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Terpene profile of some selected medicinal plants (*Ficus capensis, Morinda lucida* and *Rauvolfia vomitoria*) in South-Eastern Nigeria

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Abstract: *One advantage that earned herbal products acceptance and usage over conventional drugs is their low toxicity. Recognizing the need for more information on safety issues regarding terpenes in medicinal plants, this study examined the terpene profile of the roots of Ficus capensis, Morinda lucida and Rauvolfia vomitoria used in traditional medicine in Nigeria. The roots were obtained from Umuagwo forests, Ohaji in Imo State, South-Eastern Nigeria and made into powder. The powder was analysed for terpene content using FET headspace GC-FID. No terpene was detected in R. vomitoria; F. capensis contained only p- cymene (0.0033%) and d 3- carene (0.0021%) in quantifiable amounts, and M. lucida had α-pinene (0.0034%), β -myrcene (0.0023%), d 3-carene (0.0127%), limonene (0.0017%) and p-cymene (0.0110%). The terpene contents of these medical plants were generally low to cause any significant risk upon consumption.*

Keywords: *Ficus capensis, Morinda lucida, Rauvolfia vomitoria, medical plants, terpenes*

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I. Introduction

Medicinal plants have demonstrated their relevance in the treatment of diseases in Africa from time immemorial. Such is their importance in this area that up to 90% of the population rely on them for their health needs [1]. Plants contain different phytochemicals in form of secondary metabolites that may be beneficial or harmful to humans.

Ficus capensis is an aggressive tropical shrub that grows in deciduous or evergreen forests. The plant belongs to the family Moraceae. Traditional healers in Nigeria use it to treat several ailments. The plant parts used are leaves, stem bark, roots in powdered form or liquid decoction/infusion. In Nigeria, *Ficus capensis* is used for wound dressing, to manage threatened abortion, treatment of dysentery, oedema, epilepsy and leprosy [2-4]. Ojokuku *et al*. [5] reported that nutritional benefits can be derived from the plant parts aside from medicinal.

Rauvolfia vomitoria is a shrub of the family Apocynaceae native to sub-Saharan Africa. The descriptive name vomitoria refers to the purgative and emetic properties of the bark [6]. *R. Vomitoria* is a fast disappearing forest plant owing in part to its wide usage in traditional medicine. Ethnobotanical study of *R. vomitoria* revealed its usage for treatment of mental illness, typhoid, leprosy, arthritis, malaria and diarrhea [7-11]. *R. Vomitoria* owes most of its bioactive properties to the presence of alkaloid [12].

Morinda lucida is a tree of the family Rubiaceae commonly found in tropical West African rainforest. The leaves are used to make infusions for malaria treatment [13], the stem bark possess anticancer properties [14] and also used for treatment of fever and jaundice [2,13]. In Nigeria, *M. Lucida* is one of the most used plants in the preparation of traditional medicines against malaria fever. Idowu [15] reported that most of the herbal mixtures including *Morinda lucida* used for the treatment of malaria in South Western Nigeria were toxic to the liver and kidney of experimental mice. There are other reported cases of herb-induced liver injury due to terpenes in literatures [16-18].

The terpene safety evaluation of medicinal plants became more important following reports of terpene toxicity as entourage of cannabiniod and in aromatheraphy where terpenes containing essential oil are used. The present study reports the terpene profile of *Ficus capensis, Morinda lucida* and *Rauvolfia vomitoria* powder used in traditional medicine in South-East Nigeria.

II. Materials and Methods

Sample Collection

Fresh roots of the plants *Ficus capensis, Morinda lucida* and *Rauvolfia vomitoria* were collected from Umuagwo forests, Ohaji in Imo State, South-Eastern Nigeria. The plant samples were authenticated by plant taxonomists from Imo state Polytechnic Umuagwo, Imo state, Nigeria.

