Journal of Parasitology and Vector Biology

Volume 5 Number 2 February 2013
ISSN 2141-2510

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Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing Escherichia coli in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: 1281-1286.

Pelczar JR, Harley JP, Klein DA (1993). Microbiology: Concepts and Applications. McGraw-Hill Inc., New York, pp. 591-603.

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Journal of Parasitology and Vector Biology

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Journal of Parasitology and Vector Biology Vol. 5(2), pp. 13-16, February 2013
Available online at http://www.academicjournals.org/JPVB
DOI: 10.5897/JPVB12.027
ISSN 2141-2510 ©2013 Academic Journals

Full Length Research Paper

Antiparasitic effects of the water extract from *Chenopodium ambrosioides* L. (Chenopodiaceae) against some gastrointestinal nematodes in West African Long Legged goats

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Accepted 15 February 2013

An *in vivo* test was undertaken in order to evaluate the efficacy of an aqueous extract of leaves of *Chenopodium ambrosioïdes* against nematode parasites in goats. The study used fifteen naturally infected West African Long Legged goats (*Capra hircus*) from Northern Benin. Three levels (1, 2 or 4 ml/kg body weight/3 days treatment) of concentration of the herbal drug were administrated to three experimental groups and in comparison with two control groups (one without treatment and the other treated with levamisole as a reference drug). Results showed significant (P<0.001) decrease of faecal strongyle eggs in experimental groups. After three days of treatment, the reduction in the rate of egg shedding was over 70% in animals treated with herbal medicine, whereas egg shedding rates remained the same in the non treated group. The rates of reduction in faecal eggs reached almost 100% in few days (5 to 6 days) among treated animals without a significant dose-dependent effect. Moreover, helminthological autopsy performed on the study animals after treatment showed an almost total absence of worms. *C. ambrosioïdes* aqueous extract exerted a kind of parasite clearing effect in the abomasums and in the small intestine. This indicates the effectiveness of the herbal extract against gastrointestinal parasitic. The lowest dosage of 1 ml/kg body weight for three days treatment was found to be appropriate and prescriptive. No acute toxicity was recorded and the autopsy of internal organs revealed only rare cases of congestion and petechiae on the liver and lungs in animals treated with 4 ml/kg body weight.

Key words: Goats, gastrointestinal nematodes, controlling, herbal medicine, *Chenopodium ambrosioïdes*.

INTRODUCTION

In tropical regions, gastrointestinal parasites are an important impediment for livestock production. Their control is also a real economic constraint since the drugs used to control parasites infection can be costly. Benzimidazoles, avermectins, imidothiazoles and pyrimidines are the main and common anthelmintic moleculars used to protect small ruminants, but most of them are subject to drug resistance (Chandrawanthani, 2004; Gaskin, 2006). Due to these issues, numerous farmers in poor areas are using endogenous recipes. In recent years, there has been a resurgence of interest in herbal medicine. In Africa, many farmers use plants to control animal diseases (Djoueche et al., 2011); thus, African flora may provide pharmaceuticals that are currently unknown to the scientific community and that may be cheaper and more environmentally sound. A dynamic of rationalization of endogenous practices is underway and the medicinal properties of many tropical

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Table 1. Study animal groups and corresponding treatments.

Group	Administrated treatments (oral route)	
	Medicinal drug and dosage/kg body weight	**Duration of treatments**
CG_{WT}: Control group (no treatment)	None	-
CG_{Lev}: Control group treated	Levamisole (50 mg)	Single dose
EG 1 ml/kg = Experiment group no. 1	Plant extract (1 ml)	
EG 2 ml/kg = Experiment group no. 2	Plant extract (2 ml)	One dose daily for three days
EG 4 ml/kg = Experiment group no. 3	Plant extract (4 ml)	

Figure 1. Morning faeces recovery device ↑ (diaper) from animals.

plants are being checked. This study aims at evaluating the efficacy of an aqueous extract of the leaves of *Chenopodium ambrosioïdes* against strongyle infection in West African Long Legged (WALL) goats. The plant is common in many parts of the world like Europe, Asia and Africa. It is used as medicinal herb (Quinlan et al., 2002; Ruffa et al., 2002; Efferth et al., 2002; MacDonald et al., 2004; Patrício et al., 2008). It is well known in rural areas of Benin as "trouzouman" (in "fongbé", a national language) where it is deemed effective against some human parasitic diseases such as pinworms, tapeworms, roundworms and hookworms.

