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# An ethnopharmacological survey and *in vitro* confirmation of the ethnopharmacological use of medicinal plants as anthelmintic remedies in the Ashanti region, in the central part of Ghana



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## ABSTRACT

**Ethnopharmacological relevance:** Infections with helminths are still a big problem in many parts of the world. The majority of the people in West Africa treat such infections with medicinal plants related to the local traditional medicine. The present study aims at identifying medicinal plants traditionally used for worm infections in the Ashanti region, Ghana. *In vitro* screening of selected extracts from plants on which scientific knowledge is limited was to be performed.

**Materials and methods:** Validated questionnaires were administered to 50 traditional healers in the Ashanti region, Ghana. Interviews and structured conversations were used to obtain relevant information. Quantitative and qualitative evaluation was performed additionally to structured cross-referencing of the data using SciFinder<sup>®</sup> data base. Selected plant species were used for *in vitro* testing on anthelmintic activity against the free-living model nematode *Caenorhabditis elegans*.

**Results:** 35 plant species were recorded for the use in humans and 6 for the use in animals. Plant material most frequently used were the seeds from *Carica papaya*, mentioned by nearly all healers. The plausibility of most plants used for treatment of infections with helminths was given in most cases by documentation of potential anthelmintic activity in recent scientific literature. 9 species from plants not or scarcely described in literature for this indication were investigated on *in vitro* activity. A hydroethanolic (1:1) extract of *Combretum mucronatum* was most active with a survival rate of nematodes of 89% at 0.1 mg/mL and 58% at 1 mg/mL respectively (levamisole 16%). Extracts of *Paullinia pinnata* and *Phyllanthus urinaria* were also assessed to exhibit a minor (85% and 89% respectively at 1 mg/mL), but still significant activity.

**Conclusion:** Traditional use of anthelmintic plants from Ghana can be well rationalized by cross-referencing with published literature and phytochemical/pharmacological plausibility. The *in vitro* investigations of extracts from *Combretum mucronatum*, *Paullinia pinnata* and *Phyllanthus urinaria* exhibited significant effects against nematodes. The anthelmintic activity of these plants should be investigated in detail for pinpointing the respective lead structures responsible for the activity.

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## 1. Introduction

Infections with parasitic nematodes, including intestinal helminths and filarial worms, are among the most widespread diseases worldwide with a global prevalence of more than 2 billion (Hotez

et al., 2008) Thereof intestinal or also called soil-transmitted helminths (STH), are the major agents. The World Health Organization WHO estimates the number of people suffering from STH infections to approximately 1.5 billion, which accounts for almost a quarter of the world's population (WHO, 2013a) While soil-transmitted

**Abbreviations:** DMSO, dimethyl sulfoxide; GNATH, Ghana National Association of Traditional Healers; MDA, mass drug administration; NC, negative control; NGM, nematode growth medium; PC, positive control; STH, soil-transmitted helminthes; WHO, World Health Organization

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helminthiases in humans play a minor role in Europe, they occur throughout the tropical and subtropical regions of Sub-Saharan Africa, the Americas and Asia, imposing a great burden mainly on inhabitants of developing areas (Hotez et al., 2008; Lustigman et al., 2012).

Intestinal helminthiases are most commonly caused by roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*) and hookworms (*Ancylostoma duodenale* and *Necator americanus*) (Lustigman et al., 2012; WHO, 2013a) although coinfections with more than one parasite are rather normal (Bethony et al., 2006).

Although not lethal, infections can cause symptoms ranging from abdominal pain and diarrhea to more severe impairments such as anemia as well as growth and cognitive retardation in children due to blood loss and malnutrition (Hotez et al., 2008; WHO, 2013a) depending on the type of nematode and the worm burden. Since in most cases people affected by helminthiases face poverty accompanied by poor sanitary conditions and limited access to medication these diseases hinders them from socio-economic development, leading to a vicious circle (Lustigman et al., 2012).

