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• Research Article

In vivo antimalarial activity and toxicological effects of methanolic extract of *Cocos nucifera* (Dwarf red variety) husk fibre

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OBJECTIVE: Phytochemical constituents as well as antimalarial and toxicity potentials of the methanolic extract of the husk fibre of Dwarf Red variety of *Cocos nucifera* were evaluated in this study.
METHODS: The dried powdered husk fibre was exhaustively extracted with hexane, ethyl acetate and methanol successively and the methanolic extract was screened for flavonoids, phenolics, tannins, alkaloids, steroids, triterpenes, phlobatannins, anthraquinones and glycosides. A 4-day suppressive antimalarial test was carried out using *Plasmodium berghei* NK65-infected mice, to which the extract was administered at doses of 31.25, 62.5, 125, 250 and 500 mg/kg body weight (BW). Toxicity of the extract was evaluated in rats using selected hematological parameters and organ function indices after orally administering doses of 25, 50 and 100 mg/kg BW for 14 d.
RESULTS: Phytochemical analysis revealed the presence of alkaloids, tannins, phenolics, saponins, glycosides, steroids and anthraquinones in the extract. Moreover, the extract reduced parasitemia by 39.2% and 45.8% at doses of 250 and 500 mg/kg BW respectively on day 8 post-inoculation. Various hematological parameters evaluated were not significantly altered (P>0.05) at all doses of the extract, except red blood cell count which was significantly elevated (P<0.05) at 100 mg/kg BW. The extract significantly increased (P<0.05) urea, creatinine, cholesterol, high-density lipoprotein-cholesterol and bilirubin concentrations in the serum as well as atherogenic index, while it reduced albumin concentration significantly (P<0.05) at higher doses compared to the controls. Alanine aminotransferase activity was reduced in the liver and heart significantly (P<0.05) but was increased in the serum significantly (P<0.05) at higher doses of the extract compared to the controls.
CONCLUSION: The results suggest that methanolic extract of the Dwarf red variety has partial antimalarial activity at higher doses, but is capable of impairing normal kidney and liver function as well as predisposing subjects to cardiovascular diseases.
KEYWORDS: herbal drugs; *Cocos*; antimalarials; toxicity; *Plasmodium berghei*; rats; mice

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1 Introduction

Malaria is an infectious disease caused by *Plasmodium* species. Malaria is a prominent cause of human morbidity and mortality. About 1 million deaths occur per year worldwide as a result of *Plasmodium* infections[1], especially among children under 5 years of age in sub-Saharan African countries. The disease has been eradicated in most temperate zones but it continues to be endemic in the tropics and subtropics, with 40% of the world's population at risk[2].

Though significant progress has been made in malaria treatment, the disease has staged a huge comeback due to the development of drug resistant parasites[3,4]. Also, many of the potent drugs (the artemisinin-based combination therapies) are too expensive for the poor populations typically dwelling in rural areas. Thus, many people in both rural and urban areas have adopted alternative therapies including herbs, due to their lower cost and cultural familiarity with their use. One of such plants is *Cocos nucifera* Linn, commonly referred to as coconut in English. The decoction of the husk fibre of *C. nucifera* is indigenously used for the treatment of malaria, and its efficacy has been scientifically authenticated, with the ethyl acetate extract of the most common variety (West African Tall variety) showing a high degree of antimalarial activity[5,6].

In recent years, there has been increasing interest in cost-effective natural products that have potent antimalarial properties. In this manner, our group has been screening some medicinal plants for antimalarial properties. We have evaluated the husk fibre of various varieties of *C. nucifera* for their antimalarial activity *in vitro*, of which only the West African Tall variety was found to be active [5,6]. However, our experience with *Clerodendrum violaceum* leaf extract, which was inactive *in vitro* but active *in vivo* (unpublished data), prompted the investigation of the antimalarial activity of other inactive varieties of *C. nucifera in vivo*. Thus, this study investigated the antimalarial activity and toxicity of the methanolic extract of the husk fibre of Dwarf red variety of *C. nucifera in vivo*.

2 Materials and methods

2.1 Materials

2.1.1 Reagents

Disodium hydrogen phosphate and potassium dihydrogen phosphate were obtained from Tianjin Kermel Chemical Reagent Co., Ltd., Tianjin, China. Immersion oil was purchased from Panzonar Laboratory Supplies, Canada. Chloroquine diphosphate salt and Giemsa stain were obtained from Sigma Chemical Company, St. Louis, MO, USA. Assay kits for the determination of serum creatinine, urea, bilirubin, albumin, total cholesterol and high-density lipoprotein (HDL)-cholesterol concentrations were products of Randox Laboratories Ltd., UK. All other chemicals used were of analytical grade.

2.1.2 Parasite strain

Plasmodium berghei (NK65), a chloroquine-sensitive strain, was obtained from the Institute for Advanced Medical Research and Training (IAMRAT), College of Medicine, University of Ibadan, Ibadan, Nigeria.

2.1.3 Animals

Thirty-five adult Swiss albino mice with an average weight of (18±2) g were obtained from the Animal Breeding Unit of the Faculty of Pharmacy, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria, while twenty adult male albino rats of Wistar strain with average weight of (112±2) g were obtained from the Small Animal Holding Unit of the Department of Biochemistry, University of Ilorin, Ilorin, Kwara State, Nigeria.

2.1.4 Plant material

Husk fibres of *C. nucifera* (Dwarf red variety) dried in the shade at room temperature were obtained from Nigeria Institute for Oil Palm Research (NIFOR), Badagry, Lagos State, Nigeria, in March, 2010. It was botanically authenticated at NIFOR by Mr. Igbene Collins.

2.2 Methods

2.2.1 Preparation of extracts

The extract was prepared as described in a previous study[7]. The dried husk fibers of the *C. nucifera* (Dwarf red variety) were pulverized to powder. The powder (450 g) was successively extracted with 4 L n-hexane, 4 L ethyl acetate and 4 L absolute methanol for 72 h per solvent. The extracts were filtered using Whatman filter paper No. 1 and then concentrated. The concentrates were then exposed to air and residual solvent was allowed to evaporate at room temperature to obtain the dry extract. The percentage yield for the methanolic extract (which was used for the present study) was 0.84%.

2.2.2 Qualitative phytochemical screening

The extract was screened for flavonoids, phenolics, tannins, alkaloids, steroids, triterpenes, phlobatannins, anthraquinones and glycosides using methods described by Odebiyi and Sofowora[8].

2.2.3 Animal handling

The animals were housed in standard plastic cages and were maintained under standard conditions (12 h light-dark cycle). They had access to feed (Bendel Feeds, Ewu, Delta State, Nigeria) and clean tap water *ad libitum*.

2.2.4 Antimalarial studies

A 4-day suppressive test[9] was used with some modifications[10]. Blood was obtained from the tail of a donor mouse (infected with *P. berghei* NK65) with known parasitemia (>15%) into a sample bottle containing 2 mL citrate/glucose solution. The number of infected red blood cells (RBCs) was counted using a hemocytometer. The

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