MATERIALS AND METHODS

Experimental design

The subjects of this study were 15 over one year old Sahelian goats naturally infested with strongyles (*Haemonchus contortus* and *Trichostrongylus* species). These study animals were selected among thirty animals purchased at Zongo livestock market in Cotonou after testing their stools. Only the animals with a faecal eggs count (FEC) over 1000 eggs/g of faeces were used in the study. The subjects were divided into five homogeneous groups (based on body weight and future treatment) of three animals (Table 1).

The plant material consisted of powdered leaves of *C. ambrosioïdes*. The leaves were harvested in December 2011 at Hêvié, district of Abomey-Calavi, Department of Atlantic, Benin, where the plant grows naturally. These leaves were sun-dried, then ground, bottled and kept dry within the Applied Biology Research Laboratory (LARBA) of the Abomey-Calavi Polytechnic School. Two substances were used as drugs in the study: the herbal drug and the control drug. The herbal drug was the aqueous extract of the powder of *C. ambrosioïdes*. It was obtained by infusing, during 30 min, 50 mg of powder in 1000 ml of distilled and deionised hot water. The filtrate was used as the herbal drug at the latest 24 h after. Levamisole bolus® (a conventional anthelmintic) was used as a control drug.

In vivo test of the anthelmintic activities of the drugs

The *in vivo* anthelmintic activity of the leaves of *C. ambrosioïdes* was assessed in farm conditions. For 15 days of adaptation, the animals were fed *ad libitum* with forage and received daily 1000 g of concentrate. The experiment was undertaken from December 2011 to January 2012 at the Doguici farm, located at Attogon, district of Allada. The parasitological status of the animals was reconfirmed according to the selecting criteria (FEC ≥ 1000) first. From the beginning of the test (day 0) to the third day (day two), animals received the appropriate treatment (Table 1) and their general conditions and behaviour were carefully monitored by the booking of animal's posture, temperature, respiratory frequency, rumination, aspect and frequency of faeces; any toxicological abnormality. Each night of the experiment, each study animal was outfitted with a diaper-like collection sheet (Figure 1) in order to recover, individually and efficiently, the morning faeces of the animals. Faecal material was collected daily for each animal and was stored at 4°C in sealed labelled vials. A total of 150 samples were then taken and examined for faecal eggs counts. The parasitological examination method of Mc Master (Gaskin, 2006) was used to assess the FEC over 10 days (three adaptation days and seven experiment days). The herbal medicine's efficacy was evaluated by calculating the reduction rates of faecal eggs shedding (R_{FES}) with the following formula.

$$R_{FES}(n) = 100 \times (FEC_0 - FEC_n)/FEC_0$$

where $R_{FES\,(n)}$ = faecal eggs shedding rate of day "n", FEC_n = faecal eggs count of day "n" and FEC_0 = faecal eggs count before treatment.

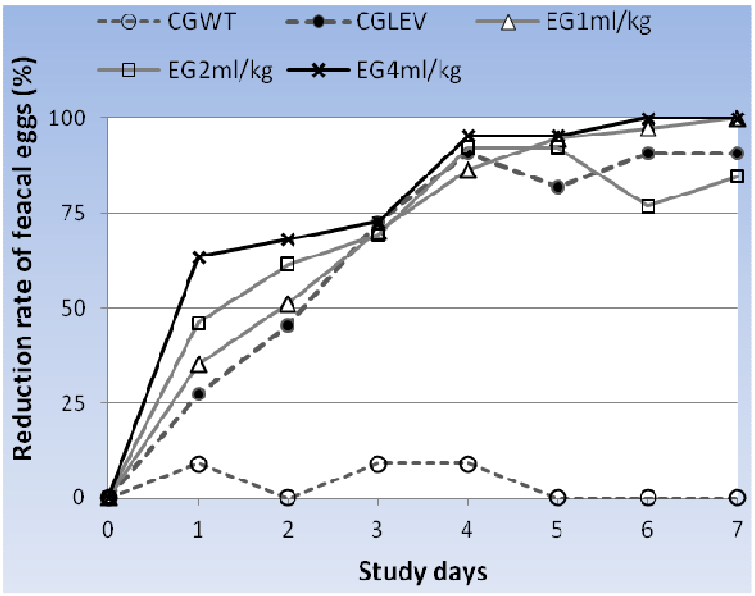

Figure 2. Effect of *C. ambrosioïdes* extract on the faecal eggs excretion.

