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VARIABILITY IN THE CHEMICAL COMPOSITION OF *JUSTICIA PECTORALIS* JACQ. (TWO VARIETIES): ESSENTIAL OILS IN OVER SEVERAL MONTHS

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Abstract

Justicia pectoralis Jacq. (Creeping and raising, the two varieties that grows in Cuba) is a plant commonly known as "tilo" in America and Caribbean. The plant is used in a same way than European *Tilia species*. The variability in the chemical composition of the volatile components derived from this plant gathered in different growing months is reported herein for the first time. The aerial parts, those parts exposed to the air, of *Justicia pectoralis* Jacq. produce only traces quantities of essential oil directly by distillation and was necessary to distil with solvent assistance to obtain volatile components in the four month period of the evaluation. Using GC-MS analysis, 23 components were detected and identified in the volatiles of the two varieties, Coumarin at 28 to 39,86%, Trans-2-hexenal, at 1, 109 to 14,93%, and 2-hexanol at 5,68 to 14,93% were the most important components identified.

Keywords: *Justicia pectoralis; Cuba; Perú; Chemical composition*

Introduction

The use of medicinal plants is as old as the history of human being. They set out to discover, use and convey knowledge that each of them had [1]. At present time, there is an increasing interest to use medicinal plants with the scientific validation in health services around the word.

Justicia pectoralis Jacq. is a medicinal plant with a long history of traditional use in South and Central America. Is popularly known as chambá, anador, trevo-cumaru, trevo-do-Pará, cachamba in Brazil; Chapantye in Caribbean and Haiti [2]; zèb chapantye in Dominica and Martinica [3]; curia in México, Venezuela, Trinidad y Panama [4]; Tilo in Cuba [5] and in Costa Rica [6]; fresh cut in Jamaica [7]; "amansa guapo" in Colombia [8].

Justicia pectoralis is traditionally used in ethnomedicinal practices: for prostate problems in Trinidad and Tobago [9]; anxiolitics in Caribbean [10]; in treatment of cough and as an expectorant in Trinidad [2]; for the treatment of menopause symptoms and dysmenorrhea in Costa Rica [6]; used for treatment of menstrual pains, cough and colds in Ecuador and treatment of diabetes, sedative, prostate and infections in Colombia [11]; used traditionally as sedative in Cuba [12] and compose the therapeutics arsenal of the National Health System [13] on home program that included the scientific role of known medicinal plant processed from 1991 in the pharmaceutical Cuban industry [14]; for treatment of respiratory tract disorders, such as cough, bronchitis and asthma in Brazil [15].

Preliminary phytochemical analysis revealed the presence of coumarins, flavonoids, steroids, triterpenoids and alkaloids [16,17,18].

Pharmacological investigations showed anti-asthmatic properties of extract of this plant [7,19]. In Cuba was development in a solid pharmaceutical tablets using validated dry extract [12].

Volatile components of plants are one of the more evaluated and used chemical constituents. Traditional medicine since ancient times used essential oil and plants containing those volatile constituents. The first study of this essential oil was reported in 2011 [20], without the statement of the variety under study neither describing the KI of the structures described for the essential oil. The present investigation undergo with the two varieties cultivated in garden in Cuba.

The use as sedative and many others of the plant, could change according to environmental factors variation and the variation of the specific chemical composition on the overall application of the volatiles is described. For that, it is important to evaluate the variability in the chemical composition of different essential oils and volatiles obtained from different months of plant growth, which was the incentive for the present investigation [12,21,22].

The objective of this research was to analysis the performance and variation of the chemical composition of the volatile fraction of *Justicia pectoralis* Jacq., because this plant is widely used in traditional medicine, with many investigations reported in the literature [18,23,24,25,26,27], but there has not been a chemical study that indicates the influence of the harvest period on the performance of essential oils, and if the influence of climate on chemical composition has been studied [28].

Materials And Methods

Collection of Plant Material

The fresh aerial parts (leaves and steams) of the plant Justicia pectoralis Jacq. (Figure 1), were collected in Havana, Cuba, from cultivars in gardens, in each month of the study (September, October, November and December 2017 for creeping variety and November for rising variety because is rare in its presence). The collection was performed as close as possible to the distillation of the volatiles. A voucher was deposited in the National Botanic Garden of Cuba with the number HFC: 087058. Identified by Renier Morejón.

