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Evaluation of the efficacy of anthelmintics in sheep in two localities of Ivory Coast

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Abstract

This study was conducted from October 4 to December 14, 2015, in the localities of Bingerville and Divo, with the aim of assessing the efficacy of anthelmintics commonly used by sheep farmers in Côte d'Ivoire. Following a survey carried out in 30 farms, albendazole and levamisole were identified as the most frequently used anthelmintics. Three farms were selected in these two localities. In each farm, two groups of animals were formed. Animals in each group were orally treated according to the assigned drug. The modified McMaster technique, according to Gordon and Whitlock, was used for laboratory analysis of the samples. The results revealed resistance to albendazole, whereas levamisole was still considered effective. A 100% reduction in fecal egg counts was observed in the other two farms where animals had never been treated with these molecules. Authorities should consider raising awareness among farmers to promote more rational use of still-effective anthelmintics against these nematodes.

Keywords: Evaluation; Anthelmintics used; Sheep farmers

1. Introduction

The use of albendazole as an antiparasitic drug is one of the main strategies for controlling intestinal parasites in small ruminants in rural farming systems in Côte d'Ivoire, due to its broad spectrum of activity and relatively low cost (Emanfo et al., 2018). However, in intensive farming systems characterized by high animal densities and rapid herd growth, farmers often tend to use antiparasitic drugs excessively and without guidance from animal health professionals (Emanfo, 2015; Apala et al., 2020). Such improper use promotes the emergence of parasite strains resistant to commonly used drugs. Albendazole plays a key role in controlling infections caused by gastrointestinal strongyles, which have a significant impact on sheep productivity. Preserving its efficacy therefore remains a major challenge for improving livestock performance (Richelme and Greil, 2019). In this context, it is essential to assess the effectiveness of this molecule in order to optimize treatment strategies and monitor the potential emergence of resistance, with the aim of ensuring food security and animal welfare in Côte d'Ivoire. To this end, a two-phase methodology will be implemented: (i) sample collection followed by an in vivo test, and (ii) laboratory coprological analysis using the McMaster method. This study aims to determine the reduction rate of parasite loads in small ruminants after treatment with albendazole in three farms located in two localities in the southern part of the country, in order to evaluate the effectiveness of this molecule and identify any potential development of parasite resistance.

2. Materials and methods

2.1. Study area

This study was conducted from November 17 to December 14, 2015, in three farms located in the southern part of the country, including one in Bingerville and two in Divo (Figure 1). This area is characterized by relatively gentle terrain,

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with stepped plateaus ranging from 200 to 500 meters in altitude, separated by low escarpments (10 to 30 meters high). The vegetation consists of patches of forest interspersed with gallery forests (Konaté and Kampmann, 2010). The climate is a transitional equatorial type, characterized by two dry seasons and two rainy seasons.

