



Antiplasmodial potential of traditional antimalarial phytotherapy remedies used by the Kwale community of the Kenyan Coast



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ABSTRACT

Ethnopharmacological relevance: In Kenya, 22 million people are at risk of malaria, 70% of them are in rural areas and most of these people use traditional plant based medicines to treat malaria. The aim of the study was to escalate documentation, from an earlier study of medicinal plants, traditionally used to treat malaria by the Digo community of Kwale County, taking cognizance of their pharmacological information by evaluating their antiplasmodial efficacies.

Materials and methods: The study was carried out in Kwale County at Shimba Hills Game Reserve and adjoining part of Kinango. Traditional health practitioners (THP) were interviewed with a standard questionnaire to obtain information on medicinal plants traditionally used for management of malaria. Group interviews were also held among THPs and members of the community. The plant samples collected were tested for antiplasmodial activity against chloroquine sensitive (D6) and resistant (W2) *Plasmodium falciparum* using the ability of extracts, prepared from the plant species, to inhibit the incorporation of [G-3H] hypoxanthine into the malaria parasites.

Results: Fifty seven (57) species in forty eight (48) genera and thirty (30) families were documented and evaluated for in vitro antiplasmodial activity. Apocynaceae, Euphorbiaceae, and Rubiaceae families had each about 12% of the plant species reported as antimalarial remedy and represented the species that are most commonly used. Twelve species (21.1%) showed antiplasmodial efficacy of $IC_{50} < 5 \mu\text{g/ml}$ and these were *Boscia salicifolia*, *Cissampelos mucronata*, *Clerodendrum myricoides*, *Commiphora schimperi*, *Flueggea virosa*, *Maytenus undata*, *Maytenus senegalensis*, *Maytenus putterlickioides*, *Vernonia amygdalina*, *Warburgia stuhlmannii*, *Zanthoxylum chalybeum* and *Tabernaemontana pachysiphon*.

Conclusions: These results seem to indicate that ethnopharmacological inquiry used in search for new herbal remedies as predictive and could form the basis of an ethnopharmacopoeia and search for new active principles. This is the first report on traditional use of *T. pachysiphon* for malaria and its antiplasmodial activity.

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1. Introduction

Malaria is a major tropical parasitic disease responsible for significant morbidity and mortality and in the absence of practical preventive measures; the current options are chemoprophylaxis and chemotherapy (Hardie and Dürrheim, 2013). The chemotherapy of malaria is one of the medicinal fields that are known to use pharmaceuticals originating from natural product research;

examples are quinine from *Cinchona succirubra* and artemisinin from *Artemisia annua* (Kayser and Atta-ur-Rahman, 2002; Renslo, 2013). The use of natural product-derived drugs and drugs from other sources in combating malaria has however been faced with several challenges, including the emergence of drug resistance parasites. This has made many of the first line drugs such as chloroquine (CQ) not effective. The need for new drugs, preferably with new mode of action is therefore urgently needed (Jansen et al., 2012).

In Kenya, 22 million people are at risk of malaria, 70% of them are in rural areas. About 34,000 Kenyan children die every year from malaria compared to a total estimate of 42,000 people dead

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(DMS, 2006). Due to either limited availability or affordability of pharmaceutical medicines in many tropical countries, about 80% of the rural population in Africa depends on traditional herbal remedies (WHO, 2002b; Zirihhi et al., 2005). Although there is widespread use of traditional herbal remedies in the management of malaria (Gessler et al., 1995), scientific understanding of the plants is, however, largely unexplored (WHO, 2002a) and therefore, there is a need to collect ethnobotanical information on antimalarial plants which is essential for further evaluation of the efficacy and safety of the plants as antimalarial remedies. To meet the criteria of efficacy, safety and quality control like synthetic drug products (Wagner, 1997); the pharmacological, toxicological and phytochemical profiles of the extracts have to be scientifically evaluated.

Malaria is endemic in Kwale and prevalent in many other communities in Kenya. The situation has become worse with increasing drug resistance by the malaria parasite, *Plasmodium falciparum* (WHO, 2001). Western style healthcare provided by the government has been expanded in the last decades, but is often not readily available and many regions remain completely underserved. Subsequently, most communities still use herbal remedies as readily and cheaply available alternative. Many tribes in Africa have much elaborated plant knowledge (Barrow, 1996). Most knowledge on medicinal plants is transferred orally in many communities (Fratkin, 1996) and there is therefore the danger of losing this precious cultural heritage. In view of the rapid loss of natural habitats, traditional community life, cultural diversity and knowledge of medicinal plants, an increasing number of ethnobotanical inventories need to be established (Van Wyk et al., 2002). In most parts of Kwale, the traditional way of life and customary beliefs are however, quite intact and the acceptability of antimalarial and other medicinal plants as claimed effective remedies is quite high among the population of this area.

