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Chemical Analysis and Antioxidant Studies of the Essential Oil of *Chenopodium ambrosioides* (L.) Growing Wild in South-West Nigeria

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ABSTRACT

Chenopodium ambrosioides L. is an aromatic herb widely used in traditional medicine in South-West Nigeria. The essential oil from the leaves is the main component used as an anthelmintic and for treatment of influenza. Due to observed chemical differences in medicinal plants of the same species, this research studied the South Western Nigerian variety of *Chenopodium ambrosioides* plant for its essential oil composition and radical scavenging activity. About 500 g of fresh leaves of C*henopodium ambrosioides* collected from Akure town, Nigeria, was subjected to hydro-distillation for 2 hours using an all-glass Clevenger-type apparatus. Extraction was repeated several times to get enough oil for analyses. The essential oil from the leaves of the species was analyzed for their chemical composition using Gas Chromatography-Mass Spectroscopy (GC-MS). A study of the radical scavenging activity of the essential oil and standard radical scavenging agent, butylated hydroxylanisole (BHA) was carried out using 2,2-diphenyl-1-picrylhydrazyl (DPPH) method. The major components of the essential oil of *C. Ambrosioides* were α-terpinene (41.36%), α-terpinenyl-acetate (31.81%), thymol (8.23%), carvacrol (6.70%) and p-cymene (5.76%). The *Chenopodium ambrosioides* essential oil possessed chemical compounds that were different from studies from other countries. The essential oil possesses antioxidant activity which ranged between 3.07 and 43.9% compared to the BHA standard that ranged between 65 and 84% within the same concentration ranges.

Keywords: Essential oil,terpinene, antioxidant, C*henopodium ambrosioides*

INTRODUCTION

Spices and their products have been sources of medicine for mankind but became relegated on the advent of modern medicine. However, in recent years, plants' secondary metabolites like Essential oils (EO) have gained popularity for applications as pharmaceuticals because they

arenon-toxic and eco-friendly. It is believed that about 75% of people in the third world countries depend on plants and or plants' extracts for their medical needs [1].

Essential oils are complex mixtures of volatile compounds which are mostly monoterpenes and sesquiterpenes [2]. However, essential oils which could be obtained from any part of plants [3], are also composed of oxygenated derivatives such as aldehydes, ketones, alcohols, phenols, acids, ethers and esters [4].

*Chenopodium ambrosioides*L. (Plate 1) is an aromatic plant species that is common and well known (because of its strong odor) locally as '*Arunpale*' and valued for its medicinal properties (Anthelmintic, emollient anti-rheumatism and anti-tumor) among the Yoruba speaking people of South-west Nigeria [5]. The plant species is found native in different corners of the world and used to cure varying illnesses [6-8]. *Chenopodium ambrosioides* has also been reported to be a potent remedy for ascaridiasis [9].

Nigeria is rich with essential oil bearing plants, many of which are completely neglected or underutilized and for which data regarding to their chemical profiles and medicinal potentials are limited. In this research, the chemical constituents and antioxidant activity studies of the essential oil from *Chenopodium ambrosioides* L. growing wild in South-west Nigeria was undertaken.

Plate 1: *Chenopodium ambrosioides* plant

MATERIALS AND METHODS

Fresh plants of C*henopodium ambrosioides* were collected within Akure metropolis, Nigeria, where the plants grow along foot paths and at back yards. Identification was carried out at the School of Agriculture and Agricultural Technology, Federal University of Technology, Akure, Nigeria.

Extraction of Essential Oils

The leaves of C*henopodium ambrosioides* were collected, then washed, and rinsed with distilled water before cutting into small sizes with a pair of scissors. The plant samples were hydro-distilled for 3 h separately in an all-glass Clevenger-type apparatus. The essential oil was stored in airtight sample bottle and stored in the refrigerator before analysis.