Obtaining the volatiles

The volatiles were obtained using a hydro-distillation Clevenger equipment. The distillation of 250 g of plant material was done using 250 mL of water assisted with 25 mL of petroleum spirit (boiling point below 60°C) for 1,5 hours, each month of the study, to yield one batch of the mixture per month of gathered plant. The volatiles with solvent were kept in the refrigerator until the GC-MS analysis was performed. Volatiles were evaluated during September 2017 to December 2017 (four month).

Analysis of the volatiles using GC-MS

An Agilent GC 6890N equipped with a 5975B mass detector and a split-split less injector in split less mode ratio was used for the analysis (Agilent, Palo Alto, CA). Separations were made on an HP-5Ms fused-silica capillary column (30 m x 0.25 mm, 0.25 µm (Agilent, Avondale, PA). The GC oven temperature was kept at 60°C for 2 min and programmed to reach 200°C at a rate of 20°C/min, then to go from 200°C to 300°C at a rate of 8°C/min before holding constant at 300°C for 5 min. The injection and source temperatures were 320°C and 250°C, respectively. The MS interface temperature was 250°C. The electron ionization/mass spectrometry (EI/MS) spectrum was taken at 70 eV with an injection of 0.3 µL. The mass spectrum was continuously acquired from 35 to 800 m/z with 3.12 scans/s in full-scan mode. Peak identification was achieved by computer matching of the mass spectra against commercial libraries (National Institute of Standards and Technology [NIST], 2011). The final identification was performed using the Kovats Retention Index in comparison with C_8-C32 paraffins. Quantitative calibration mix D-2887 (cat 4-8882, Supelco, PA, USA) was used for the quantification. Petroleum spirit was injected previously to avoid interference with possible residual hydrocarbon structures in the determination.

Results

The results of the investigation are summarized as follows:

Figure 2 shows the chromatographic analysis by GC-MS of the volatiles obtained. In Table 1 are summarized the volatile components detected and identified in each variety during the four month of the evaluation.

Discussion

In the present investigation, coumarin was identified as the main component of the volatiles from *Justicia pectoralis*, in the two varieties under evaluation, in the creeping variety 28-39% and in the raising variety 42,2%. It is coincident with literature in the presence of this compound in the volatile fractions of the plant [18,20,24].

Only it is available in the literature the table of identified components from Pino (2011) [20] (Table 2) reporting 7,4% for coumarin in the volatiles of the plant. It is important to notice that Pino described the identification of 32 components, being the most abundant nonanal with 45,9% and not coumarin. In the present work the highest per cent of nonanal was found only in one month (December) with 6,6% of relative yield.

Besides, only 9 components are similar to Pino report and 14 different in the present investigation. Twenty three in the investigation of Pino [20], were not found in the present evaluation of the volatiles from the plant. He do not describe the variety under his investigation. The main results are quite different in the two investigations, in the present investigation are describes the two varieties under evaluation but in the case of Pino publication is not described which variety was used.

The variability of the main three components of the volatiles identified in the present investigation is represented in Figures 3 to 5.

Figure 3 shows the variability in the % of coumarin in the different month and varieties. In the creeping variety the heist % correspond to September (39,9%) lower than the rising variety (42,4%) in November. In both varieties is the main component of the volatiles and the lowest % for creeping variety is in December with 24,7%.

The thirst important components identified in the volatiles from the plant is 2-hexanol. Figure 5 show the variability in % in the different month of the evaluation.

The relative % increase in different month until December for the creeping variety. Relative increase from 5, 6 to 14,9, but lower in the four months fin comparison with the rising variety 2,0%.

Conclusions

The volatiles made from the aerial parts of Justicia pectoralis Jacq, varieties creeping and rising are obtained over the four months of the evaluation period. In total, 23 components were identified using GC-MS analysis with 16 of them present in a greater than 1% yield. The main components of the volatiles are coumarin present at 28-42,4%, Trans (Z) 2-hexenal, present at 0,5 to 15,7% and 2 hexenol, present at 2,0 to 14,9% in the two varieties under evaluation.

Recently was demonstrated that extract of Justicia pectoralis possesses potentual pharmacological properties to be useful in pathophysiological conditions involved with the development of the hyper-reactive phenotype of asthma [29].

The results of the present investigation have some differences respect to literature information of the volatiles from the plant species.

