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Medicinal plants used by the people of Nsukka Local Government Area, south-eastern Nigeria for the treatment of malaria: An ethnobotanical survey

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Chemical compounds studied in this article:
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Allicin (PubChem CID: 65036)
Azadirachtin (PubChem CID: 5281303)
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Damnacanthal (PubChem CID 2948)
Hydroxyvernolide (PubChem CID: 5281472)
Gedunin (PubChem CID: 12004512)
Jatrorrhizine (PubChem CID: 72323)
Nimbolide (PubChem CID: 100017)
Oleanolic acid (PubChem CID: 10494
Palmatine (PubChem CID: 19009)
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ABSTRACT

Ethnobotanical relevance: Malaria is a serious public health problem especially in sub-Saharan African countries such as Nigeria. The causative parasite is increasingly developing resistance to the existing drugs. There is urgent need for alternative and affordable therapy from medicinal plants which have been used by the indigenous people for many years.
Aim of study: This study was conducted to document the medicinal plant species traditionally used by the people of Nsukka Local Government Area in south-eastern Nigeria for the treatment of malaria.
Methods: A total of 213 respondents, represented by women (59.2%) and men (40.8%), were interviewed using a semi-structured questionnaire. The results were analysed and discussed in the context of previously published information on anti-malarial and phytochemical studies of the identified plants.
Results: The survey revealed that 50 plant species belonging to 30 botanical families were used in this region for the treatment of malaria. The most cited families were Apocynaceae (13.3%), Annonaceae (10.0%), Asteraceae (10.0%), Lamiaceae (10.0%), Poaceae (10.0%), Rubiaceae (10.0%) and Rutaceae (10.0%). The most cited plant species were *Azadirachta indica* (11.3%), *Mangifera indica* (9.1%), *Carica papaya* (8.5%), *Cymbopogon citratus* (8.5%) and *Psidium guajava* (8.5%).
Conclusion: The present findings showed that the people of Nsukka use a large variety of plants for the treatment of malaria. The identified plants are currently undergoing screening for anti-malarial, toxicity and chemical studies in our laboratory.

1. Introduction

According to a recent World Health Organization (WHO) report, nearly half of the world's population is at risk of malaria. In 2015, there were roughly 212 million malaria cases and an estimated 429,000 malaria deaths with sub-Saharan Africa having high share of the global malaria burden (90% of malaria cases and 92% of malaria deaths) (WHO, 2015). Nigeria accounts for a quarter of all malaria cases in Africa (WHO, 2008) and transmission occurs all year round especially in the southern part of the country where there are more rain forests. The Federal Ministry of Health (2004) report shows that malaria is the most common disease in Nigeria and half of its population will have one or more malaria attacks annually (Adebayoa and Krettli, 2011).

Malaria in humans is caused by five species of parasites belonging to the genus *Plasmodium*. Four of these – *P. falciparum, P. vivax, P. malariae* and *P. ovale* – are human malaria species that are spread from one person to another *via* the bite of female mosquitoes of the genus *Anopheles*. The fifth *Plasmodium* specie (*P. knowlesi*) is not spread from person to person but rather, occurs in people when an *Anopheles* mosquito infected by a monkey bites and infects humans. Of the five species of the protozoan genus that cause malaria in humans, *P. falciparium* is the most deadly (WHO, 2015). With the recent reports of increasing resistance of the *Plasmodium* organisms to the existing drugs in many endemic areas (WHO, 2011), including the newly introduced

