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Comparative study of the effects of albendazole and annual mug wort (*Artemisia annua*) powder on gastrointestinal nematodes in cattle

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Abstract

Nowadays, cattle breeding is a major economic issue throughout the world. However, gastrointestinal nematode parasitism remains a major sanitary threat on a global scale, affecting animal health, farm productivity and the well-being of farmers. Until recently, chemical anthelmintics occupied a prominent place in the fight against these parasites. But some of them have developed resistance to antiparasitic drugs. The objective of this study is to compare the anthelmintic effects of commercial albendazole (8.3 mg/kg body weight) and annual mugwort (*Artemisia annua*, 100 mg and 150 mg) powder on gastrointestinal roundworms in cattle. Lots of animals were formed in a population of 92 animals, and underwent different treatments: with albendazole and with annual mugwort powder. The results showed that the artemisia annua powder has a strong inhibition on the nematodes but failed to eliminate them completely. Albendazole, for its part, showed a very effective effect with a 100% elimination of nematodes. These results highlight the possibility of using annual mugwort as an alternative to albendazole on farms.

Keywords: Albendazole; *Artemisia annua*; Parasites; Nematoda; Bovine

1. Introduction

The control of ruminant *strongylosis* has traditionally relied on the repeated administration of synthetic anthelmintic molecules. An ideal anthelmintic drug can be defined as a treatment that is multivalent, non-toxic, rapidly eliminated by the host, easy to administer, and reasonably priced. For many years, synthetic anthelmintics have been effective. However, the use of these molecules is now encountering more and more limitations.

Synthetic anthelmintics are generally metabolized in the animal's digestive tract or by the liver after absorption [1]. The majority of those molecules are then found in the feces, in varying amounts, in the active form, or as metabolites. For the past 20 years, studies have been conducted on the activity of these drugs or their metabolites on the functioning of the grassland ecosystem and on their possible consequences for certain biotic components [1, 2, 3, 4].

In general, the first cases of resistance to anthelmintics appear about 10 years after the first use [5, 6].

Moreover, cases of multiple resistances have been detected since the 1980s in Australia, South Africa, and New Zealand [5, 7, 8, 9], in Southeast Asia [10], and recently in Europe [11].

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For small ruminants, the prevalence of resistance to the 3 main families of synthetic anthelmintics now involves all species of gastrointestinal nematodes [5, 12, 13].

For a long time, cases of resistance were absent in cattle, but they are increasingly being reported [5, 13]. Like other countries in the West African sub-region, the control of gastrointestinal nematodes in Benin is mainly based on the use of albendazole [14]. However, in tropical Africa, particularly in the Democratic Republic of Congo [15], Ethiopia [16], Gambia and Senegal [17] studies have shown that the repetitive use of *albendazole* for more than 40 years has led to the phenomenon of resistance of gastrointestinal parasites.

In order to maintain the efficacy of synthetic anthelmintic treatments and to reduce the emergence and spread of resistance, it has become necessary to use these molecules in a more rational manner, and to resort to other alternative control methods [18].

One of them could be the use of plants for the treatment of animal diseases. Plants are available and inexpensive [14], and their use to treat animal diseases has remained a common practice among farmers despite the development of chemotherapy [19].

Artemisia annua is widely used in traditional medicine against malaria, and *artemisin*, one of its active ingredients, is found in several pharmaceutical products. The plant also has antioxidant, antibacterial and antiparasitic properties [20, 21, 22]. *Artemisia annua* contains a wide range of bioactive components that could be highlighted in different parts of the plant [23]. These compounds include flavonoids, coumarins, steroids, phenolic compounds, purines, lipids, aliphatic compounds, monoterpenoids, triterpenoids, and sesquiterpenoids [23, 24]. Some of these compounds may also play a role in the antiparasitic action of the plant [24].

Albendazole is an active molecule on gastrointestinal nematodes, respiratory nematodes (Menziez, 2010; Sabater, 2012), flukes and the adult sheep tapeworm, *Moniezia* (Menziez, 2010). It also has action on eggs and hypobiotic gastrointestinal nematodes (Menziez, 2010).

Therefore, the present study proposes to compare the antiparasitic effects of *Artemisia annua* with those of *albendazole* in cattle reared under extensive rearing system.