Helminthological and toxicological autopsy

At the end of the experiment (day 10), the animals were slaughtered at the abattoir of Cotonou. Their digestive systems were collected and examined tracking lesions and present adult nematodes or cestodes worms. The abomasums and intestines of each gut are separately and carefully inspected after being incised along their long axis. The luminal content was recovered in a container for examination. The mucosa was also inspected for fixed worms. Worms were then collected in glass bottles containing 70° ethanol for nematodes and 5% formalin for other helminthes and were transferred to the LARBA. Identification of parasites was done later based on criteria provided by Zajac et al. (2006). The worm burden for each animal was determined for each species of parasite.

Statistical analysis

The FEC recorded data and the calculated eggs shedding reduction rates (R_{FES}) were performed under Stata 11 following a Poisson distribution model.

RESULT AND DISCUSSION

In vivo anthelmintic effects of *C. ambrosioïdes* aqueous extract

The daily reduction (percent) of faecal eggs excreted in each treatment condition is as shown in Figure 2. There was a significant decrease in eggs excreted with all treatment when compared with the control group ($P<0.001$). Reduction of faecal eggs excretion (increase of R_{FES}) was seen spontaneously (72 h) at levels over 70% (required level for biological significance according to Githiori et al., 2003) in the experimental groups ($EG_{1\ ml/kg}$, $EG_{2\ ml/kg}$ and $EG_{4\ ml/kg}$). Reduction in rates approached 100% by the sixth day in the $EG_{4\ ml/kg}$ group. No significant difference was found between the results for the $EG_{4\ ml/kg}$ and CG_{Lev} groups. With reference to the results of similar tests with other herbal plants, *C. ambrosioïdes* can be considered very efficient in decreasing the excretion of faecal parasites eggs. For example, roots' extracts of *Halothamus somalensis* have induced only 50% reduction within three weeks (Dawo and Tibbo, 2005). A high R_{FES} of 96.2% was recorded in sheep as maximum with a four plants formulation (Zaman et al., 2012) within two weeks. The efficacy of *C. ambrosioïdes* was not dose-dependent like several other cases of herbal medicines since the levels of success were not significantly different between the dosages. This means that the lower concentration could be a suitable and prescriptive one.

Acute clinical toxicity

Only the presence of pasty stools indicated a perturbation of the digestive transit in animals treated with the two highest doses of extract.

Autopsy results

At helminthological autopsy, the parasites burden in the animals was near zero with treated animals while the un-treated group harboured more than 350 adult of the main gastrointestinal nematodes (*H. contortus, Trichostrongylus*

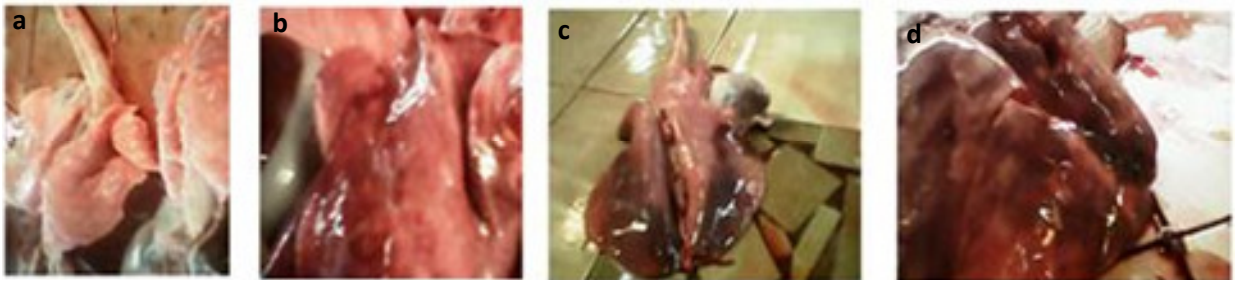

Figure 1. Pathological impact of *C. ambrosioïdes* extract on lungs with Wall goats.
a. Normal lungs taken from animal in group CGWT; b. Normal lungs taken from animal in group EG 1 ml/kg; c. Mild pulmonary congestion with animal group EG 2 ml/kg; c. Marked pulmonary congestion with animal in group EG 4 ml/kg.

spp, and *Trichurus* spp). The herbal extract had a potent deworming effect similar to that seen with levamisole.

The intestinal mucosa, the lung and liver's parenchyma showed a few petechial lesions (Figure 3) with animals treated with 4 ml/kg body weight dosage. This implies a dose-related toxicity, but no immediate distress or life-threatening effects were observed. These results confirm however the toxicological risks of the plants. Therefore, using a minimum dosage must be recommended.