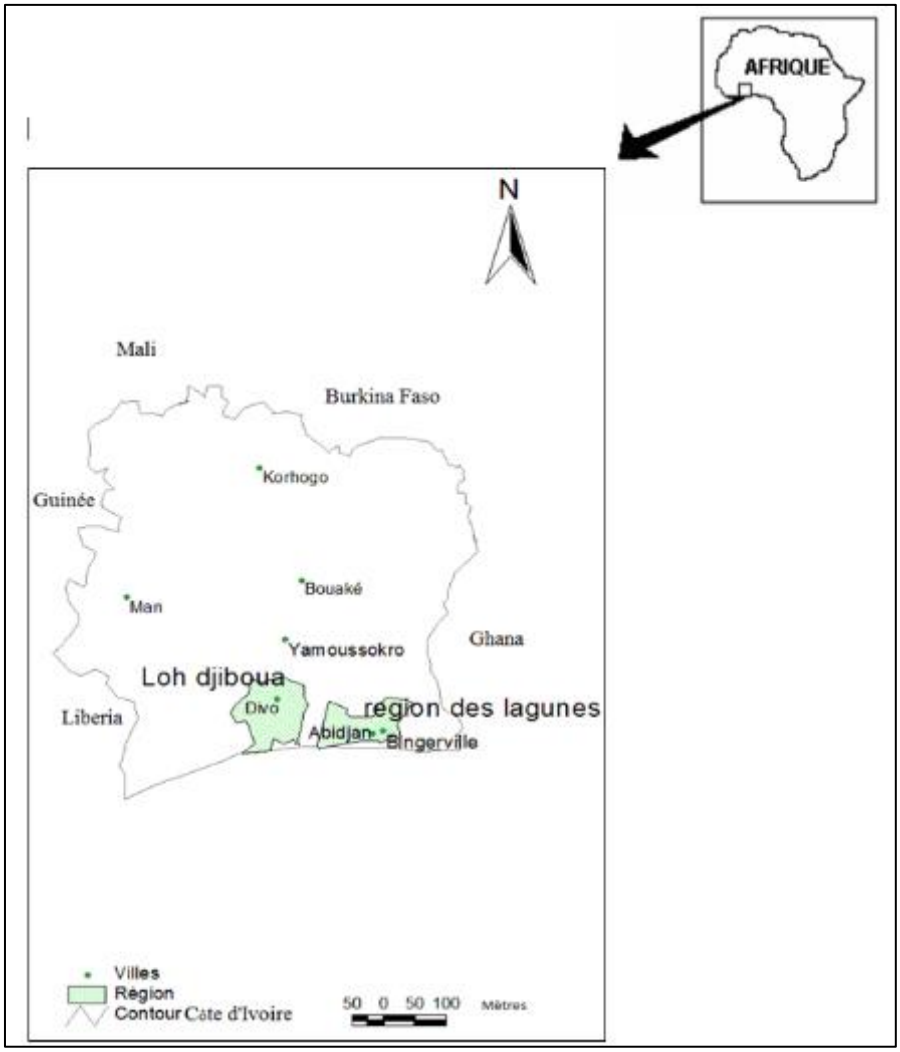

Figure 1 Study area

2.2. Materials

In this study, the biological material consisted of fecal samples collected from animals in each farm. The equipment used for sampling and deworming included a cooler containing ice for preserving parasite eggs present in the feces, 20-milliliter syringes for administering the anthelmintic treatment, two one-liter containers of anthelmintics containing levamisole and albendazole, respectively, and a weighing scale used to measure the body weight of each animal individually.

2.3. Methods

2.3.1. Selection of farms

Only farms in which animals had not been dewormed for at least two months prior to the socio-economic survey were included in the study.

2.3.2. Selection of anthelmintics

In order to identify the anthelmintics commonly used by sheep farmers, a survey was conducted over a 30-day period in the southern part of the country (Divo and Bingerville). A total of 30 farms were surveyed, leading to the identification of albendazole and levamisole as the most frequently used anthelmintics by sheep farmers in Côte d'Ivoire.

2.3.3. Sampling and deworming procedure

Fecal samples were collected directly from the rectum of each animal to avoid contamination with soil or other external materials. The samples were stored in a cooler containing ice and transported to the laboratory to prevent further development of parasite eggs. The animals selected for the study were weighed in order to calculate the appropriate dose of anthelmintic to be administered, in accordance with the manufacturer's recommendations. They were then marked with paint for identification purposes (Figures 2, 3, and 4). The prescribed dose was 1 ml per 10 kg of body weight.

Figure 2 Fecal sample collection from the rectum

Figure 3 Weighing of animals

Figure 4 Oral deworming of animals

A total of 90 animals were dewormed with both molecules across three different farms, including one located in Bingerville and two in Divo.

In the first farm, two groups of 15 animals each were formed: one group treated with albendazole and the other with levamisole. In the second and third farms, two groups of 8 animals and two groups of 7 animals were formed, respectively. In each farm, the two groups received different anthelmintic treatments, as illustrated in the first farm.

The fecal egg count on day 1 (eggs per gram, EPG) was recorded as EPG_1. On the same day, the animals were treated with the assigned anthelmintic according to their group. On day 10 post-treatment, another coprological examination was performed on the same animals, and the number of eggs per gram of feces was recorded as EPG_2. The 10- to 11-day interval is sufficient for the expulsion of killed worms and occurs before any reinfestation of the animals.

The fecal egg count reduction (FECR, %) was calculated as follows:

$$\mathbf{FECR\ (\%) = 100 \times (1 - T_2 / T_1)}.$$

Treatment efficacy was evaluated without a control group. T_1 and T_2 represent the arithmetic means of EPG values before treatment (EPG_1) and after treatment (EPG_2), respectively (Mejia, 2003).

Data were entered into Excel (Microsoft 2010) and analyzed using Stata version 9.1 (StatCorp, College Station, Texas, USA) to calculate the percentage reduction of the active compounds. The results were interpreted according to the recommendations of the World Association for the Advancement of Veterinary Parasitology (WAAVP) (Coles et al., 1992): resistance to anthelmintics is present if the reduction percentage is less than 95% and the lower bound of the confidence interval is below 90%. If only one of these criteria is met, resistance is suspected.