The Kaya forests were the traditional social-cultural focal point of the Digo community in Kwale County, one of the nine deeply traditional ethnic groups that form the Mijikenda community of the coast province. More than half of the Kenyan's rare plants grow in the coastal region; most have been identified within the Kaya forest patches, which comprise about 10% of the Kenya's coastal forest. The traditional medicinal knowledge from the resources of these forests, in possession of a few traditional healers, requires documentation for the benefit of current and future scientific research on the plants to determine their efficacy, safety and phytochemical properties. As a follow up of an earlier ethnobotanical study, twenty-five (25) species in twenty one (21) genera and sixteen (16) families (Muthaura et al., 2007a) were encountered; in the present study this escalated to fifty seven (57) species in forty eight (48) genera and thirty (30) families were documented. In addition, the *in vitro* antiplasmodial efficacy of the plant species was carried out as a step in proposing appropriate scientific measures through ethnopharmacological evaluation of the plant extracts for further pharmacological and phytochemical studies.

2. Materials and methods

2.1. Study area

In Kwale County, the study area centered around at 4°12' S and 39°25' E in the Shimba Hills Forest Game Reserve and in Kinango division (Fig. 1). The area is hot and humid all year round with annual mean temperatures ranging between 23 °C and 34 °C and the average relative humidity ranging between 60% and 80%. The Coastal uplands commonly known as Shimba Hills rise steeply from the Coastal belt to 462 m above sea level. The soils are made of sandstone and grit and are fairly fertile for cultivation. The type of climate is monsoon, hot and dry from January to April while

June to August is the coolest period. Rainfall comes in two seasons with long rains from March/April to July and short rains from October to December. The total precipitation varies from 900 mm to 1500 mm per annum along the Coastal belt to 500–600 mm in the hinterland, which comprises 92% of the land whose agricultural potential is low (Muthaura et al., 2007a).

The population of Kwale County is 649,931 (2009 National Population Census Report) people, inhabited mainly by the Digo and Duruma who belong to the Mijikenda ethnic group of Coastal Kenya. The Digo are the major Bantu tribe, 90% of who are Muslim and are concentrated on the Southern Coastal strip of Kenya between Mombasa and the border with Tanzania. The community is rural and depends on agriculture as its major source of livelihood. In most parts of Kwale, the traditional way of life and customary beliefs are quite intact (Muthaura et al., 2007a). Traditional practices (such as animism and ancestor worship) have more influence on the Digo community than does Islam. The Kaya forests are the traditional social-cultural focal point of the Digo community. The medicinal knowledge of the Digo is considered communal. However, the Kaya elders are reputed as historical repository holders of cultural knowledge, with a comprehensive understanding of the Digo plant knowledge. These are revered and trusted people in the community and play multiple roles as spiritual guides, counselors and healers. These attributes and the knowledge on the use of medicinal plants were bequeathed to them from their fathers, albeit orally, from generation to generation (Muthaura et al., 2007a). The spirit of the departed THP was supposed to possess the chosen THP who would in turn keep the knowledge to himself and only transmit it to a lineage in the family a few years before death (Muthaura et al., 2007a).

The community plant knowledge is inseparable from the day-to-day life of the people, and the acceptability of antimalarial and other medicinal plants as claimed effective remedies is quite high among the population. Malaria is common in the study area and is associated with significant morbidity and mortality, especially children aged 5 years of age and below and pregnant women (DMS, 2006). The prevalence of *P. falciparum* malaria is reported to exceed 50% and the area is classified as a malaria endemic zone (DMS, 2006). Most parts of the County are remote and health facilities far apart. The inhabitants are generally poor and cannot afford conventional antimalarial drugs (Nguta et al., 2010) with consequent widespread use of traditional medicine. The traditional medicinal knowledge from the resources of the forests, in possession of a few traditional healers requires documentation and evaluation of their efficacy for the benefit of current and future generations.

2.2. Data collection

Fieldwork to collect plant material was carried in the month of October and December, 2008. Permission for a sustainable plant harvesting was granted by KWS at the Shimba Hills Forest Game Reserve, and the local community outside the forest areas. To obtain information on medicinal plants traditionally used for the management of malaria, local people facilitated access to THPs who were interviewed with a standard questionnaire. Prior to surveys in each area, a research assistant was identified who had grown up in the area and knew the people and the local language well. Several contacts were made with THPs before the actual interview to win their trust. A taxonomist who was conversant with the flora of the area was part of the collection team. Nine THPs (2 women and 7 men; mean age: 55 years) were interviewed.

2.3. Collection of plant samples

Traditionally the disease is treated in function of symptomatology and those plant parts claimed to treat malaria, fevers and joint

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