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Studies of the Volatile Compounds Present in Leaves, Stems and Flowers of *Vernonanthura patens* (Kunth) H. Rob

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Abstract

The study of the volatile components of the leaves, stems and flowers of *Vernonanthura patens* is discussed. A micro solid-phase extraction at constant temperature with a dimethylsiloxane fiber of 100 µm was performed. The compounds extracted were analyzed by gas chromatography coupled to mass spectrometry (GC-MS). 7 monoterpenes structures were assigned to leaves, and three to stems, these compounds were not detected in the flowers with the configuration of the system used. 17 sesquiterpenes were identified in the leaves; 6 in stems and 2 in flowers, finding coincidence in some of them. The major components were *α*-humulene in leaves, bergamotene in stems and caryophyllene in flowers.

Keywords

***V. patens*, Volatile, Bergamotene, Caryophyllene, *α*-Humulene**

1. Introduction

Asteraceae (Asteraceae), gather more than 23,500 species spread over about 1600 genera, so the family of Angiosperms is rich and biological diversity [1] [2]. Members of this family are distributed from Polar Regions to the tropics, conquering all available habitats, from dry deserts to swamps and from forests to mountain peaks. In many regions, this family reaches up to 10% of vernacular flora and contains some genera with a large number of species, as *Vernonia* (*Vernonanthura*), with more than 1000 species [3]. Many species have latex and essen-

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tial oils and may or may not be resinous.

Vernonanthura patens is an Asteraceae that grows wild in Ecuador and is employed by people of the Ecuadorian coast to cure various conditions. Manzano *et al*. have reported that alcoholic extracts of the leaves show "*in vitro*" antileishmanial activity against *Leihsmania amazonensis* [4].

Studies conducted on the chemical composition of the species of the Ecuadorian coast have reported the presence of some terpene compounds (mainly pentacyclic triterpenoids), diterpenoids and sesquiterpenoids [5]. Those last are a part of the volatile fraction of the species and not essential oils which are presented in appreciable conditions so this work is carried out to study the volatile components obtained by solid phase micro extraction (SPME) at constant temperature (50˚C) with a fiber of 100 microns dimethylsiloxane.

2. Materials and Methods

Leaves, flowers and stems of the species in phenological stage of flowering, collected around the Biotechnology Research Center of Ecuador located at Km 30.5 via Perimeter province of Guayas-Ecuador, were used. A sample of the plant material was taken for botanical identification which was botanized at the National Herbarium of Ecuador (QCNE), Quito, with CIBE37a code.

The volatile compounds were obtained by solid phase microextraction (SPME) at constant temperature of 50˚C with a fiber of 100 microns dimethylsiloxane.

The chemical composition of the volatile compounds was analyzed in a gas chromatograph connected to a mass spectrometer (GC-MS) Agilent Technologies, equipped with a J & W capillary column GC of 30 × 250 microns × 0.25. The conditions were as follows: initial temperature in the oven 60˚C for 1 minute to 260˚C with an increment of 5˚C per minute; followed by an increase of 15˚C per min to 300˚C for 1 minute. Temperatures for injector and detector were 150˚C and 280˚C, respectively in split mode. The volatiles compounds were assigned by comparison of their spectra with reference compounds existing in the Wiley and Nist library ninth edition 2011 installed on the computer.

3. Results and Discussion

Chromatograms of the volatile compounds from leaves, stems and flowers of *V. patens* is shown in **Figure 1**; the chromatogram of the volatile compounds from the leaves was the most complex and the chromatogram of the flowers was less complex. It is noteworthy that most of the major components are in the range of retention times between 15 and 20 min. Between 20 and 25 min., only the leaves had components with relative abundance. Moreover, the presence of a compound with high relative abundance correspond to the sesquiterpene caryophyllene with a retention time of 18.2 min approximately. This compound had been identified for the leaves of the Ecuadorian species [5] and Vernonia ssp [6].