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Table 1. Identification and quantification of the volatile components of the two varieties of *Justicia pectoralis* Jacq. during the four month of the evaluation. In green the main components identified (Theoretical KI according to Adams, 1995 [30]). If the type of isomer is not declare is because was not possible to establish they.

No.	Volatile compounds Name	RT	KI Experimental	KI Theoretical	(%) Creeping variety				
					A	B	C	D	E
1	2-methyl-2-pentanol	3.465	736	735	**0.4**	**0.5**	**1.2**	**2.0**	
2	3-methyl-3-pentanol	3.796	755	758	**1.6**	**1.4**	**3.4**	**5.3**	**0.2**
3	3-hexanone	4.46	787	790	**2.2**	**2.1**	**4.9**	**4.2**	**2.5**
4	2-hexanone	4.548	791	790	**4.8**	**4.6**	**8.6**	**11.3**	**4.2**
5	3-hexanol	4.652	796	797	**3.5**	**3.3**	**6.1**	**7.6**	**1.1**
6	2-hexanol	4.758	801	803	**5.6**	**5.8**	**10**	**14.9**	**2.0**
7	Cis (Z)-2-hexenal	5.857	855	855	0.2	0.5	0.9	**1.3**	
8	Trans (E)-2-hexenal	5.981	856	848	**15.6**	**15.2**	**6.0**	**1.0**	0.5
9	Cis (Z)-3-hexenol	6.058	862	857	**9.5**	**9.2**	**4.8**	**3.4**	
10	Cis (Z) -2-hexenol	6.337	871	865	**3.7**	**3.3**	0.7	0.6	
11	Cyclohexanol	6.782	886	886	0.2	0.3	0.7	**1.2**	
12	Heptanal	7.232	902	902	0.2	0.3	0.5	0.7	0.3
13	Benzaldehíde	8.79	965	961	0.3	0.5	0.3	0.2	0.1
14	1-octen-3-ol	9.258	980	980	**7.3**	**7.1**	**11.9**	**9.3**	**9.9**
15	1-octen-3-ona	9.47	979	979	0.2	0.3	0.4	0.5	1.0
16	3-octanol	9.691	993	990	**1.1**	**1.4**	**2.0**	**1.8**	0.9
17	Octanal	9.906	1000	1004	0.1	0.3	0.4	0.3	0.4
18	Nonanal	12.524	1101	1098	0.4	0.8	**2.1**	**6.6**	0.4
19	Coumaran	13.771	n.d.		0.1	0.3	**3.6**	0.3	0.1
20	C13	17.195	1300	1300	0.3	0.4	1.1	1.1	
21	C14	19.388	1400	1400	0.1	0.2	0.5	0.5	1.2
22	Coumarin	20.294	1434	1434	**39.8**	**37.0**	**28**	**24.7**	**42.4**
23	phytol	32.16	2116	2122	**1.9**	**4.2**	0.7	0.2	**8.**
					100.0	100.0	100.0	100.0	76.4

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Table 2: Compounds from *Justicia pectoralis* according to Pino (2011)[20]

Compound	RI	%
2-Furfural	836	0.4
(*E*)-2-Hexenal	855	0.5
(*Z*)-3-Hexenol	859	1.0
1-Hexanol	871	0.7
Nonane	900	0.3
Heptanal	904	4.4
Benzaldehyde	960	2.1
1-Heptanol	967	Tr
1-Octen-3-one	979	1.1
1-Octen-3-ol	982	8.4
3-Octanone	985	Tr
2-Octanone	991	0.7
3-Octanol	993	1.7
Octanal	999	4.7
Limonene	1030	0.7
Phenylacetaldehyde	1042	1.2
(*E*)-2-Octenal	1057	0.3
1-Octanol	1068	1.9
2-Nonanone	1090	0.2
Nonanal	1101	45.9
(*E*)-2-Nonenal	1162	0.6
1-Nonanol	1169	0.9
2-Decanone	1192	3.2
Safranal	1197	0.3
Decanal	1202	1.5
(*E*)-2-Decenal	1264	2.7
Undecanal	1307	0.3
Nonanoic acid	1371	2.7
(*E*)-¿-Damascenone	1385	0.3
Ethyl decanoate	1396	3.7
Dodecanal	1410	0.3
Coumarin	1434	7.4

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Figure 1. *Justicia pectoralis* Jacq

Figure 2: GC-MS analysis of the volatiles from *Justicia pectoralis* Jacq. Creeping variety upper one and raising variety below chromatogram**.**

