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Leaf and fruit essential oil compositions of *Pimenta guatemalensis* (Myrtaceae) from Costa Rica

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Abstract: *Pimenta* is a genus of flowering plants in the Myrtaceae family, which has about 15 species, mostly found in the Caribbean region of the Americas. Commonly used for culinary and medicinal purposes, the best known commercial species are allspice, *P. dioica* (*P. officinalis*) and bay rum, *P. racemosa*, but there is little information concerning *P. guatemalensis*. The aim of the present study was to identify the chemical composition of the leaf and fruit essential oils of *P. guatemalensis*. The extraction of essential oils of *P. guatemalensis* growing wild in Costa Rica was carried out by the hydrodistillation method at atmospheric pressure, using a modified Clevenger type apparatus. The chemical composition of the oils was analyzed by capillary gas chromatography-flame ionization detector (GC/FID) and gas chromatography-mass spectrometry (GC/MS) using the retention indices on DB-5 type capillary column. A total of 103 and 63 compounds were identified in the leaf and fruit oils, respectively, corresponding to 96.8% and 86.1% of the total amount of the oils. The leaf oil consisted mainly of eugenol (72.8%), and mono- and sesquiterpene hydrocarbons (18.2%). Among terpenes the major components were β-caryophyllene (8.2%) and terpinolene (3.0%). The fruit oil also consisted mainly of eugenol (74.7%) and minor amounts of oxygenated mono- and sesquiterpenes (7.3%), mainly caryophyllene oxide (3.3%). This is the first report of the chemical composition of the essential oils obtained from this plant species. Rev. Biol. Trop. 63 (1): 303-311. Epub 2015 March 01.

Key words: *Pimenta guatemalensis*, Myrtaceae, essential oil composition, eugenol, β-caryophyllene, caryophyllene oxide, terpinolene, Costa Rica.

Myrtaceae is a family constituted of about 142 genera and includes more than 5 500 species of mostly trees and shrubs with conspicuous oil glands, distributed predominantly in the Southern hemisphere, mainly in Australia and South America (Wilson, 2011).

Worldwide, the family has a considerable economic value because species from several genera are used as a source of timber (for example, *Eucalyptus globulus* Labill., Tasmanian blue gum). Also, some species provide edible fruits [*Psidium guajava* L., *guava*; *P. friedrichsthalianum* (O. Berg) Nied., *cas* and *Eugenia uniflora* L., *pitanga*], are utilized as spices [*Syzygium aromaticum* (L.) Merr. & L. M. Perry, *clove*, and *Pimenta dioica* (L.) Merr., *allspice*], as a source of commercial essential oils [*clove*, *Melaleuca alternifolia* Cheel, *tea-tree* oil, *Eucalyptus* spp. and *Pimenta racemosa* (Mill.) J.W. Moore, *bay rum* oil] and many Myrtaceae are important in horticulture as flowering ornamentals (*Callistemon* spp., *Melaleuca* spp.).

The genus *Pimenta* Lindl. contains about 15 species, mostly in the Caribbean region of the Americas. *Pimenta guatemalensis* (Lundell) Lundell is a tree about 5-16(20) m tall with a straight trunk and reddish brown bark (Barrie, 2007). In Costa Rica, it is commonly known as *Jamaica* (León, & Poveda, 2000). This plant is distributed along Central America, from Guatemala to Panama. The young branchlets are 4-angled. The leaves are evergreen, simple, opposite and oblanceolate to elliptical, the blade cuneate at the base and acuminate at the apex. When the leaves are crushed they give off a scent with an aromatic flavor resembling a mixture of clove and cinnamon due to an oil of unknown composition. The fragrant flowers are small and the receptacle has five calyx lobes, arranged in panicles (*ca*. 20 flowers) in the leaf axils. The ovaries are uni-locular or without loculi. This plant grows wild in Costa Rica and it can be found distributed between 250 and 900m above sea level mostly in the rain forests of the North region and Caribbean slopes. To the best of our knowledge, no previous reports on the chemistry of *P. guatemalensis* have been published.

Pimenta species are used in several countries of Mesoamerica and Caribbean for culinary and medicinal purposes (Morton, 1981; Germosén-Robineau, 2005). Paula, Reis, Ferreira, Menezes, and Paula (2010), and Rao, Navinchandra, and Jayaveera (2012) and Lim (2012) have recently reviewed some botanical aspects, traditional medicinal uses, biological and pharmacological activities and chemical compositions of *Pimenta dioica* and *P. racemosa* (the most important from the economical point of view) and *P. pseudocaryophyllus*, the only species of this genus that grows in the Brazilian Atlantic Rain Forest in South America (Marques et al., 2010; Paula et al., 2011). Formerly the name *Pimenta dioica* was frequently misapplied to *P*. *guatemalensis* native populations in Costa Rica (Barrie, 2007).