2. Material and methods

2.1. Study area

The study was carried out in the breeding farm of the Faculty of Agricultural Sciences, precisely in the village of Sekou, 30 km from Cotonou.

2.2. Biological material

The study was conducted on a herd of 92 animals resulting from a cross between the *Borgou* and *Lagoon* races. After a coprological analysis, homogeneous lots of animals according to the degree of infestation were formed in a purposive way, for a better evaluation of the variation after treatment.

The used plant material was *Artemisia annua*, a plant widely used in traditional African human and veterinary pharmacopoeia [25].

2.3. Methods

The *Artemisia annua* plant used in this study was harvested, chopped and then shade dried for a period of 21 days. It was oven dried for 24 h. After that, it was reduced to powder using a BROITER CADET Plant grinder and stored in plastic bags to avoid rewetting.

2.4. Experimental set-up and treatment

The experimental set-up consisted of three groups of animals of fifteen subjects per group. The animals of the same batch were identified with a specific-colored string. Each group received a given treatment and the different treatments were administered orally.

- group 1 was composed of animals treated with *Artemisia* powder (T1) at a dose of 100 g per subject twice in two weeks.
- group 2 was treated with *Artemisia* powder (T2) at a dose of 150 g per subject twice in two weeks.
- group 3 was treated with *Albendazole* (T3) at a dose of 8.3 mg/kg of body weight at the beginning of the experiment.

During the test, the animals had natural pasture. Seven days before the start of the trial, the parasite status of the animals was determined through coproscopy (fecal count). Individual fecal samples from the rectum were taken on the 7th, 14th, and 21st days after treatment, placed in bags, and transported the same day to the Laboratory of Ethnopharmacology and Animal Health (LESA) of the Faculty of Agricultural Sciences of the University of Abomey-Calavi.

The observation of parasite eggs was done by the Mini-FLOTAC method.

2.5. Statistical analysis

Excel 2016 software was used as the database for recording data and calculating means as well as standard deviations.

The non-parametric test of Kruskal wallis helped in the study of the normality of the physicochemical parameters.

3. Results

At the beginning of the test, the presence in the feces of eggs of the parasites was noted in all batches. The reduction of egg excretion, which allows evaluating the variation of the level of excretion of parasite eggs of an instant (t) compared to a previous situation was appreciated through the rate of reduction (R).

During the whole duration of the trial, we had the excretion of parasite eggs. In the lot that received *Artemisia annua* powder, we noted a remarkable parasite regression over time, but the total elimination of nematodes did not occur. In the lot that received albendazole, on the other hand, a 100% elimination of nematodes was noted.

Descriptive analysis of the data is shown in table 1

Table 1 OPG (eggs per gram) in the animals before (OPG initial) and after treatment on the 7th, 14th, and 21st day respectively (OPG control 1, 2, 3)

Groups	Samples	OPG initial	OPG control 1	OPG control 2	OPG control 3
T1 n=15	S1	412.85±39.30	322.17± 25.47	212.33± 8.5	153.06± 6.01
	S2	555.10±47.13	391.22±44.9	311.33± 21.06	235.13± 17.22
	S3	2956.15±314.24	1117±176	889.17±101.62	632.33± 7.17
	M±m	1308.03±133.55	610.13±82.12	470.94±43.72	340.17±31.8
T2 n=15	S1	371.67±45.86	213.17± 18.79	98.06± 11,3	55.67± 4.11
	S2	622.50±56.19	47113±33.16	213.5± 18.66	93.4± 8.8
	S3	2015.33±451.44	875.43±78.11	414.17± 86.14	112.17± 4.23
	M±m	1003.16±184.49	519.91±116.31	241.91±38.7	87.08±18.04
T3 n=15	S1	339.17±35.01	0	0.833±0.833	5.83±4.17
	S2	705.83±54.90	0	0.833±0.833	7.5±5.12
	S3	2377.5±515.17	0	0	3.33±1.67
	M±m	1140.83±201.69	0	0.555±0.555	5.55±3.65

We also analyzed the dynamics of change in average OPG in the studied groups (figure 1).

There was no significant difference between the initial OPG in the treated groups. In T1 and T2 each new dose of *artemesia* has significantly reduced OPG, while in T3 only one dose of albendazole was enough to eliminate all nematodes. However, it is necessary to emphasize that the treatment with 150 g showed a greater decrease in excreted eggs between the initial OPG and the control OPG 3 than T1 – by 11.52 times and 3.84 times respectively. The reduction in OPG control 1 is similar in T1 and T2 – 2.14 and 1.93 times, respectively. The effect of 150 mg of *artemesia* powder after the third administration was almost close to that of albendazole.