Conclusion

This study shows that an aqueous extract of the leaves of *C. ambrosioïdes* is a potent anthelmintic in WALL goats. Ease of formulation and the efficacy of low dose promote its use in farmers as an alternative to synthetic molecules. Further studies are needed to clarify the active ingredients and the mode of action as well as long term dosage utilization.

ACKNOWLEDGEMENTS

The study was made possible through the support of the NGO Doguici who put provided access to their unit of livestock production facilities. They authors thank the villagers in Kpoguetomey, Attogon, District of Allada for their cooperation. This study is dedicated to the memory of the Late Mother Anne-Marie KPOGUE, a resident of the village and resource person who actively contributed to the monitoring of the study animals.

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Journal of Parasitology and Vector Biology Vol. 5(2), pp. 17-19, February 2013
Available online at http://www.academicjournals.org/JPVB
DOI: 10.5897/JPVB12.026
ISSN 2141-2510 ©2013 Academic Journals

Full Length Research Paper

Prevalence and intensity of nodular oesophagostomosis in West African Long Legged goats in Northern Benin

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Accepted 28 January, 2013

This study was conducted between January and December, 2011 to assess the prevalence and intensity of nodular lesions caused by *Oesophagostomum* species into the intestine of Benin goats. Intestines of 384 West African Long Legged (WALL) goats, from Northern Benin, were examined during slaughter, and 241 intestines (62.8%) were found to be positive for nodular lesions. The infection rate was significantly ($p < 0.05$) higher during the rainy season in comparison with dry season. Animals above one year of ages were mostly affected (82.5%). Extensive lesions were observed in 95 large intestines (24.9%) and calcified nodules were observed in 130 intestines (34%).

Key words: *Oesophagostomum* species, nodules, goats, prevalence, Northern Benin.

INTRODUCTION

The climatic conditions of tropical Africa are conducive for development of parasites, notably the exogenous stage of their life cycle. Therefore, helminthosis is an absolute and important constraint in livestock production in Tropical Africa. The prevalence of gastrointestinal strongyles and their impact on yields are described by many authors (Sykes, 1994; Mortensen et al., 2003) and several reports are also available regarding haemonchosis, most detrimental of which is strongylosis which is synonymous to small ruminants production in Sub-Saharan Africa (Ouattara and Dorchies, 2001; Achi et al., 2003; Osakwe and Anyigor, 2007; Attindéhou et al., 2012). However, information is available regarding other pathogens like *Oesophagostomum,* which also causes important economic losses (Olivares et al., 2001) by decreasing animal productivity and market value of the viscera due to the presence of nodules in the intestines. The assessment of nodular oesophagostomosis importance in Benin is very timely and relevant, especially in the Northern region where farming is a major activity. This study aimed to determine the prevalence and intensity of nodules due to *Oesophagostomum* spp. in West African Long legged Goats in Benin.

MATERIALS AND METHODS

Period and study area

The study was undertaken between January and December, 2011 in the region located between latitudes 9.5° and 12.5° North and longitudes 1° and 4° West, covering four agro-ecological zones of Northern Benin. During the study period, rainfall was 921.5 mm and temperature varied between 16.2 and 40.6°C. Wet season was from May to November.

Animal

A total of 384 West African Long-Legged (WALL) goats (196 female and 188 males) were selected randomly for the study. On average, 30 animals were screened each month.

Parasitological examination

The parasitological examination consisting of usual slaughterhouse

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Table 1. Prevalence of nodular oesophagostomosis relative to the seasons and the animal's age and sex.

Variable	Category	Number of examined animals	Number of infected animals	Infection rate (%)	p value
Season*	Dry	159	91	57.2	0.020
	Wet	225	150	66.7	
Age*	Below one year	144	49	34.0	0.000
	Above one year	240	192	80.0	
Sex	Female	193	123	63.7	0.278
	Male	191	118	61.8	
Total	-	384	241	62.8	

*Significant variation factor.

inspection has been used to assess the prevalence and the intensity of nodular lesions in animals. After slaughter, the intestines were isolated, emptied and washed with pressured tap water injection. The external and internal mucosa of both intestines was inspected carefully in search of nodules. Some nodules were incised with a knife in order to characterize the nature (calcified or not calcified). Nodular lesions affecting more than 50% of the length of the small intestine or large intestine were called generalized and considered as a result of heavy infection. When nodules affect less than 25% of the tract, the infection was declared localized. The other cases are referred to as fairly extensive lesions. A logistic regression was performed in Stata 11 (Nicoletti, 2011) to analyze and evaluate age, sex and season influence upon the prevalence and intensity of nodular lesions.