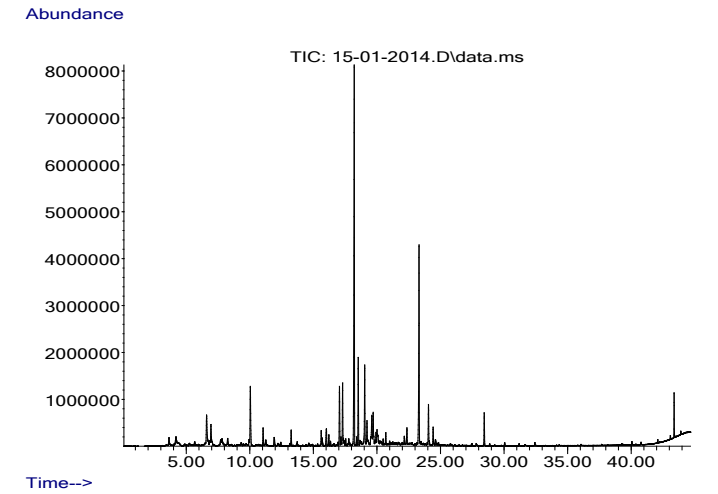
Table 1 shows the monoterpenes isolated from different plant organs.

It is appreciated that the leaves had a higher number of monoterpene compounds, with a total of seven while in the stems were identified three. In the flowers these compounds could not be detected, or were absent.

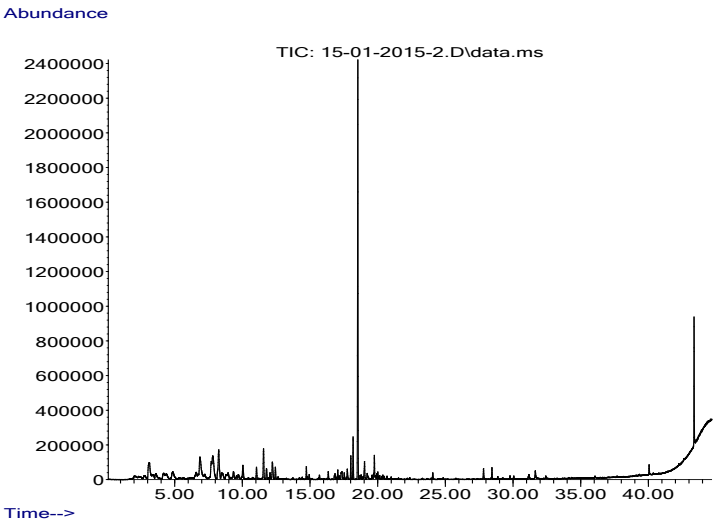
Monoterpene compounds eluted from the column between the minutes 5.5 and 8.5 of the run. Retention time

Table 1. Monoterpenes identified in the fraction of volatile compounds of *V. patens*.

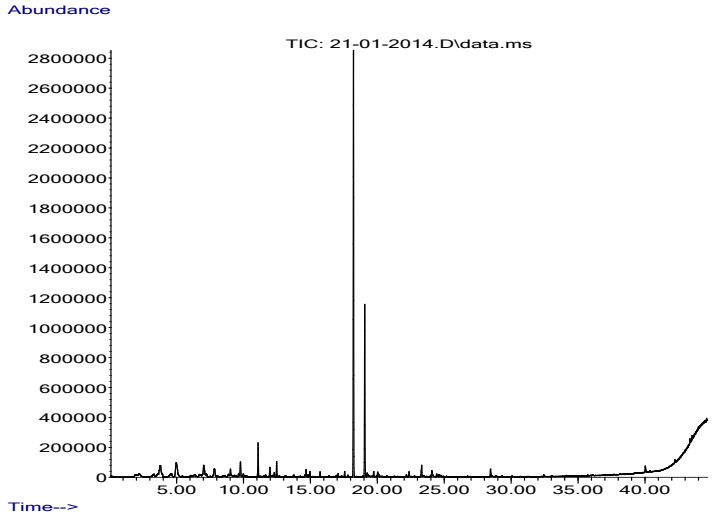
leaves			steams		
tr min	compounts	% abund	tr	compounts	% abund
5.66	*α*-pinene	0.27	-	-	-
6.50	sabinene	0.23	-	-	-
6.59	*β*-pinene	3.32	-	-	-
6.86	*β*-myrcene	0.39	-	-	-
7.70	p-cymene	0.66	7.70	p-cymene	3.01
7.81	D-limonene	0.85	7.81	D-limonene	7.41
8.25	*β*-ocimeno	0.76	8.25	*β*-ocimeno	6.46