In our study, the efficacy of albendazole against bovine gastrointestinal parasites was very high, above 95% in all controls.

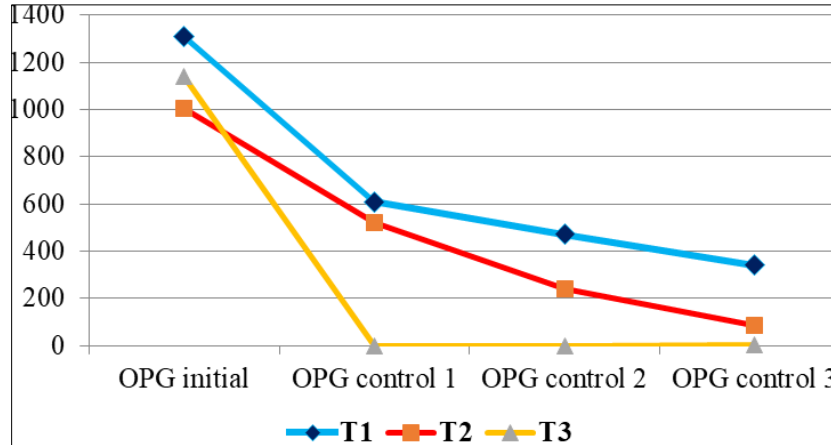


Figure 1 Dynamics of change in the average OPG in the groups

4. Discussion

At the beginning and throughout the test, all cattle were infected with gastrointestinal nematodes. According to Achi et al [26], the nematode population was statistically significantly related to the number of eggs in the feces. This prevalence of gastrointestinal helminths is thought to be related to the fact that in the benign south, the highest parasite densities are observed during the wet period (rainy season), during which this study was conducted [27, 28].

These parasites are responsible of important economic losses, through pathologies, mortalities, or growth delays that they cause [29, 30, 31].

Artemisia annua leaves caused a significant reduction in OPG from the 2nd control onwards. This high leaf activity could probably be explained by the fact that leaves are the main site of biosynthesis and storage of active principles responsible for the biological properties of plants [32]. These findings concur with those of several authors on the use of plant leaves on egg hatch and larval stages of *H. contortus* [33, 34, 35]. The use of *Artemisia annua*, in traditional therapy as an anthelmintic for cattle in veterinary pharmacopeia to combat intestinal worms and gastrointestinal disorders [25] by livestock farmers is therefore justified.

However, the reduction rates by *artemesia annua* powder were lower than that of albendazole. Only after the third dose of 150 mg *artemesia* was able to demonstrate an efficacy comparable with *albendazole* effect. Our results support the conclusion of Githiori et al. [36] that herbal remedies have, in most cases, lower reductions in parasitism levels than synthetic anthelmintics in *in vivo* control tests. Nevertheless, it must be recognized that in this study, the methods used for processing *Artemisia annua* were very mechanical.

The inferiority of inhibition in relation to *albendazole* on egg excretion does not therefore correspond systematically to a lack of efficacy. The possibility that *Artemisia annua* powder could have a total elimination effect of parasites with time is strong if the conditions of powder reduction are improved and if the research manages to identify the right dose per animal.

5. Conclusion

This study has allowed demonstrating an anthelmintic activity *in vivo* of *artemesia annua* in cattle, especially on gastrointestinal nematodes. It, therefore, allows us to affirm that the use of this plant by farmers as an anthelmintic for ruminants is justified; and that in a farming environment, the leaves seem to be effective and are able to replace synthetic molecules to avoid the resistance observed during the repeated use of these molecules.

All these results are a basis for further research to contribute to the development of a therapeutic approach based on *artemesia annua* in farm animals.

Therefore, further research is needed on the mode of action of the plant in ruminants and the effective dose. We believe that nutritional potential and other effects will need to be determined, as compounds active against internal parasites sometimes have anti-nutritional effects, such as reduced feed intake and performance. Studies also need to address the definition of LD50 for the determination of acute systemic toxicity of *Artemesia annua* powder in mice, the duration of treatment, and the persistence of the product in the cattle body.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest.

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