggs within the marked boundaries of the slide for each chamber were counted, and eggs per gram (EPG) was calculated using the formula,

$$EPG = (E_1 + E_2) \cdot 50 \tag{1}$$

2.7. Administration of Anthelmintics to Grouped Subjects

First, the fecal samples of all experimental subjects were collected. Next, the ten (10) subjects were weighed and treated by drench with their appropriate dosages and medicines based on the group. Subjects in treatment Group A were administered Neem extract at 0.5 $mL \cdot kg^{-1}$ body weight. Subjects in treatment Group B were administered Cydectin drench at 0.2 $mL \cdot kg^{-1}$ body weight as prescribed by the manufacturer.

2.8. Analysis of Results

The efficacy of the Cydectin drench and Neem extract was calculated using the fecal egg count reduction (FECR) test according to the following formula,

$$FECR = \left(\frac{Initial\ EPG - Post\ treatment\ EPG}{Initial\ EPG} \right) \cdot 100 \tag{2}$$

The Shapiro-Wilk test was used to assess the normality of the FECR% data for each treatment group. The data was approximately normal. The Two-tailed T-Test was used to compare the mean FECR between treatment groups ($p < 0.05$).

3. Results & Discussion

Table 1. Raw EPG data and subject data for groups A & B.

Treatment	Animal ID	Weight (kg)	Age (months)	EPG			FECR (%)
				Day 0	Day 28	Day 55	
A	90	18	5	2500	200	0	100
	161	17.8	4	1100	600	0	100
	69	13.8	5	1050	350	300	71.4

Continued

	191	15.5	4	400	250	350	12.5
	86	16.3	5	1550	500	200	87.1
	190	16.6	4	500	300	0	100
	150	19	5	1200	400	150	87.5
B	991	26.4	5	300	0	50	83.3
	143	20	5	500	150	150	70
	162	17.2	4	600	0	0	100

Table 1 shows the mean EPG of Groups A and B at day 0 was 1320 ± 680.8 and 620 ± 299.8, respectively. After day 28 post-treatment, the mean EPG was recorded as 380 ±147.3 and 170 ± 156.8, respectively. The results indicated a 61.9% and 75.3% decrease in the EPG in treatment groups A and B, respectively, on day 28 post-treatment. Furthermore, on day 56 post-treatment, the EPG was recorded at 170 ± 144.03 and 70 ± 66 in treatment groups A and B. These results indicate a peak efficacy of 74.2% for Neem extract and 88.2% for Cydectin.

Table 2. Showing mean EPG data FECR of treatments at days 28 and 55 post treatment.

Group	Anthelmintic	Dose ($mL \cdot kg^{-1}$)	Route	Mean EPG Pre Treatment	Mean EPG Post Treatment (FECR)	
					Day 28	Day 55
A	Neem Extract	0.5	Oral drench	1320 ± 347.3^{a}	380 ± 75.2^{a} (61.9%)	$170 \pm 73.5^{a*}$ (74.2%)
B	Cydectin	0.2	Oral drench	620 ± 153^{a}	$170 \pm 80^{a*}$ (75.3%)	$70 \pm 33.9^{a*}$ (88.2%)

Note: a. Values above are mean ± SE of 5 sheep, different superscripts (a and b) differ significantly ($p < 0.05$) from other values in column, *significantly decreased ($p < 0.05$).

According to Villarroel A. (2013), Cydectin, as a registered anthelmintic, has proven to be an effective drug against internal parasites, reaching 100% effectiveness in eliminating 11 species of nematodes, including *Heamochus placei, Ostertagia ostertagi, and Trichostrongylus axei* [14]. Comparatively, Neem has also been known to reach high efficacies. Azadirachta was shown to have 98% effectiveness against Strongyles [10], a mere 2% less than Cydectin. The results of these two experiments suggest that Neem and Cydectin have similar properties. Based on the results of this study (Table 2), it was shown that the efficacy of the Neem extract and the Cydectin drench peaked at 74.2% and 88.2%, respectively, at day 55 post-treatment, which is not agreeable with the studies done by Williams *et al.* (1991) and Jamra *et al.* (2014). However, the findings of this study agrees that the anthelmintic properties of Neem and Cydectin do not differ significantly ($p < 0.05$) across all sampling days. Neem significantly ($p < 0.05$) decreased EPG on day 55 post treatment whereas Cydectin showed a significant decrease on day 28, suggesting that Neem is slower acting.

The results of this study also convey inconsistencies in EPG for individual subjects throughout the experiment which may have caused the disagreement between this experiment and the previously mentioned ones. The EPG of subject 90 was reduced from 2500 on day 0 to 200 on day 28, which is a 92% decrease in EPG and 20.8% above the average efficacy of the neem extract. Results also show that in some animals, there was an increase in EPG at day 55 post-treatment. For example, subjects 991 and 191 experienced an increase in EPG from 0 to 50 and 250 to 350, respectively, at day 55 post-treatment. To the best of our knowledge, studies have evaluated the anthelmintic properties of botanicals and other dewormers over a shorter period, typically 14 - 28 days [15]-[18]. This roughly coincides with the life cycle of many Trychostrongyloids [19]. This study aimed to observe the effects over a longer period, modeled after the deworming practices of the BAMSI farm managers. Coverage of multiple life cycles allows for more irregularities in EPG levels as L1, L2 or L3 larvae outside of the animal at the time of anthelmintic administration would be less affected without pasture treatment. Studies with extended periods display this [20]. However, no such irregularities in EPGs were consistent across subjects suggesting that other factors influenced the changes.

4. Conclusion

This study demonstrated the anthelmintic potential of *Azadirachta indica* in the control of GI parasites with it being similar in efficacy to Cydectin. Further research is necessary to determine specific active chemicals, their lethal and effective dosages, the most effective route of administration and the helminths that are most susceptible to Neem treatments. Furthermore, the effect of neem on the health/productivity of animals affected by helminths needs to be investigated to enhance its usefulness as a control for helminth infection in livestock.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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