Sample Preparation

The roots of *F. capensis, M. lucida* and *R.vomitoria* were shade dried for 2 weeks, oven dried in hot air cabinet oven at of 60^{O} for 30 minutes and crushed to powder using a Marlexelectroline grinder. The powder was analyzed for the presence of terpene.

Terpene Analysis

The full evaporation technique (FET) headspace gas chromatography-flame ionization detection (GC-FID) method was used for the identification of terpenes. The analysis was performed by Anresco laboratories, San Francisco, CA, United State of America. The method is as described by Hilliard *et al*. [19].

Samples were analyzed on an Agilent® 6890 gas chromatograph equipped with a Tekmar® HT-3 headspace autosampler. A 30 m x 0.25 mm x 1.4 µmRxi®-624Sil MS column was installed based on its selectivity for terpenes and because it was also used for analysis of residual solvents in the sample concentrates. A 1 mm straight Sky® inlet liner was used to limit the volume in the GC inlet. Ten milligram (10 mg) ground powder sample was placed in headspace. An incubation temperature of 140 °C was used to ensure volatilization of all terpenes and terpenoids in the sample. An incubation time of 30 minutes was used to ensure the establishment of equilibrium during incubation, which is required for reproducible, quantitative results.

To aid in peak identification, a multi-component terpene standard was prepared with each compound at approximately 0.02% wt/vol. 10 µL of this standard solution was injected into a capped headspace vial and analyzed by FET headspace GC-FID. Standards were analyzed under the same conditions as the samples in order to eliminate the potential for discrimination across the volatility range. Since any discrimination effect would be the same in both the sample and standard, analytes were quantified based on their relative response factor compared to the standard. This normalizes the values between sample and standard, ensuring accurate quantification across the full range of volatility for terpenes. The data presented in this article should be considered semi-quantitative.

III. Results

Table 1 shows terpene profiling result for *Rauvolfia vomitoria*. Terpene were either too little to be detected or absent as seen in the table. Table 2 shows terpene profiling result for *Ficus capensis.* Only two terpenes (p- cymene and d 3- carene) were detected in quantifiable amount. Table 3 shows terpene profiling result for *Morinda lucida*. Terpenes detected were α-pinene, β -myrcene, d 3-carene, limonene, and p-cymene, all in trace amounts.

Table 1: Terpene profile of *Rauvolfia vomitoria* (root)

Analyte	**%**
α-Pinene	BLOQ
Camphene	ND
β-Myrcene	BLOQ
β -Pinene	ND
d 3-Carene	BLOQ
Limonene	BLOQ
α -Terpinene	ND
Ocimene 1	ND
Ocimene 2	ND
p-Cymene	BLOQ
Eucalyptol	ND
y-Terpinene	ND
Terpinolene	ND
Linalool	ND
Isopulegol	ND
Menthol	ND
(-)-Borneol	ND
Terpineol	ND
Citronellol	ND
Geraniol	ND
β -Caryophyllene	ND
α -Humelene	ND
Nerolidol 1	ND
Nerolidol 2	ND

Guaiol	ND
Caryophyllene Ox	ND
α -Bisabolol	ND
Eudesmol	ND
TOATL	0.000

BLOQ: Below Limit of Quantification**. ND:** None Detected limit 0.0015%

Table 2: Terpene profile of *Ficus capensis* (root)

Analyte	**%**
α-Pinene	BLOQ
Camphene	ND
β-Myrcene	BLOQ
β –Pinene	ND
d 3-Carene	0.0021
Limonene	BLOQ
α –Terpinene	ND
Ocimene 1	ND
Ocimene 2	BLOQ
p-Cymene	0.0033
Eucalyptol	ND
y-Terpinene	ND
Terpinolene	ND
Linalool	BLOQ
Isopulegol	ND
Menthol	ND
(-)-Borneol	ND
Terpineol	ND
Citronellol	ND
Geraniol	ND
β –Caryophyllene	ND
α –Humelene	ND
Nerolidol 1	ND
Nerolidol 2	ND
Guaiol	ND
Caryophyllene Ox	ND
α –Bisabolol	BLOQ
Eudesmol	ND
TOATL	0.0053

