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CONTENT OF THE ESSENTIAL OILS IN THE CHEMICAL COMPOSITIONS OF A *CHENOPODIUM AMBROSIOIDES* LEAF GROWN IN SOUTH WESTERN NIGERIA

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Abstract

Monoterpenes and sesquiterpenes make up the majority of the volatile chemicals found in complex combinations called essential oils. However, oxygenated derivatives such aldehydes, ketones, alcohols, phenols, acids, ethers, and esters are also present in essential oils, which can be extracted from any portion of a plant. A common and well-known aromatic plant species, Chenopodium ambrosioides L. is locally known as "Arunpale" among Yoruba speaking people in South-Western Nigeria and is prized for its medicinal characteristics (anthelmintic, emollient, anti-rheumatism, and anti-tumor). The plant species is endemic to many parts of the world and is used as a medicine for a variety of ailments, including ascaridiasis. Investigating the levels of composition of Chenopodium ambriosiode leaf essential oil is the goal of this study. The plant sample was collected from the Ayekale area of Saki, Oyo state, and identified by a botanist from the Oke-Ogun Polytechnic, Saki, department of environmental biology. The leaves underwent a two-week air drying period and were pulverized using a Clevenger set-up device before to hydrodistillation. Gas chromatography in

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Essential oil, GC-MS, Monoterpenes, Sesquiterpenes, Hydrodistillation.

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conjunction with a mass spectrometer was used to examine the essential oil's composition and amount. The essential oil of C. ambrosioides was found to contain thirty-nine (39) constituents, of which the majority were Eucalyptol (28.8%), Fenchol (16.8%), Terpinen-4-ol (14.5%), Benzene-1-methyl-4-cl-methyylethenyl (11.8%), Bicyclo(2-2)heptan-one4,7,7,trimethyl (11.4%), Enddo-bomeol (2.56%), Benzene,2-ethyl-1-methyl (2.2%), O-cymene (1.6%), Neopentylethylhetone (1.4%), and 2-Bomanone (1.09%). The remaining constituents are less than 1%. As a result, it can be inferred that the most abundant chemical constituents in the essential oil of C. ambrosioides are these five compounds, and as such, they are responsible for the plant's suppressant and aromatic qualities. It is recommended that industries shed more light on this subject.

INTRODUCTION

Essential oils are biochemical products, or mixtures of related chemicals, that are produced in the cytoplasmic fluid and exist as tiny droplets in the intercellular space. They have a strong smell and are erratic in their behavior. They may consist of mixtures of aromatic and non-aromatic compounds, with the definition of an aromatic compound being "a compound which possess chemical purity, volatile in ambient environment and possess odor which can please the aesthetic sense of the society." According to Turek et al. (2013), the International Organization for Standardization (ISO) has proposed a more precise definition that reads, "extract procured from raw material of natural origin i.e. plant by steam distillation, by processes that involve mechanical extraction from the epicarp of citrus fruits or by physical extraction such as dry distillation following elution of the aqueous phase and may also have post extraction physical analysis provided that no changes in its composition take place." Essential oils can contain both liquid and solid particles, as they are composed of several constituents. These yields are fragrant, easily absorbed through the skin's epidermis, and can range in color from colorless to pale yellow when obtained at room temperature. A few exceptions exist: the essential oils of cinnamon, sassafras, and cloves have a density greater than that of water, but they are nonetheless soluble in ethanol and diethyl ether and miscible in vegetable oils, waxes, and fats. High refraction index and rotational strength are two of the physical characteristics of essential oils.

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Essential oil variety

The depictions include about three thousand different types of essential oils. Of these, about 300 are used financially in the seasoning and fragrance industries. Whatever the case, the industry that produces scents may face a serious issue due to the wide variation in the chemical composition of aromatic plants (Burt S, 2004). As such, a great deal of research has focused on the various elements other than genetic ones that contribute to this assortment. Research has shown, for example, that specific races of closely related species, such as *Melaleuca bracteata,* have rich main ingredients, and that each of these races generates a different essential oil. It has including methyl eugenol, methyl isoeugenol, or elemicin. Other fragrant plants, such as sweet flag (*Acorus calamus*), wormwood (*Artemisia absinthium*), sweet basil (*Ocimumbasilicum*) camphorwood (Cinnamomumcamphora), lemon balm (*Melissa officinalis*), thyme (*Thymus vulgaris),* peppermint (*Menthapiperita*), or tansy (*Tanacetum vulgare*) have been broadly considered and distinctive chemotypes and synthetic races have been depicted (Evans *et al*., 2009). Similarly it has been found that different variables can alter the chemical composition of essential oils, for example, atmosphere, precipitation, or geographic location of the plant.