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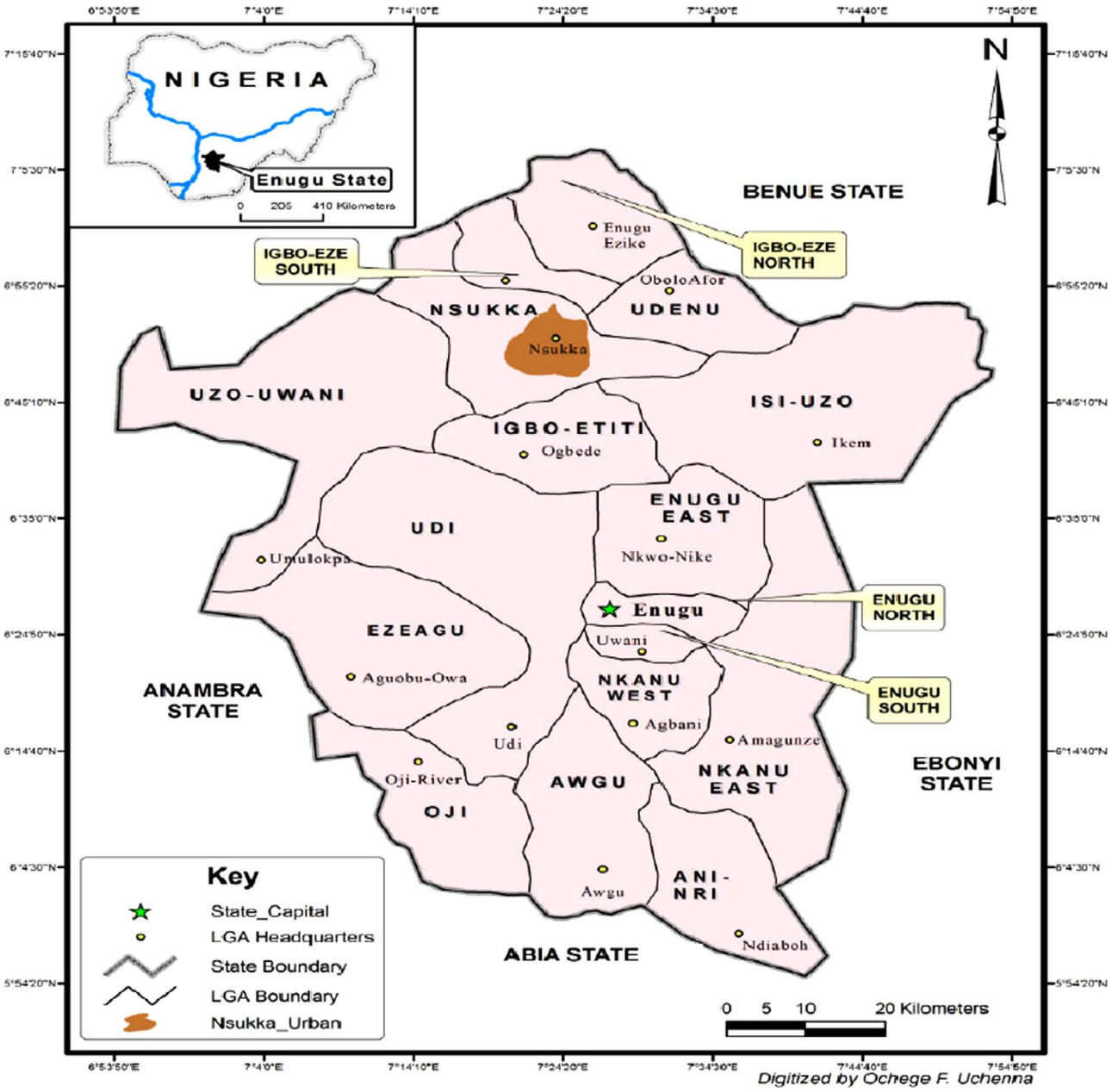

Fig. 1. Map of Enugu State showing the study region. (Source: Department of Geography, University of Nigeria, Nsukka).

artemisinin-based compounds (Cui et al., 2012; Htut, 2009), there is presently a deep concern that the parasite will soon develop total resistance to the orthodox drugs (Dike et al., 2012). This concern becomes more worrisome given the fact that the mosquito vector has also developed resistance against insecticides, such as dichloro-diphenyltrichloroethane (DDT) while chemoprophylaxis has not often yielded the expected results (Ntie-Kang et al., 2014; White, 2004). Hence, there is urgent global need to search for more effective and safer drugs to combat the disease.

Medicinal plants have been used in the traditional treatment of malaria for thousands of years due to their efficacy, safety, lower cost and availability. There are documentations of over 1200 plant species from 160 families used in the treatment of malaria or fever (Willcox and Bodeker, 2004). In addition, medicinal plants are the source of the two most successful anti-malarial drugs, artemisinin and quinine (Batista et al., 2009; Willcox and Bodeker, 2004). In view of the above, exploration of the naturally endowed rich biodiversity of indigenous communities, therefore, becomes quite paramount. Ethnobotany is the scientific study of the traditional classification and uses of plants in different human societies for food, clothing, medicine and other activities (Aiyeloja and Bello, 2006). Documentation is necessary for the conservation and proper utilization of such plants (Dike et al., 2012; Muthu et al., 2006). In addition, documentation of traditional medicines could facilitate future research on the safety and efficacy of medicinal plants which is necessary for the identification of anti-malarial compounds for subsequent development of standardized phytomedicines (Ngarivhume et al., 2015). Indeed, ethnobotanical and ethnopharmacological studies are now considered the most viable methods of identifying new medicinal plants for use or for future research (Balick, 1990, 1994; Cotton, 1996).

Several ethnobotanical studies on plants used to treat malaria have been reported in various parts of the world such as Brazil (Milliken, 1997), India (Namsa et al., 2011), Malaysia (Al-Adhroey et al., 2010) and Africa (reviewed in: Chinsembu, 2015; Lawal et al., 2015). In Nigeria, similar studies have been documented in the northern (Ampitan, 2013; Ene et al., 2010), south-western (Dike et al., 2012; Idowu et al.,