The chemical composition of *Pimenta* spp. leaf oils produced in different countries has been investigated thoroughly (Tucker, Maciarello, & Landrum, 1991a; Tucker, Maciarello, Adams, Landrum, & Zanoni, 1991b; Tucker, Maciarello, Adams, Landrum, & Zanoni, 1991c; Tucker, Maciarello, & Landrum, 1992a; Tucker, Maciarello, & Landrum, 1992b; Bello et al., 1995; Ayedoun et al., 1996; Pino, & Rosado, 1996; Bello, Urquiola, García, Rosado, & Pino, 1998; Pino, Bello, & Urquiola, 2002; Jirovetz et al., 2007). The major component of the leaf oil of *P. dioica* from Jamaica and Cuba was the phenylpropanoid eugenol ranging from 54.3 to 79.2% with lesser amounts of the monoterpenoid 1,8-cineole (1.1-4.6%) and the sesquiterpenoids β-caryophyllene (1-8.7%), α-humulene (1.0-3.9%) and caryophyllene oxide (0.2-1.8%) (Tucker et al., 1991a; Pino, & Rosado, 1996). The foliar oil of *P. haitiensis* (Urb.) L. R. Landrum of the Dominican Republic, presented high amounts of the phenylpropanoids methyl chavicol (11.7-41.1%) or methyl eugenol (0.6-24.4%) and *trans*-anethole (4.7-8.7%), and the monoterpenoids 1,8-cineole (11.4-33.1%), linalool (16.0-17.8%) and α-terpineol (2.8-5.6%) (Tucker et al., 1991c). *Pimenta jamaicensis* (Britton, & Harris) Proctor of Jamaica gave leaf oils which were dominated by either eugenol (61.8%), limonene (10.4%) and β-caryophyllene (5.8%), or 1,8-cineole (43.4-43.9%), α-terpineol (0.3-18.0%), terpinen-4-ol (6.4-7.2%) and *p*-cymene (2.2-10.4%) (Tucker et al., 1992a). Sesquiterpenoids dominated the oil of one collection of *P. obscura* Proctor of Jamaica (51.8%) with ledol (13.5%) and palustrol (7.6%) as main constituents (Tucker et al., 1992b). Other samples were found to be rich in 1,8-cineole (16.8-25.1%), limonene (5.3-11.5%), *p*-cymene (*ca*. 11%), α-terpineol (6.7-8.1%) and terpinen-4-ol (4.9-9.8%) (Tucker et al., 1992a). Tucker et al. (1991b) studied the foliar oils of three varieties of *P. racemosa* and two commercial bay oils. The leaf oil of commercial variety was composed mainly of phenylpropanoids [eugenol (44.4-68.9%), chavicol (traces-15.5%) and/or methyl eugenol (11.9%)], together with variable amounts of myrcene (0.1-16.2%). This composition is similar to the same variety cultivated in Benin (Ayedoun et al., 1996) and North India (Pragadheesh, Yadav, Singh, Gupta, & Chanotiya, 2013). From this study the authors were able to ascertain that leaf oils of varieties of *P. racemosa* may be dominated by chavicol, 1,8-cineole, eugenol, methyl chavicol, geraniol, limonene, methyl eugenol, myrcene, *trans*-methyl isoeugenol, γ-terpinene, terpinen-4-ol, α-terpineol and/or thymol (Tucker et al., 1991b; Bello et al., 1995). The leaf oil from *P. adenoclada* (Urb.) Burret from Cuba (Pino et al., 2002) was dominated by the oxygenated sesquiterpenes caryophyllene oxide (15.4%), α-muurolol (9.4%) and humulene epoxide II (7.6%). *Pimenta pseudocaryophyllus* (Gomes) L. R. Landrum, native to Brazil, gave leaf oils dominated by chavibetol (70.9%) and methyl eugenol (20.7%) (Marques et al., 2010). A recent study of this species in central Brazilian Cerrado (Paula et al., 2011) showed three chemotypes: one composed mainly by citral [geranial (*ca*. 40%) and neral (*ca*. 25%)], a second type with high amount of asarone (*ca*. 65%) and another with high amounts of (*E*)-methyl isoeugenol (*ca*. 93%).