Function and existence within the kingdom of vegetables

Secondary metabolites are typically formed as essential oils. They are often found in non-differentiated cells (*Lauraceae*, for example) or, conversely, in secretary organs (*Lamiaceae*, *Asteraceae*), glandular hairs (*Rutaceae, schizogenous, Myrtaceae*), secretary ducts (*Rutaceae, schizolysigenous, Myrtaceae*), or cavities (Conifers) (Figure 1). In some instances, like in the case of garlic or valeriana, essential oils are not generated by the plant itself but rather are produced by the hydrolysis of a few plant-derived molecules (Fidyt *et al.,* 2016). Essential oils are produced in all parts of the plant, including the aerial organs (which are typically made up of leaves, blooms, and stems; examples of these include chamomile, peppermint, and lavender); fruits (anise); bark (cinnamon); seeds (nutmeg); and rhizomes and radix (ginger and curcuma). Essential oils have a variety of uses in plants. They can be used as an irritant or repellent in addition to being used as a component of protection and fertilization. Furthermore, unique theories have been proposed regarding their function as antioxidants, namely that they contribute hydrogen during oxidative processes, especially photoreactions. Additionally, they are believed to serve as antifungal or antibacterial components,

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protecting the plant from any pathogenic attack (Evans *et al*., 2009). Essential oils are a significant class of agricultural-based industrial products that are used in a wide range of industries, including food and beverage, cosmetics, pharmaceutical, and adlard *et al.,* 2020; Cechinel-Zanchett *et al.,* 2020; Hammer *et al*., 2012; Herzi *et al.,* 2013; Jalali-Heravi *et al.,* 2010; Teixeira da Silva, 2004). The production and consumption of essential oils are rising rapidly on a global scale (Lawless, 1995). The production of essential oils has been rising even with their high cost (because of the enormous amount of plant material needed).

Pest Repellant Potency

Fruits, grains that have been stored, and other foods high in cellulose are among the many contaminated foods that are caused by various rodents, mostly arthropods. Such commodities must be preserved immediately to avoid the food becoming contaminated by these parasites. There are several health concerns about the use of insecticides to eradicate the pests. The use of substances that have been extracted from natural sources and are very adequate with no negative environmental effects is one of the alternative choices under investigation. Among these substances with high efficiency that are extracted from natural reserves for use as repellents are essential oils (EOs). Citrus, lemon, and eucalyptus essential oils have been approved by the US Environmental Protection Agency as adequate essential oils for use as insect repellents in localized areas due to their relation to medical issues affecting humans. Natural source compounds have demonstrated great potency and little toxicity to humans, leading to consumer adoption (Katz *et al.,* 2009). The safety and efficacy of these chemicals have to be evaluated by many assays, therefore these decoctions might not always be a safer option. The extensive analysis indicates that essential oils derived from plants and their distinct metabolites have demonstrated excellent potential in discouraging various types of arthropods and insects. When combined with fixative compounds, these EOs demonstrate activity similar to that of synthetic repellents, so resolving the issue of EO volatility and function loss.

Chenopodium ambrosioides

A specific population's use of plant or herbal materials provided in different pharmaceutical formulations including active components is the basis of ethnomedicine, which is a subset of folk medicine (Soner *et al.,* 2013). According to Suntar *et al.* (2013), plants offer a source of chemicals with therapeutic and

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commercial value. Owing to extensive study on phytochemistry and pharmacognosy in recent decades, natural plant compounds have become increasingly important for the treatment of many illnesses (Cardona *et al.,* 2017). More than fifty thousand plants would have medicinal properties. For their fundamental medical needs, almost 80% of people in underdeveloped nations rely exclusively on plant-based medications (Farnsworth *et al.,* 1985). Since the early 1970s, the World Health Organization (WHO) has encouraged governments in developing nations to take advantage of indigenous knowledge about traditional herbal medicines (WHO, 2008). The genus Chenopodium is one of the most important groups of valuable plants. This genus is found globally, particularly in the temperate and subtropical zones, and comprises roughly 102 genera and 1400 annual herbaceous species with a strong odor (Nowak *et al.,* 2016).Known by several names, including Mexican tea, Jesuit's tea or bluebush, Indian goosefoot, Spanish tea, or wormseed in English, Chenopodium ambrosioides L. (Amaranthaceae) is a strong-smelling shrub that can be either annual or perennial. It is extensively available throughout West Africa, particularly in Senegal, Ghana, Nigeria, and Cameroon (Kuete V., 2014).