Gas Chromatography Analysis

Gas Chromatography analysis of the extracted oil was carried out in a research laboratory, at Lagos State, Nigeria, using Perkin-Elmer Auto System (HP 6890 powered with HP ChemStation Rev. A09.01 (1206) Software) equipped with a dual Flame Ionization Detection (FID) system. The oven temperature was programmed from 35 °C to 100 °C for 2 min. The detector temperature was maintained at 300 °C. Samples were injected in the split mode using hydrogen as the carrier gas with a flow rate of 1.0 mL/min. The chemical constituents of the essential oil of C*henopodium ambrosioides* were obtained through auto-integration of their GC-MS spectral data by ChemStation and comparison with mass spectral database and data from literature.

DPPH Radical Scavenging Activity Assay

A comparative study of the radical scavenging activity of the essential oil from C*henopodium ambrosioides* and standard radical scavenging agent, Butylated hydroxyl anisole (BHA) was carried out using 2,2-diphenyl-1-picrylhydrazyl (DPPH) method. The assay consists of a methanolic solution (50 µL) of each sample (essential oil and BHA) at different concentrations and 2 cm^3 of 60 µM methanolic solution of DPPH (Sigma-Aldrich, Steinheim, Germany). Absorbance was measured at 517 nm after incubation for 60 minutes in the dark at ambient temperature. Absorption of a blank sample containing the same amount of methanol and DPPH solution act as negative control, while BHA act as the positive control. Measurement was performed in triplicate. The weight of the DPPH solid sample was 2.365g, which was dissolved

into 100 ml of methanol to make the DPPH solution. The percent of the free radical scavenging activity was calculated as the ratio of the absorption of the sample relative to the control (which is distilled water) by the following equation:

$$\% \text{ DPPH Radical Scavenging} = \frac{A_0 - A_1 \times 100}{A_0}$$

Where A_0 was the absorbance of the negative control (blank sample) and A_1 was the absorbance of the sample tested. Tests were carried out in triplicates.

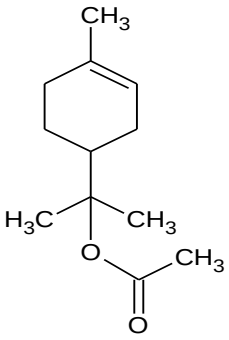
RESULTS AND DISCUSSION

A yellow-coloured EO was obtained by hydro distillation procedure yielding 0.52% v/w. Forty-four compounds were identified, most of them being monoterpenes and oxygenated monoterpenes. Eight major components representing 99.6% of the oil (Table 1) were identified to be α-terpinene (41.36%), α-terpinenyl-acetate (31.81%), thymol (8.23%), carvacrol (6.7%), p-Cymene (5.76%), Phytol (2.97%), Ascariodole (2.62%) and Camphor (0.18%). In C. *ambrosioides*, it was realized that the geographical origin of the plant has the greatest influence.

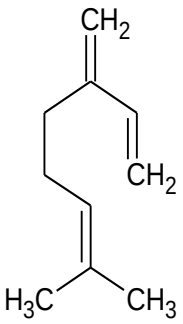
The result from this work tallies with previous studies of the plant in Nigeria [10-12] in terms of α-terpinene as the major component of the EO of C*henopodium ambrosioides*. From India, *m*-cymene has been reported as the major portion, corresponding to 43.9% of the oil [13]. In Cameroon, Tapondjou *et al.* [14] found ρ-cymene corresponding to 50.00 % of the chemical constitution of the EO. In this work, only 5.76% was P-cymene. In Brazil, Jardin *et al*. [15] reported 80% of ascariodole compared to 2.62% recorded for this sample. Reasons for the observed differences may include; climatic factors, age of plants, seasons, geological or the type of treatments after harvesting. The structures of the major compound presented in Table 1 are shown in Figure 1.

Table 1: Chemical composition of essential oil of *Chenopodiumambrosioides*L.