The chemical composition of *P. dioica* fruit (*pimento-allspice*) oil has been the subject of several studies. One review paper reported, that this oil contains eugenol (68.6-87.0%), methyl eugenol (2.9-13.0%), β-caryophyllene (2.5-5.4%) and 1,8-cineole (2.3-3.3%) as main constituents (Pino, 1999, and references therein cited). The oils from berries collected in Xaltipan, Puebla, Mexico (García Fajardo et al., 1997), and extracted by steam distillation and hydrodistillation, were composed mainly by methyl eugenol (48.3-62.7%), myrcene (16.5-17.7%) and, eugenol (8.3-17.3%).

In the present work we report the chemical composition of the oils isolated by hydrodistillation from leaves and fruits of *P. guatemalensis* collected in Costa Rica.

MATERIALS AND METHODS

Plant material: Leaves and fruits of *Pimenta guatemalensis* (Lundell) Lundell, Myrtaceae, growing wild in Costa Rica in a rain forest, were collected in August 2005 (rainy season), in Bajo Rodríguez, San Ramón, Province Alajuela. A voucher specimen was kept at the Herbarium of the University of Costa Rica (USJ 77482).

Isolation of the essential oils: Air-dried (in the shade at room temperature) leaves (500g) of *P. guatemalensis* were subjected to hydrodistillation at atmospheric pressure, for three hours, using a modified Clevenger-type glass apparatus. The light yellowish distilled oil (2.5mL) was dried over anhydrous Na_2SO_4; and the yield (v/m) of the oil was 0.5%. The same procedure was utilized for the air-dried fruits (250g). The colorless oil was dried, yielding 1.8mL (0.7% v/m). The oils were filtered and stored at 0-10°C in the dark for further analysis.

GC/FID analysis: The oils of *P. guatemalensis* were analyzed by GC-FID (gas chromatography with flame ionization detector) using a Shimadzu GC-2014 gas chromatograph. The data were obtained on a poly (5% phenyl-95% methylsiloxane) fused silica capillary column (30m x 0.25mm; film thickness 0.25μm), (MDN-5S, Supelco), with a LabSolutions, Shimadzu GC Solution, Chromatography Data System, software version 2.3. Operating conditions were: carrier gas N_2, flow 1.0mL/min; oven temperature program: 60-280°C at 3°C/min, 280°C (2min); sample injection port temperature 250°C; detector temperature 280°C; split 1:60.

GC/MS analysis: The analyses by gas chromatography coupled to mass selective detector were performed using a Shimadzu GC-17A gas chromatograph coupled with a GCMS-QP5000 apparatus and CLASS 5000 software with Wiley 139 and NIST computer databases. The data were obtained using the same column described above. Operating conditions were: carrier gas He, flow 1.0mL/min; oven temperature program: 60-280°C at 3°C/min; sample injection port temperature 250°C; detector temperature 260°C; ionization voltage: 70eV; ionization current 60μA; scanning speed 0.5s over 38-400amu range; split 1:70.

Identification of chemical constituents: The oil components were identified using the retention indices (RI) on capillary DB-5 type column (van den Dool, & Kratz, 1963), and by comparison of their mass spectra with those published in the literature (Adams, 2007) or those of the author's database. To obtain the retention indices for each peak, 0.1μL of *n*-alkane mixture (Sigma *retention index standard for gas chromatography*, C_8-C_{32}, R 8769, USA) was injected under the same experimental conditions reported above. Integration of the total chromatogram (GC/FID), expressed as area percent, has been used to obtain quantitative compositional data.

RESULTS

From the hydrodistilled oils, a total of 126 compounds were identified using GC/FID and GC/MS, accounting for 96.8% (leaves) and 86.1% (fruits) of the total composition of the essential oils. The compounds identified in the leaf and fruit oils of *P. guatemalensis* are presented in Table 1, where the components were listed in order of elution on a MDN-5S column. Table 1 also includes the relative percentages of single components, their experimental retention indices (RI) with reference to a homologous series of linear alkanes (C_8-C_{32}) and, for comparison purposes, previously published values. Additionally, percentages of oils various types/classes of constituents were also indicated.

TABLE 1
Percentage composition of the leaf and fruit oils of *Pimenta guatemalensis* from Costa Rica

