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Insecticidal Ability of Essential Oil Content of *Eucalyptus camaldulensis* from Onigambari Forest Reserve, South West, Nigeria

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ABSTRACT

Biodegradable and ecologically natural products such as essential oils are emerging candidates for the replacement of usually applied chemical pesticides. This work reported the chemical composition andeffects caused by leaves essential oils (EOs) from *Eucalyptus camaldulensis*. Leaves of *Eucalyptus camaldulensis* gave 1.36 % w/w oil dried weight basis. GC-MS analysis of the oils resulted in theidentification of 15 constituents, representing 96.24% of the oil. 1,8-cineole (CIN) (65.26%), ?-terpinene(18.45%), o-cymene (13.55%) and terpinen-4-ol (7.01%) were the major components of *E. camaldulensis*.From the results; *E. camaldulensis* leaf oils have great potential and can be utilized as cheap sources for thecommercial isolation of 1,8-cineole.

Keywords: Eucalyptus camaldulensis, Essential oil composition, Nigeria, 1,8- cineole, Insecticidal properties, Secondary metabolite.

INTRODUCTION

Among the families of plants investigated to date, the one that shows great potential is the Myrtaceae family. Myrtaceae family or the myrtle family is made up of more than 3,800 species of trees and shrubs that are present in temperate, subtropical, and tropical regions of the world.

The main genera are *Eucalyptus*, *Eugenia*, *Melaleuca*, *Leptospermum*, *Myrtus*, *Pimenta*, *Psidium*, and *Syzygium*. Species of the Myrtaceae family provide many useful products, including timber and essential oils, and contain a number of economically important species. They're also rich sources of essential oils containing bioactive constituents [2]. The Myrtaceae family contains volatile compounds of great economic importance. The leaves and the stems of several species are sources of essential oils used for medicinal purposes, food, perfume, cosmetic and pharmaceutical industries [6]. The volatile oil of the *Eucalyptus* hasa number of constituents (terpenes) such as cineole, phellandrene, and globular, which occur in different proportions depending on the species and can vary within species depending on many factors including subspecies and specific environmental conditions. Less than 20 of the over 700 species of *Eucalyptus* appear to have been used for the commercial extraction of oil [4].

Several storage systems utilize chemical pesticides and fumigants as the most economical and common practice [1]. Insect strains are resistant to pesticides, toxic residues for human consumption, acute and chronic toxicity for workers, and adverse effects on the environment have been reported in, other countries [7].

Studies indicate that essential oils (EOs), plant secondary metabolites, may affect significantly the plant resistance to parasites and microorganisms. The active components are monoterpenes and sesquiterpenes (hydrocarbon and oxygenated terpenoid derivatives), and aliphatic compounds such as alkanes, alkenes, ketones, aldehydes, acids, and alcohols.

Secondary metabolites play an important role in the adaptation of plants to the environment and in overcoming stress conditions. Biotic and abiotic factors may alter plant growth and the production and composition of secondary metabolites. Also, in previous work, we describe the effect of drought stress onthe EO composition in leaves from *E. camaldulensis* Dehnh.. Another factor that can modify the composition of EOs is the ontogenetic stage of plants, so in this paper, we check the EO content of *Eucalyptus camaldulensis* from Nigeria to see the secondary metabolites that may be responsible for their insecticidal abilities.

MATERIALS AND METHOD

2.1 Extraction of Essential Oils and chemical analysis

Essential oils were extracted from Eucalyptus camaldulensis collected in June 2020 from Onigambari Forest Reserve (7°51'9.25" N 3° 55' 52.50" E) Oyo State, Nigeria. The essential oils were extracted from freshly collected leaves (100 g) by hydrodistillation using a modified Clevenger steam distillation apparatus for 2 hours. EO was stored at - 18 °C, in an amber bottle with anhydrous sodium sulfate, until chromatographic analysis. Essential oil content was calculated for each repetition (n = 4) and expressed as a percentage (v/w, fresh weight). Gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) were performed to evaluate qualitative and quantitative changes in composition in EOs..