RESULTS

Prevalence of nodular oesophagostomosis and variation factors

Out of 384 examined animals, 241 (62.8%) were positive to nodular oesophagostomosis. Figure 1 shows the infection rates recorded monthly. It highlights the endemic nature of the parasitosis whereas Table 1 clearly shows a higher prevalence in the wet season ($p < 0.05$). Animals aged one and older were significantly ($p < 0.001$) more infested than younger ones. No influence of the animal sex could be proven.

Location and intensity of nodular lesions

Parasitic nodules due to *Oesophagostomum* spp. were found on the terminal portion of the abomasum, on the small intestine and on the large intestine. The mucosa of the large intestine was the most dominant location of nodules (Figure 2). Respectively, 17.8, 25.7, and 56.4% of infected viscera had generalized, fairly extensive and localized lesions.

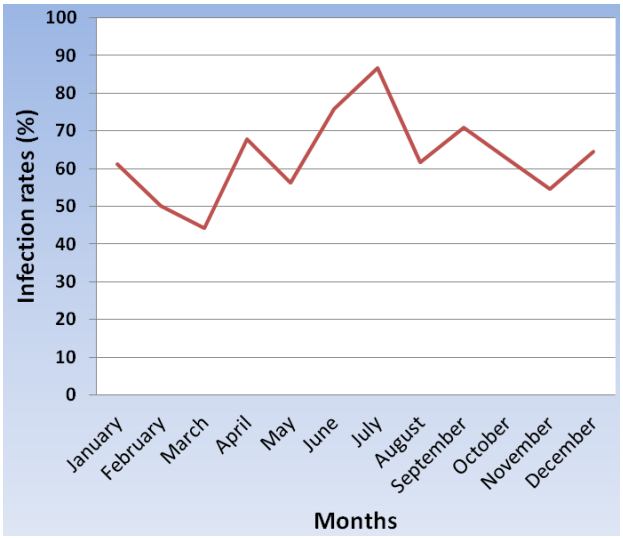

Figure 1. Nodular oesophagostomosis prevalence.

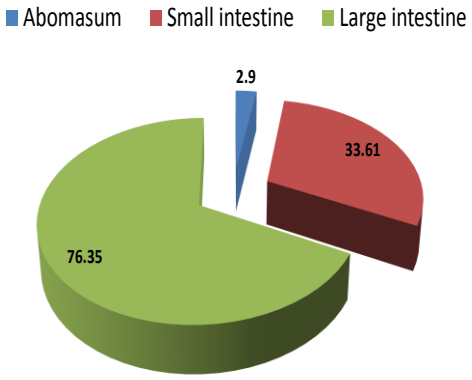

Figure 2. Nodular lesions localisation (Frequency of infection; %).

DISCUSSION

The prevalence of nodular oesophagostomosis was important (almost 63%) even if lower values have been recorded in neighboring regions. This is the case in Northern Nigeria where Nwosu et al. (2011) reported a prevalence of 71% in a slaughterhouse investigation. This difference is probably due to the fact that slaughterhouses surveys are likely to overestimate pathology's prevalence. Indeed, the candidates for the slaughter often look bad, health wise. However, it is clear that oesophagostomosis is an important strongylosis in West African Long Legged goats in West Africa.

O. columbianum have been reported in 88.3% of goats in the Central Plateau of Burkina (Belem et al., 2005). The nodular oesophagostomosis was reported in 62% of goats in the Middle Guinea by Barry et al. (2002). Contrary to this, a low rate of 43% was reported by Achi et al. (2003) in savannah region in north of Ivory Coast. The results of the study revealed a fairly clear seasonal variation, with high levels of infection during wet, which was consistent with the observations of Nwosu et al. (2011) but somewhat contradicted the results recorded in Burkina Faso and Ivory Coast (Belem et al., 2005; Achi et al., 2003). A highly significant effect of the age was observed. The elderly were most affected. This is understandable considering the chronicity of nodules, especially in the calcification phase. The intensity of the lesions has been similar to reported findings (Kulo and Seme, 2007; Nwosu et al., 2011).

Conclusion

Nodular oesophagostomosis must be considered as the second main strongyle of high sanitary importance for livestock in Northern Benin after *Haemonchus contortus*. The control of this *Oesophagostomum* spp is very necessary and need to be conducted based on climatic calendar, in association with haemonchosis management.

ACKNOWLEDGEMENTS

The study was funded by Association Doguici NGO through its West African Zoopole Program and with the support of Benin Ministry of High Education and Scientific Research. The authors express their gratitude to these partners.

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