In the recent past considerable efforts have been made by the WHO to tackle the currently 17 neglected tropical diseases, including guidelines for preventive chemotherapy in helminthiasis and recommendations for treatment and donations of anthelmintic medicines (WHO, 2013a). The set up of mass drug administration (MDA) programs to treat inhabitants in endemic areas with anthelmintics given annually or biannually has led to a significant success in the reduction of morbidity. While the WHO (2013b) currently lists four anthelmintics, namely albendazole, mebendazole, levamisole and pyrantel pamoate as essential drugs in most cases benzimidazoles, and in particular albendazole, is administered due to its low costs and broad spectrum of activity (for review see Humphries et al. (2012)). Still, great differences in the susceptibility among STH species and also in the over-all success of the anthelmintic treatment could be observed, which raises the question on the reliability of MDA, particularly with respect to development of benzimidazole, levamisole and pyrantel resistant helminth strains. Also adverse effects that occur in quantity during deworming of whole populations should be considered (for review see Keiser and Utzinger (2008); Vercruyse et al. (2011) and Humphries et al. (2012); ). Finally, these programs focus on the most commonly occurring helminthiases, neglecting millions of infections with less prominent infectious agents, such as *Strongyloides*, of which little is known about its epidemiology and the success of MDA measures (for review see Olsen et al. (2009)).

Instead of conventional drugs, many African patients (almost 70% of the people) rely on remedies of traditional healers and herbal practitioners (Agyare et al., 2009). Therefore, it is not surprising that plants or plant products have also been successfully used in the treatment of filarial (Ndjonka et al., 2011, 2013) and intestinal parasites (Waterman et al., 2010; Koné et al., 2012) and are also a considerable resource for nematode control in livestock and agriculture (Chitwood, 2002).

Furthermore, Fabricant and Farnsworth (2001) not only underline the importance to confirm the traditional use of herbal remedies by *in vitro* investigations, but also highlight the potential of ethnopharmacological approaches towards the discovery of new lead compounds that are certainly awaited.

In this study we aim to identify herbal remedies that are traditionally used to treat helminth infections in a defined area of Ghana and to confirm the efficacy of the most promising candidates revealed in the field study in a bioassay. By this approach we intend to support the ethnopharmacological use by *in vitro* data and to identify previously undescribed herbal drugs for this indication that could be the base for further phytochemical and pharmacological research.

## 2. Material and methods

### 2.1. Study area and survey

The ethnopharmacological survey was performed in Ashanti region in the central part of Ghana, located between 0.15–2.25°W and 5.50–7.46°N (Fig. 1). The region shares boundaries with four of the 10 political regions of Ghana. The region covers a total land area of 24,389 km<sup>2</sup>, representing 10.2% of the total land area of Ghana.

The ethnopharmacological survey was carried out from October 2012 to February 2013 in accordance with the national rights of Ghana and with acceptance and in close co-operation with Ghana National Association of Traditional Healers (GNATH). A house to house visitation strategy was employed for interviewing the practitioners. All participants were informed about the survey and personal visits were made to their facilities, centers and homes. In respect to the local tradition, some gifts in cash or kinds were given. Interviews and conversations were used to administer the questionnaires. Questionnaires were designed in English and administered to 50

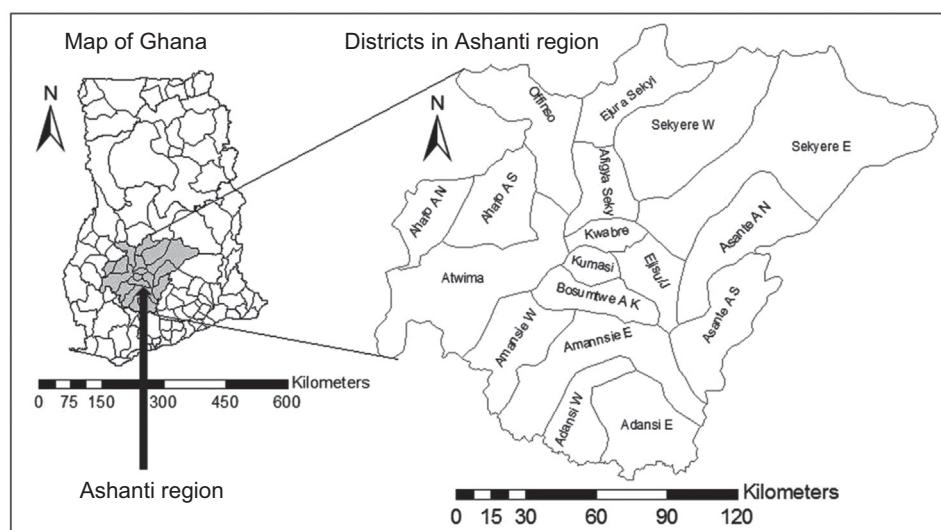


Fig. 1. Map of Ghana with Ashanti region (shaded) with detailed boundaries of all the districts (study area).

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