Phytochemistry

The phytochemical composition of C. ambrosioides was primarily composed of monoterpenes (43.16%), with flavonoid glycosides (10.33%), sesquiterpenes (8.51%), esters (5.78%), aliphatic acids and ketones (4.26%), alcohol (3.65%), aliphatic hydrocarbons and aromatic acids (2.43%), carbohydrates (2.13%), and other phytochemicals following in order. Terpenes, for instance, made up the largest composition of essential oils identified from four plants in Kenya (ginger, garlic, tick berry, and Mexican marigold). According to Mugao *et al*. (2020), the primary components of essential oils and natural goods are monoterpenes and sesquiterpenes. The six functional groups of organic molecules that aromatherapists need, particularly in the terpenoid and nonterpenoid volatile components (aliphatic and aromatic hydrocarbons) of essential oils, are alcohols, aldehydes, esters, ethers, ketones, and phenols. These essential oils contain the largest single family of chemicals, terpenes or isoprenoids (Buckle J, 2015).

Similarly, flavonoids glycosides made up the majority of the plant (10.33%), followed by monoterpenes. After essential oil, hydroalcoholic extraction (8.33%) and polar fraction from ethanol (8.14%) have been employed as the most important sources of chemicals. Typically, ethanol and hydroalcoholic extracts are

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used to extract flavonoids and flavonoid glycosides. According to Weirong and colleagues (Weirong et al., 2010), 80% ethanol at 90 °C produced the highest yield of flavonoid extraction from Opuntia milpa alta skin. In general, flavonoids can be extracted using aqueous alcohol solutions (Rodrigues *et al.,* 2020). Among those 329 compounds, terpinene was the most cited (6.76%). Two isomers of terpinene were found, and β-terpinene (3.82%) has been the most cited than α-terpinene (2.94%). However, from 37 studies on chemical composition essential oil of *C. ambrosioides*, as presented in the above table, α-terpinene was found to be the main constituents (40.5%) of essential oils from different countries include Brazil, Cameroon, China, Colombia, Egypt, India, Morocco, Nigeria, and Rwanda. His concentration was variable according to countries and used parts. His highest concentration was 65.4% from essential leaf oil collected and analyzed from India (Jirovetz *et al.,* 2000). The terpinenes, both α- and γ-isomers, are naturally occurring cyclic monoterpenes that are widely distributed throughout the kingdom of plants. They have been identified in a number of species. For instance, α-terpinene is a major constituent of the essential oil tree in tea trees (Rudback *et al.,* 2012). Following terpinene, ascaridole with its three isomers [cis-ascaridole/ascaridole (3.24%), isoascaridole (1.76%), and trans-ascaridole (0.88%)] was also cited (5.88%). Of those 37 studies, cis-ascaridole was found to be the majority monoterpene (35.13%) in the essential oil of *C. ambrosioides*. In essential oil that was gathered from Argentina, Benin, Brazil, China, France, Hungary, India, Mexico, and Togo, for instance, it was the primary secondary metabolite. In addition to α-terpinene and ascaridole, we also occasionally detected carvacrol (5.4%), m-cymene (2.7%), p-cymene (2.7%), o-cymene (2.7%), α-terpinyl acetate (2.7%), limonene (2.7%), cis-piperitone oxide (2.7%), and trans-pinocarveol (2.7%) as the primary secondary metabolites of *C. ambrosioides* essential oil. This research is aimed at studying the levels of chemical compositions of leaf essential oil of *C. ambrosioides* harvested from Saki, South-Western Nigeria.

Materials and Methods

The plant sample was collected from the Ayekale area of Saki in Oyo state, cleaned, and dried in a laboratory. A botanist from the Oke-Ogun Polytechnic, Saki department of environmental biology then identified the sample. Next, using a Clevenger set-up apparatus, the leaves were separated, allowed to air dry for two weeks, and then ground up in preparation for hydrodistillation. 500 gms of the pulverized sample was weighed and hydrodistilled for 3 ½ hours using a Clevenger

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set-up apparatus. The essential oil was collected into a cleaned sample bottle, covered and refrigerated before analysis using Gas Chromatography coupled with Mass spectrophotometer method.

GC-MS Analysis and Identification of Component

To identify the plant components of C. ambrosioides, GC-MS analysis was done. A Hewlett-Packed HP5973 mass spectrometer interfaced with an HP-6890 gas chromatograph was used for the GC-MS analyses. The following temperature conditions and column would be applied: The parameters of the system are as follows: inlet: split less; initial temperature: 2200C; pressure: 8.27psi; purge flow: 30 ml/ml; purge time: 0.20 min; gas type: helium; column: capillary; 30 m x 0.25 mm i.d.; film thickness: 0.25µm; initial flow: 0.7 ml/min; average velocity: 32 cm; MS: EI method at 70eV.

Results

TABLE 1; Components found in a *Chenopodium ambrosioides* leaf essential oil cultivated in southwest Nigeria.