BLOQ: Below Limit of Quantification**. ND:** None Detected limit 0.0015%

Table3: Terpene profile of *Morinda lucida* (root)

Analyte	**%**
α-Pinene	0.0034
Camphene	ND
β -Myrcene	0.0023
β-Pinene	BLOQ
d 3-Carene	0.0127
Limonene	0.0017
α –Terpinene	ND
Ocimene 1	BLOQ
Ocimene 2	BLOQ
p-Cymene	0.0110
Eucalyptol	ND
y-Terpinene	ND
Terpinolene	BLOQ
Linalool	BLOQ
Isopulegol	ND
Menthol	ND
(-)-Borneol	ND
Terpineol	ND
Citronellol	ND
Geraniol	ND

β –Caryophyllene	ND
α –Humelene	ND
Nerolidol 1	ND
Nerolidol 2	ND
Guaiol	ND
Caryophyllene Ox	ND
α -Bisabolol	ND
Eudesmol	ND
TOATL	0.0310

BLOQ: Below Limit of Quantification**. ND:** None Detected limit 0.0015%

IV. Discussion

Terpenes are naturally occurring hydrocarbons found in plants. In the present study, no terpene was detected in *Rauvolfia vomitoria*; *Ficus capensis* contained only p-cymene (0.0033%) and d 3- carene (0.0021%) in measurable amount, and *Morinda lucida* had α-pinene (0.0034%), β -myrcene (0.0023%), d 3-carene (0.0127%), limonene (0.0017%) and p-cymene (0.0110%). Odoriferous and aromatic medicinal plants are likely to contain more terpenes because they contribute to the flavour and taste of plants. The terpene limonene for instance is used as a fragrance and flavour additive [1].

Ficus capensis, Morinda lucida and *Rauvolfia vomitoria* powder are used in traditional medicine in Nigerian. Several terpenes have been reported in African medicinal plants and some of them showed toxic effects. Mbaveng *et al*. [20] reported cicutoxin, atractyloside, daphnetoxin, digoxin and gibberellic acid as some toxic terpenes in African medicinal plants. This present study reported low terpene content and absence of any of the reported toxic terpenes. Romano and Hazekamp [21] reported a significant loss of terpene components of cannabis with heating. Terpenes are volatile compound and might have been lost during processing.

Some terpenes are local irritant which cause skin discomfort. The World Health Organization [1] reported limonene as a human allergen which can cause burning, itching and rash upon dermal exposure. Ingestion is the most significant route of exposure to terpenes for which severe consequences have been reported. Rapid absorption occurs upon ingestion of terpenes, where they move on to exert effects on the gastrointestinal tract and central nervous system. Ingestion of turpentine whose primary constituent is α-pinene as well as β-pinene, camphene, and limonene was reported to cause mild to severe symptoms including headache, dizziness, nausea, abdominal pain, vomiting, diarrhea, fever, glycosuria, hematuria, albuminuria, delirium, seizures and coma [22]. The implication therefore is that if herbal formulations contain significant amounting of these compounds and are consumed regularly, any of the mentioned effects can be suffered.

Terpenes absorb through the skin, such that topical application can cause redness, blisters, burns and contact dermatitis. Turic *et al.* [23] reported that fragrance containing eugenol, isoeugenol, geraniol, citronellal caused contact dermatitis in test subjects. Linalool and geraniol caused skin diseases in workers at a perfume factory [24]. Caution must therefore be exercised in using terpene containing topical products.

V. Conclusion

Evidence suggests that some plant terpenes are toxic. Most African medicinal herbs lack safety report particularly on terpene content. *Ficus capensis, Morinda lucida, Rauvolfia vomitoria* roots as prepared, contained no objectionable concentration of terpenes.

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