A volume of 1µL of each sample, dissolved in CH2Cl2 (1:100 v/v), was injected. Relative abundances of EO-type components were determined by GC by means of a gas chromatograph (7890A, Agilent Technologies, Santa Clara, California, USA) equipped with a flame ionization detector (FID) using an HP-5 (phenyl methyl siloxane, 30 m × 250 µm id × 0.25 µm) capillary column. Nitrogen was used as carrier gas and hexadecane as the internal standard. Temperature program: Initial temperature 60 °C (2 min), 60 °C to 280 °C with a ramp of 8 °C min-1; injector and detector temperature 250 °C. Qualitative identification ofthe different terpenes was based on a comparison of their retention times to n-alkanes, compared to published data, and confirmed by co-chromatography with authentic samples. Response factors were determined for standard commercial samples, and as expected when FID is used, they did not differ significantly from unity. Determination of individual compounds was achieved by capillary GC electron impact mass spectrometry (GC-MS; GC-6890, Agilent Technologies) coupled to a mass spectrometer (MSD 5973, Agilent Technologies) with the same characteristics column and identical operating conditions tothose previously used for GC. Helium was used as a carrier gas, and the ionization voltage applied was 70eV, mass ranges m/z 40-400 Da.

RESULTS AND DISCUSSION

The chemical composition of *E. camaldulensis* leaf oils from the Onigambari forest reserve was investigated for essential oils composition. The total yield of leaf essential oils of the Myrtaceae species; *E. camaldulensis* was 1.36 % w/w based on the dried weight. This is in slight contrast to the works of *[3]*,which got a total yield of 1.4% from the study conducted in Malaysia. It can be suggested that thedifferences in the yield and constituents of the oils could be attributed to the differences in location, genetic, geographical, and environmental conditions.

The chemical composition of the leaf essential oils described above was assessed using the GC-MS technique and resulted in the identification of 15 compounds of essential oil components from

E. camaldulensis representing 96.24% of the essential oil. *E. camaldulensis* oil main components are 1,8-cineole (CIN)(65.26%),?-terpinene (18.45%), o-cymene (13.55%) and terpinen-4-ol (7.01%). In addition, componentssuch as Linalool (0.06) and Cis-Sabinol (0.01) were identified in trace amounts in *E. camaldulensis* oils in this study (Table 1).

The chemical composition of E. camaldulensis and E. viminalis essential oils investigated in some previous studies have obvious differences from the present findings. For example, γ-terpinene (42.5%), 1,8-cineole (33.6%), p-cymene (17.5%), and terpinene-4-ol (3.9%) were determined as the main components of E. camaldulensis essential oil in the study of Siramon et al [5],

In the study of [2], it was concluded that 1,8-cineole (CIN) was largely responsible for the pesticidal properties of Eucalyptus spp. Recent studies have also shown that the toxicity of several constituents of EOs such as 1,8-cineole, chavacol, p-cymene, limonene, linalool, myrcene, α-pinene, γ-terpinene, terpinene-4-ol, and α-terpineol can be considered as the main reasons for the insecticidal activities from the Myrtaceae family on insect pests [3].

Regarding the toxicity of eucalyptus oils, not much is known; but EOs is considered to reduce the harmful effect of conventional insecticides on humans and the environment. However, several works have been conducted to prove the toxicity of the EO of this plant species for instance 1,8-Cineole have proven toxicity against the larvae of Culex quinquefasciatus Say. Fumigant toxicity against the adults of S. oryzae [1].

Table 1: Composition of Essential Oil from the leaf of E. camaldulensis.

s/n	Chemical Composition	RI	Relative Percentage (%) *E. camaldulensis*
1	α-Pinene	931	0.54
2	α-Phellandrene	1003	0.02
3	α-Terpinene	1015	0.19
4	o-Cymene	1024	13.55
5	Limonene	1027	0.48
6	1,8-cineole	1029	65.26
7	γ-Terpinene	1062	18.45
8	Terpinolene	1087	1.10
9	Linalool	1101	0.06
10	cis-Sabinol	1131	0.01
11	Terpinen-4-ol	1178	7.01
12	α-Terpineol	1191	0.10
13	Piperitone	1253	0.01
14	Thymol	1291	0.07
15	Charvacrol	1294	0.04

RI=Retention Index is relative to C8-C20 n-alkanes on the HP-5MS column.

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CONCLUSION

The higher percentage of 1,8-cineole (65.26%) and γ-terpinene (18.45%) in E. camaldulensis leaf oils from Onigambari forest reserve have great potential and can be useful for insect control, hence, the leaves of this plant species could be utilized as potential sources for the commercial isolation of 1,8-cineole, O-Cymene, and γ-terpinene.

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