S/N	% Composition	RT	Compositions
1.	0.15	10.772	Oxirane
2.	0.10	10.934	O-xylene
3.	0.21	12.145	Cylopropaneil,1.di-methyl
4.	1.43	12.258	Neopentylethylketone
5.	0.30	12.451	3-Octanol
6.	0.11	12.695	Alpha-phellandrene
7.	2.19	12.851	Benzene,2-ethyl-1,3-dimethyl-
8.	1.62	12.891	O-cymene
9.	28.76	13.015	Eucalyptol
10.	0.29	13.200	Gamma-terpinene
11.	11.78	13.494	Benzene-1-methyl-4-c1-methyylethenyl.
12	11.42	13.529	Bicyclo(2-2)heptanone-4,7,7,trimethyl.
13.	16.79	13.813	Fenchol
14.	1.09	14.042	2-Bornanone
15.	0.12	14.202	Terpineol
16.	2.55	14.282	Endo-borneol
17.	14.50	14.338	Terpinen-4-ol

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18.	0.89	14.398	Alpha-Terpineol
19	0.08	14.980	1.(4–Hydroxylmethylphenyl)ethanone
20.	0.22	15.079	4–Hydroxy-3–methylacetophenone
21.	0.10	15.699	2–Heptenoicacid.7(-methylenecyclopropyl)–methylester
22.	0.06	15.789	Caryophyleneoxide
23.	0.20	15.884	Tridecane
24.	0.40	16.227	Bicycl(7.2.0)undec–4–ene4,11,11–trimethyl–8–methylene
25.	0.99	16.355	4–Tridecen–6–yne
26.	0.16	16.494	Aromandendrene
27.	0.40	16.565	Isolonylfolene,4,5,-dehydro.
28.	0.01	16.597	phenol,2,6,-bis(1,1dimethylethyl)
29.	0.31	16.829	Cis–alpha–bisabolene
30.	0.20	16.872	Naphthalene–2,3,4,4a,5,6–hexahydro–1,4a–dimethyl–y–(i–methylethyl)
31.	0.15	16.931	1–Isopropyl–4,7,dimenthyll1,2,3,4,5,6hexahydronaphthalene
32.	0.07	17.228	1–Tetradecene
33.	0.21	17.301	Hexadecane
34.	0.56	17.478	-Spathulenol.
35.	0.18	18.112	Globulol.
36.	0.10	18.980	Dichloroaceticacid–4–hexadecylester
37.	0.15	19.074	Octadecane.
38.	0.24	22.897	7–Isopropyll1,1,4a–trimethyl-1,2,3,4,4a,5,6,9,10,10adecahydrophenanthrene.
39.	0.16	24.433	Phenanthrene,1,2,3,4,4a,9,10,10aoctahydrol,1,4a,-trimethyl–7–(1-methylethyl)
TOTAL	99.25		

Discussion

The essential oil of C. ambrosioides leaf was found to have thirty-nine (39) components, which were recognized and quantified to total 99.25%. The components that were discovered include various hydrocarbons and terpenes, specifically monoterpenoids and sesquiterpenoids. Eucalyptol(28.8%), Fenchol(16.8%), Terpinen-4-ol(14.5%), The primary ingredients in the mixture were Benzene-1-methyl-4-cl-methyylethenyl(11.8%), Bicyclo(2-2)heptanone-4,7,7,trimethyl(11.4%), Endo-borneol(2.56%), Benzene,2-ethyl-1-methyl(2.2%), O-cymene(1.6%), Neopentylethylhetone(1.4%), and 2-Bomanone (1.09%). There is less

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than 1% of the original mixture left.The amounts of endo-borneol and benzene, 2-ethyl-1,3-dimethyl-, that were secreted were 2.55 and 2.19 percent, respectively. Neopentylethylketone, Bornanone, and O-cymene were present in acceptable concentrations, ranging from 1.62-1.09%. Brazilian, Cameroonian, and Indian samples have extremely low concentrations of eucalyptol, which is regarded as a quality indication of this oil (Juliana *et al*., 2016, Tapondjou *et al*., 2002). However, according to Koba *et al*., (2009) and Moses *et al*., (2009), respectively, alpha terpene appears to be the primary component of Togolese and Lagos, Nigeria. These differences in outcomes may also point to the presence of chemotypes in C. ambrosioides plant species, even if environmental influences might also affect the chemical makeup of the oil.

Conclusion and Recommendation

The most prevalent chemical constituents in the essential oil of C. ambrosioides from Saki were found to be eucalyptol, fenchol, terpen-4-ol, benzene-1-methyl-4-ol-methylethenyl, and bicyclo(2-2)heptan-one4,7,7,trimethyl. These constituents are responsible for the plant's aromatic and suppressive properties. It is therefore advised that more research be done on this plant in order to isolate some key and specific chemical ingredients, particularly eucalyptol, which was discovered in a little higher percentage than other constituents.

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