(a)



(b)



(c)

Figure 1. Analytic gas chromatograms of volatile from leaves (a), stem (b) and flowers (c) of *V. patens*.

of the compounds found in leaves and steams was the same, but relative abundances in steam was higher. For leaves the majority monoterpene was *α*-pinene, whereas in the stems was D-limonene.

The sesquiterpene compounds eluted from the column between 16.3 to 22.2 minutes. 19 compounds were identified in the leaves, 6 in the stems and 3 in the flowers. The results are shown in **Table 2**.

Sesquiterpenes present in the stems and flowers, are in the leaves as well, with the exception of zingiberene that is only present in stems. For those sesquiterpenes, variability is high and the most abundant is the Caryophillene with a relative abundance of 23.42%. However, in the stems the most abundant sesquiterpene was the *α*-bergamotene with 34.51% of relative abundance and in the flowers was the *α*-humulene with 19.57% of relative abundance.

Caryophyllene compound and its oxide report properties of pharmacological interest as anti-inflammatory, antitumor, antibacterial, spasmolytic, anti-septic, anti-parasite against *Trypanosoma cruzi* and *Leishmania brasi-*

Table 2. Sesquiterpenes identified in volatile fraction of *V. patens*.

leaves			steams		flowers	
rt min	compound	% abund	compound	% abund	compound	% abund
16.01	*δ*-elemene	1.38				
16.33	*α*-cubebene	0.25				
17.04	1,4-cadinene	3.46				
17.04			*α*-copaene	0.78		
17.29	*β*-bourbonene	3.47				
17.43	*β*-elemene	0.31				
17.75			zingiberene	1.09		
18.17	caryophyllene		caryophyllene	3.72		
18.20		23.42			caryophyllene	8.30
18.40	germacrene-D	0.47				
18.52	*α*-bergamotene	4.55	*α*-bergamotene	34.51		
18.66	aromadendrene	0.42				
18.78	γ-muurolene	0.27				
19.02			*α*-humulene	1.94		
19.03	*α*-humulene	4.96				
19.57					*α*-humulene	19.57
19.58	γ-curcumene	2.23				
19.69	*β*-cubebene	2.73				
19.74			*β*-farnesene	1.77		
19.84	cis-muurola-3,5-diene	0.34				
20.06	bicyclogermacrene	0.52				
20.24	*α*-farnesene	0.23				
20.48	*α*-amorphene	0.31				
20.68	*δ*-cadinene	0.71				
22.14	caryophyllene oxide	0.49				

liensis [7] [8]; *β* Ocimene as a powerful agent of tick [9]; *α*-bergamotene compound as antibacterial and antioxidant [10]; insecticidal activity is reported for linalool [11]; and *β*-caryophyllene and *α*-humulene present anti-fumigant activity [12].

Unfortunately there is no study on the volatiles of *V. patens* reported in the literature for comparison.

These results confirm the wealth in terpene compounds of *V. patens* from the Ecuadorian coast, for which Manzano *et al.*, [13] [14] identified pentacyclic triterpenoids as major constituents of the species. The results are reported for first time in the species growing in Ecuador.

4. Conclusion

The fraction of volatile compounds from leaves, stems and flowers of *V. patens* is rich in sesquiterpene compounds, which are much more abundant in the leaves of the species together with monoterpene. A total of 20 sesquiterpenoids and 7 monoterpenoides in the samples studied are identified.

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