3. Results

The results obtained are presented in the table below. In the Bingerville farm, before treatment, the mean EPG was 396.55 for the first group and 359.09 for the second group. After treatment, the mean EPG was 123.07 for the first group (treated with albendazole), corresponding to a 69% reduction. For the second group (treated with levamisole), the mean EPG was 6.66, corresponding to a 98.15% reduction.

In the first farm in Divo, 14 animals were treated, forming two groups of 7 animals. Before treatment, the mean EPG was 541.66 and 592.85 for the two groups, respectively. After treatment, an EPG of 0 was recorded, corresponding to a 100% reduction for both groups.

In the second farm in Divo, 16 animals were dewormed, forming two groups of 8 animals. Before treatment, the mean EPG was 355.71 for the first group and 683.33 for the second group. After treatment, an EPG of 0 was recorded, corresponding to a 100% reduction for both groups.

Table 1 Comparative efficacy of anthelmintics in the three farms

	ALBENDAZOLE			**LEVAMISOLE**		
	OPG moyen		**FECR (%) [IC]**	**OPG moyen**		**FECR (%) [IC]**
	J 0	**J 10**		**J 0**	**J 10**	
ELEVAGE 1	396,55	123,07	**69** [88 98.5]	359,09	6,66	**98,15** [97 100]
ELEVAGE 2	541,66	0	**100** [100]	592,8	0	**100** [100]
ELEVAGE 3	335,71	0	**100** [100]	683,33	0	**100** [100]

4. Discussion

A post-treatment fecal egg count reduction (FECR) of 69% was recorded, indicating the presence of resistance. This finding confirms the high prevalence of strongyle resistance to benzimidazoles, as the only farm that regularly dewormed animals using this class of drugs showed resistance to albendazole. This resistance can be explained by the

almost exclusive use of benzimidazole compounds over many years, due to their low cost, broad spectrum of activity, and safety of use.

Although only albendazole was tested in this study, the observed resistance likely reflects class-wide resistance, given the similar mechanism of action shared by all benzimidazoles. These results are consistent with previous findings reported in Morocco (Zouiten, 2006), Brittany (Tanguy, 2011), and Nigeria (Balajoko and Morgan, 2012).

The fecal egg count reduction obtained with levamisole was markedly different from that of albendazole, reaching 98.15%. At this level, levamisole can still be considered effective. It should be noted that cases of resistance to levamisole are relatively rare, with only one reported case of dual resistance (levamisole/benzimidazole) in a goat herd (Paraud et al., 2009).

A 100% post-treatment fecal egg count reduction was recorded in farms 2 and 3. Analysis of the questionnaire revealed that animals in these two farms had never been exposed to the two molecules evaluated in this study. In the first of these farms, animals were dewormed twice a year exclusively with ivermectin. In the second farm, no routine mass deworming was practiced; treatment was only administered to severely ill animals, often as a last resort, which frequently resulted in slaughter.

These practices did not expose the animals in either herd to levamisole or albendazole, thereby preventing the development of resistance to these molecules. According to the definition proposed by Wolstenholme et al. (2004), anthelmintic resistance is a heritable and irreversible genetic change that enables parasites to survive treatment with recommended doses of anthelmintics. Therefore, resistance can only be established if parasite populations have been repeatedly exposed to these drugs, which was not the case in these two farms, explaining the observed 100% reduction rates.

Studies such as this one provide valuable insight into the current status of anthelmintic resistance in Côte d'Ivoire. Although the present results are not sufficient to definitively confirm the widespread establishment of resistance, they highlight the urgent need to raise awareness among farmers regarding the proper use of anthelmintics in order to preserve their efficacy.

5. Conclusion

The reduction tests carried out in this study revealed a decrease in the efficacy of Albendazole, whereas Levamisole was still found to be effective. The resistance observed with Albendazole may be associated with the repeated and long-term use of this molecule, as well as underdosing practices by some farmers. Studies such as this one are essential for assessing the status of anthelmintic resistance in Côte d'Ivoire. Although the results obtained are not yet sufficient to definitively confirm the establishment of widespread resistance, they nevertheless constitute an important warning signal. Above all, they highlight the need to raise farmers' awareness of the proper use of anthelmintics in order to sustainably preserve their effectiveness. It is therefore essential to adopt a rational approach to antiparasitic treatments in order to limit the emergence and spread of resistance to other classes of antiparasitic drugs.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that there are no conflicts of interest that could have influenced the results or interpretation of the data presented in this study.

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