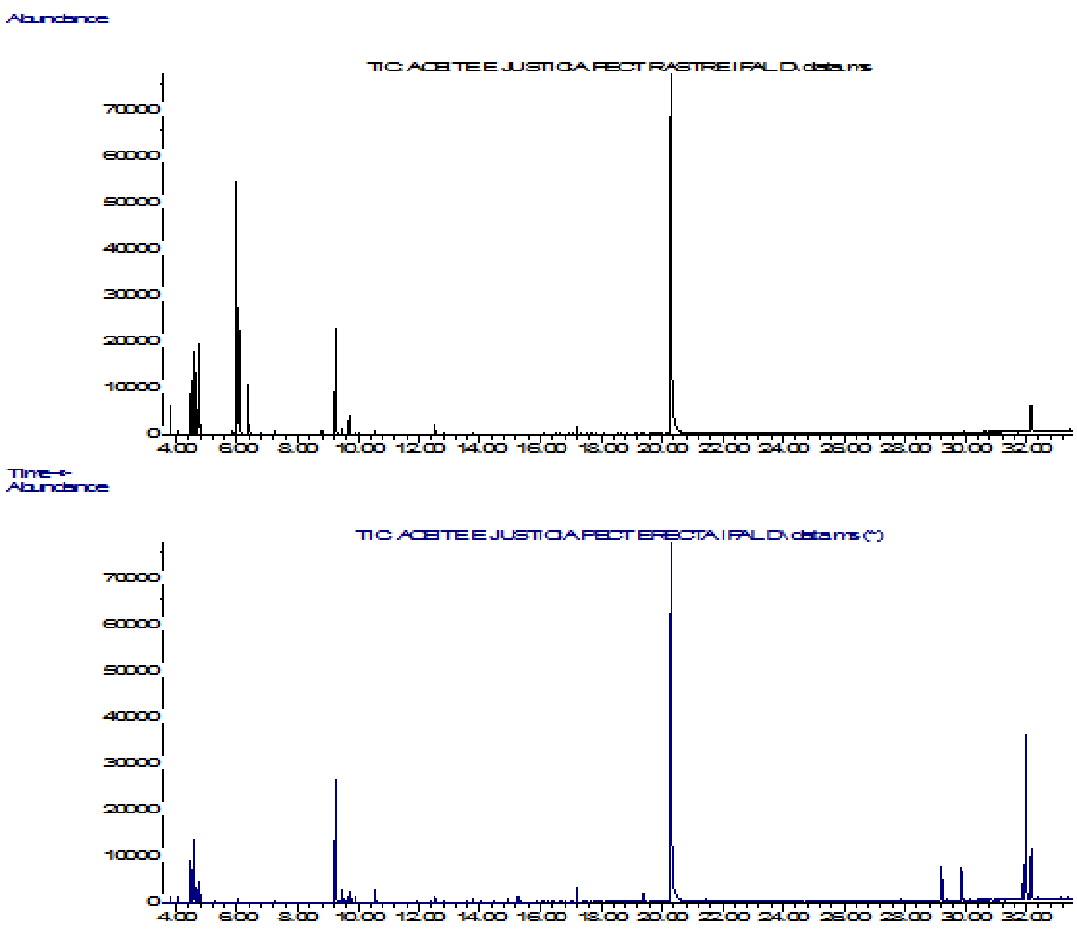

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Figure 3:

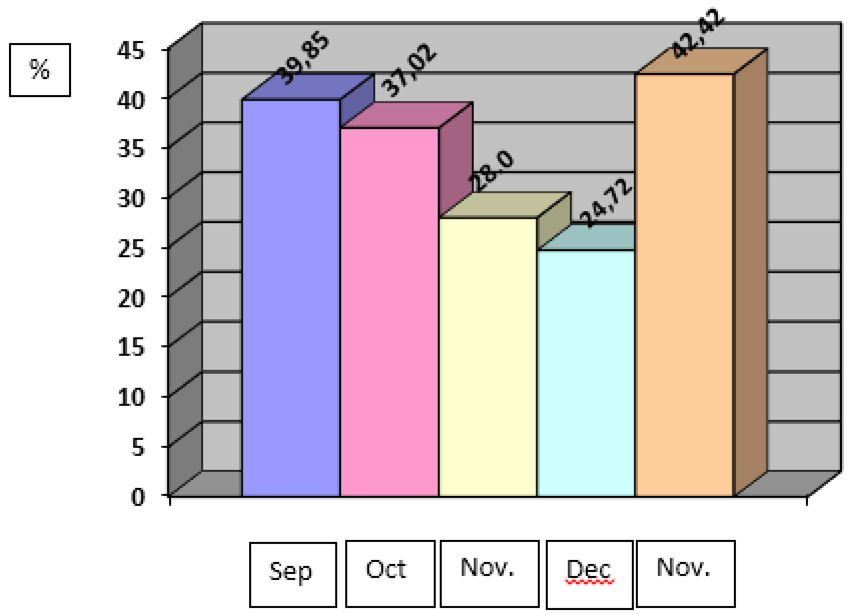

Figure 3. Variation of coumarin contain in different month.

Figure 4:

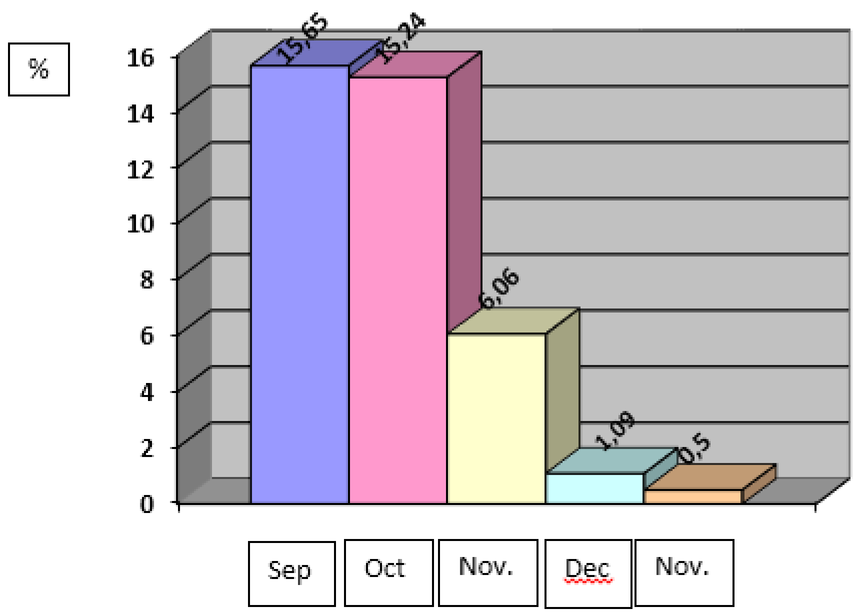

Figure 4. Variation of Trans (Z) 2- hexenal contain in different month.

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Figure 5:

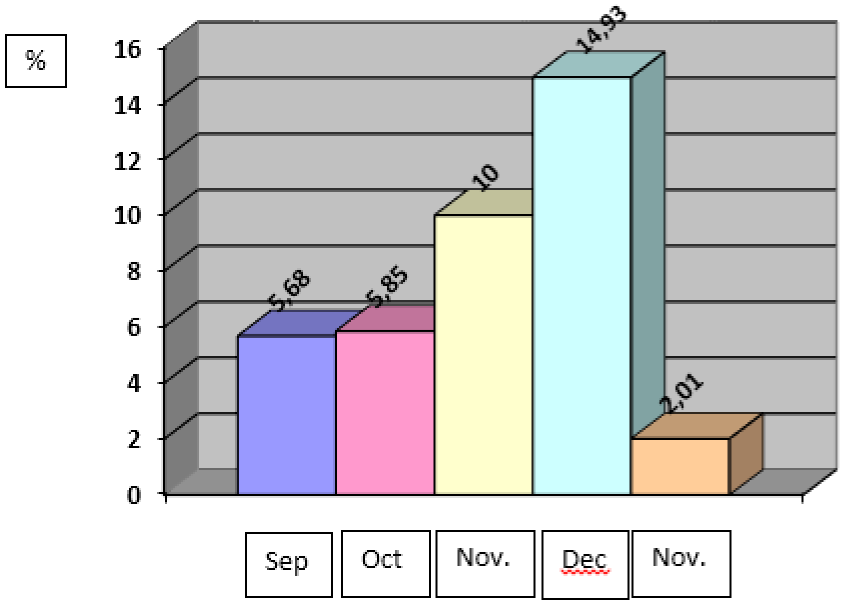

Figure 5. Variation of 2- hexenol contain in different month.

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