



## RESEARCH PAPER

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## *In vitro* antimalarial activity of essential oils of *Deverra scoparia* Coss. & Dur

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### Abstract

The essential oils of the plant *Deverra scoparia* Coss. & Dur. (Apiaceae) used in traditional medicine in Algeria were subjected to testing the antimalarial activity. Their potential ability to inhibit the *in vitro* proliferation was evaluated in two strains of *Plasmodium falciparum*; chloroquine-resistant (K1), and chloroquine-sensitive (3d7) strains. The essential oils displayed good antimalarial activity with IC<sub>50</sub> values  $1.51 \pm 0.71$  µg/mL and  $0.93 \pm 0.89$  µg/mL against the 3d7 chloroquine-sensitive and the K1 chloroquine-resistant strains respectively. So, *Deverra scoparia* presented a potential source of antimalarial molecules.

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## Introduction

The genus *Deverra* or *Pituranthos* (Apiaceae) is a perennial plant (Ozenda, 1983), possesses more than twenty species, some of which are specific to northern Africa and are often found in arid or desert regions (Quezel and Santa, 1963). In Algeria, this genus has (03) three endemic species: *Deverra scoparia* Coss. & Dur. or *Pituranthos scoparius* Benth. & Hook; *Pituranthos chloranthus* Benth. & Hook; *Pituranthos battandrieri* (Ozenda, 1983). The genus *Deverra* is widely used in traditional pharmacopoeia in many areas and the pharmacological properties of some species have been validated by appropriate tests (Abdelwahed *et al.*, 2006; Djeridane *et al.*, 2008). Some species are used against diabetes, fever, urinary tract infections, stomach pain, intestinal parasites, asthma, hepatitis and to relieve the pain associated with rheumatism (Bellakhdar, 1997; Hammiche *et al.*, 2006).

Malaria is a potentially fatal parasitic disease caused by protozoa of the genus *Plasmodium*. *P. falciparum*, the specie responsible for the vast majority of infections (Kamatou *et al.*, 2008). The disease remains a global problem with consequences for both the health and economic potential of the world's poorest endemoepidemic communities. There were an estimated 247 million malaria cases among 3.3 billion people at risk in 2006, causing nearly a million deaths, mostly of children under 5 years. 109 countries were endemic for malaria in 2008, 45 within the WHO African region. In 2007, according to the WHO report, about 40% of the world's population, mostly in the poorest countries of the world, is exposed to malaria. Every year, more than 500 million people are seriously affected (WHO, 2008). In Algeria, however, malaria cases has occurred regularly since the 1980s introduced by infected patients using the newtrans-Sahara route. In 2002, for example, 300 malaria cases were recorded in Algeria, 255 of them were imported (Hammadi *et al.*, 2009). Drug resistance of malaria parasites has become an issue of utmost concern and complicates treatment, but an antimalarial vaccine that could be protective against this disease is not yet available.

It is also necessary to find new effective and affordable therapies. Medicinal plants could be a potential source of antimalarial agents (Sanon *et al.*, 2013). A view of literature has not revealed any previous researches on the antimalarial activity of *Deverra scoparia* Coss. & Dur. essential oils.

## Materials and methods

### Plant material

The aerial parts of *D. scoparia* Coss. & Dur. were collected during January 2013 from Tamanrasset (23° 81' 756" N, 05° 93' 888" E), south of Algeria. The identification was performed according to botanists of the National Forest Research Institute in Tamanrasset. The voucher specimens (PM/02) were available at the Herbarium of the Laboratory of Biogeochemistry of Desert Environments, University of Ouargla, Algeria.

### Essential oil extraction

The essential oils from dried plant were extracted by hydrodistillation using a Clevenger-type apparatus for 4 h. The oils were stored in sealed glass vials at 4°C prior to analysis.

### Antimalarial activity

The essential oils of *D. scoparia* were tested *in vitro* against two reference clones of *Plasmodium falciparum*: the chloroquine-resistant (K1) and the chloroquine-sensitive (3d7) strains. The malaria strains were maintained in continuous culture in O<sup>+</sup> human erythrocytes using RPMI 1640 (Mega Cell, Sigma Aldrich, USA) medium supplemented with 2-hydroxyethylpiperazine- N-ethanesulfonic acid (HEPES acid) (25mM; Gibco-BRL, Paisley, Scotland), NaHCO<sub>3</sub>(25 mM), 1% Albumax and washed erythrocytes to yield a final haematocrit of 4%. The culture flasks were incubated at 37°C in a CO<sub>2</sub> incubator (Hera Cell 150, Forma Scientific), with 2% O<sub>2</sub>, 5% CO<sub>2</sub>, 93% N<sub>2</sub> and 90% humidity.

The essential oils or reference control (chloroquine diphosphate salt (CQ) (Sigma Aldrich) was applied in a series of seven duplicate dilutions and dissolved in DMSO.

Infected and non-infected erythrocytes O<sup>+</sup> were used as positive and negative controls, respectively. Parasite growth was determined by measuring the content of *Plasmodium* lactate dehydrogenase (pLDH) using Malstat, NTB/PES reagents. The 96-well microplates were read using a spectrophotometer (Biotek EL x 808) at a wavelength of 650 nm (Sanon *et al.*, 2013). MatLab version 2016 was used to plot inhibition curves and calculate the inhibition

concentrations of drugs that reduced the level of parasitaemia to 50% (IC<sub>50</sub>).

### Results and discussion

The result of the *in vitro* antimalarial activity of *Deverra* essential oils against the chloroquine-resistant and the chloroquine-sensitive *P. falciparum* was shown in Table 1.

**Table 1.** IC<sub>50</sub> values of the antimalarial activity of the essential oils against *P. falciparum*.

Antimalarial activity	IC <sub>50</sub> (3d7) (µg/mL)	IC <sub>50</sub> (k1) (µg/mL)
Essential oils	1.51 ± 0.71	0.93 ± 0.89
Reference control (CQ)	4.81 ± 1.17	23.36 ± 1.17

CQ, chloroquine diphosphate salt; K1, chloroquine-resistant *P. falciparum*; 3d7, chloroquine-sensitive *P. falciparum*.

The essential oils have a good antimalarial activity with IC<sub>50</sub> value: 1.51 ± 0.71 µg/mL against the 3d7 strain and 0.93 ± 0.89 µg/mL against K1. The essential oils were more potent against the parasites than the antimalarial reference (CQ) (IC<sub>50</sub> values: 4.81 ± 1.17 and 23.36 ± 1.17 µg/mL against 3d7 and K1 respectively).

Less of *in vitro* studies demonstrated that *Deverra* species displayed antiplasmodial activity.  $\alpha$ -Bornyl acetate (31.99%) and  $\alpha$ -Pinene (12.05%) were the major compounds detected in the essential oils of *D.scoparia* from south Algeria (Hammoudi *et al.*, 2015). These compounds may therefore be responsible for the antimalarial activity of the oils.

Kamatou *et al.* (2008) confirmed that the antimalarial activity of essential oils may be attributed to their high sesquiterpene content.

In theory, fractionation leading to the isolation of individual compounds should result in aliquots having higher activity than the original extract. The activity may also be due to the fact that synergy or antagonist might account for the better activity of mixture than isolated compounds or inverse (Kamatou *et al.*, 2008).

In this study, The essential oils of *Deverra scoparia* showed good antimalarial activity with IC<sub>50</sub> < 5 µg/mL. So, it is suggested that future studies should consider this plant as a potential source of antiplasmodial molecules.

A further study is also necessary to determine the toxicity of the essential oils and their components.

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