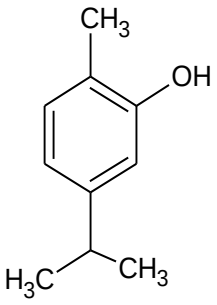
S/N	Retention time (min)	Phytochemical Constituent	Composition (%)
1	7.79	p- Cymene	7.76
2	12.65	Thymol	8.23
3	14.03	α- Terpinene	41.36
4	15.232	Carvacrol	6.70
5	17.126	Camphor	0.18
6	19.790	Ascariodole	2.62
7	20.353	α – Terpinenyl Acetate	31.81
8	24.405	Phytol	2.79



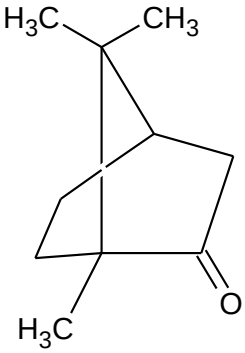
α – Terpinenyl Acetate



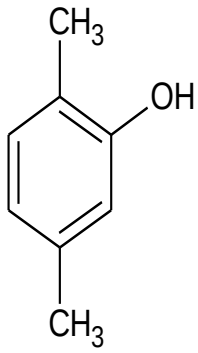
β-mycene



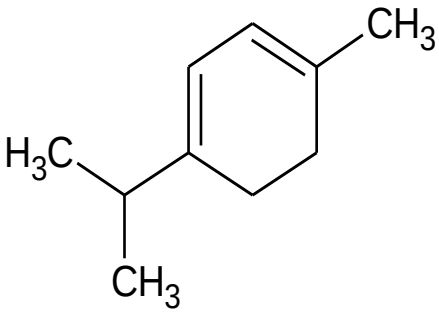
Thymol



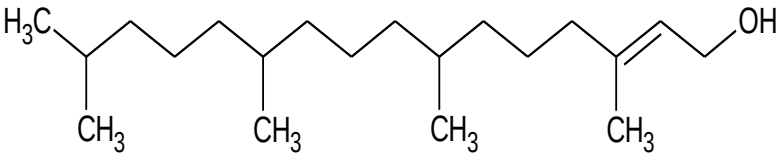
Camphor



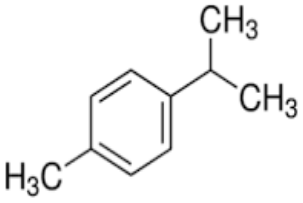
Carvacrol



α-Terpiene



Phytol



P-cymene

Figure 1: Some Constituents of essential oils of *Chenopodium ambrosioides*

The radical scavenging activity of the essential oil of *C. ambrosioides* and BHA (Butylated hydroxyl anisole) solution are presented on Table 2. The inhibition of the DPPH radical by the essential oil ranges between 3.07 and 43.90% compared to 65.6 – 84.7% recorded for the

standard antioxidant agent BHA. The ability of the essential oil to inhibit the DPPH radical showed that essential oil may be suitable as additives in foods for the promotion of general wellbeing [16].

Table 2: Antioxidants (Radical DPPH scavenging) activity of the essential oil of *Chenopodium ambrosioides* and Butylated hydroxylanisole (BHA).

Samples	Essential oil	BHA	Relative potency
2.5 mg/mL	3.07±0.06	65.60±0.09	0.047
5.0 mg/mL	20.00±0.02	87.60±0.01	0.228
10.0 mg/mL	26.90±0.01	84.40±0.08	0.818
15.0 mg/mL	44.60±0.01	87.50±0.01	0.510
20.0 mg/mL	43.90±0.01	84.70±0.00	0.518

CONCLUSION

The essential oil extracted from *Chenopodium ambrosioides* collected from Akure, Ondo State, South-West Nigeria was composed of α-terpinene, α-terpinenyl-acetate, thymol, carvacrol and p-cymene as the major compounds. The result tallies with previous studies of chemical compositions of Nigerian *Chenopodium ambrosioides* but are different from reports of chemical compositions of *Chenopodium ambrosioides* from India and other countries. This observation implies that *Chenopodium ambrosioides* from Nigeria are of the same chemo-type but different from the plant species from other climes. The antioxidant assay confirmed the essential oil to be powerful radical scavenging agent and thus possess potentials as bio-pharmaceutical.

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