Compound[a]	R.I.[b]	R.I.[c]	Leaf	Fruit	Identification Method[d]
Pentan-1-ol	762	762	t	nd	1, 2
Hexanal	801	801	t	nd	1, 2
(2*E*)-Hexenal	849	846	0.1	t	1, 2
(2*E*)-Hexenol	853	854	t	nd	1, 2
Hexan-1-ol	863	863	t	t	1, 2
Heptanal	901	901	t	nd	1, 2
(2*E*,4*E*)-Hexadienal	907	907	t	nd	1, 2
(3*Z*)-Hexenyl formate	915	913	nd	t	1, 2
α-Thujene	927	924	0.2	t	1, 2
α-Pinene	933	932	0.1	t	1, 2, 3
(2*E*)-Heptenal	959	947	t	nd	1, 2
Heptan-1-ol	966	959	0.1	t	1, 2
Hexanoic acid	967	967	t	nd	1, 2
β-Pinene	978	974	t	nd	1, 2, 3
6-Methyl-5-hepten-2-one	984	981	t	nd	1, 2
Myrcene	988	988	0.6	0.8	1, 2
Butyl butanoate	992	993	t	nd	1, 2
Octanal	1 004	998	0.1	nd	1, 2
α-Phellandrene	1 008	1 002	0.6	nd	1, 2
p-Mentha-1(7),8-diene	1 004	1 003	0.1	t	1, 2
(2*E*,4*E*)-Heptadienal	1 005	1 005	t	nd	1, 2
δ-3-Carene	1 009	1 008	nd	t	1, 2
α-Terpinene	1 014	1 014	0.2	t	1, 2
p-Cymene	1 024	1 020	0.9	0.1	1, 2
Limonene	1 023	1 024	0.4	0.1	1, 2, 3
β-Phellandrene	1 026	1 025	0.1	t	1, 2
1,8-Cineole	1 028	1 026	0.1	t	1, 2, 3
(*Z*)-β-Ocimene	1 037	1 032	t	t	1, 2
(*E*)-β-Ocimene	1 044	1 044	0.9	t	1, 2
Pentyl isobutanoate	1 053	1 049	t	nd	1, 2
γ-Terpinene	1 057	1 054	0.5	nd	1, 2
(2*E*)-Octen-1-ol	1 059	1 060	t	nd	1, 2

TABLE 1 (Continued)

Compound[a]	R.I.[b]	R.I.[c]	Leaf	Fruit	Identification Method[d]
Octan-1-ol	1065	1063	0.1	nd	1, 2
trans-Arbusculone	1066	1066	nd	t	1, 2
cis-Linalool oxide (furanoid)	1067	1067	nd	0.1	1, 2
trans-Linalool oxide (furanoid)	1081	1084	nd	0.1	1, 2
m-Cymenene	1084	1082	nd	0.1	1, 2
Terpinolene	1086	1086	3.0	nd	1, 2
p-Cymenene	1091	1089	0.1	nd	1, 2
Linalool	1098	1095	0.8	0.6	1, 2, 3
trans-Sabinene hydrate	1099	1098	nd	0.1	1, 2
(*E*)-6-Methyl-3,5-heptadien-2-one	1104	1100[e]	t	nd	1, 2
Nonanal	1105	1100	t	nd	1, 2
1,3,8-*p*-Menthatriene	1112	1108	0.1	nd	1, 2
cis-*p*-Menth-2-en-1-ol	1118	1118	0.1	t	1, 2
Octyl formate	1127	1127	nd	0.1	1, 2
(*Z*)-Myroxide	1133	1131	nd	t	1, 2
cis-*p*-Mentha-2,8-dien-1-ol	1134	1133	0.1	nd	1, 2
(*E*)-Myroxide	1142	1140	t	0.1	1, 2
β-Pinene oxide	1153	1154	nd	t	1, 2
(2*E*)-Nonenal	1156	1157	t	nd	1, 2
Octanoic acid	1167	1167	nd	t	1, 2
Ethyl benzoate	1168	1169	nd	t	1, 2
cis-Pinocamphone	1170	1172	0.1	nd	1, 2
Terpinen-4-ol	1179	1174	1.0	0.3	1, 2
p-Cymen-8-ol	1184	1179	0.4	0.3	1, 2
Methyl salicylate	1189	1190	t	t	1, 2
Hexyl butanoate	1192	1191	t	nd	1, 2
α-Terpineol	1196	1198[f]	0.4	0.1	1, 2
cis-Sabinol	1201	1202[g]	t	t	1, 2
Decanal	1204	1201	t	nd	1, 2, 3
Octyl acetate	1209	1211	0.1	t	1, 2
(2*E*,4*E*)-Nonadienal	1215	1210	t	nd	1, 2
Nerol	1223	1227	t	nd	1, 2
Neral	1237	1235	t	t	1, 2
Geraniol	1247	1249	t	t	1, 2
2-Phenyl ethyl acetate	1249	1254	t	nd	1, 2
Methyl citronellate	1254	1257	t	nd	1, 2
(2*E*)-Decenal	1257	1260	0.1	nd	1, 2
Geranial	1268	1264	0.1	nd	1, 2
iso-3-Thujanyl acetate	1269	1267	nd	0.1	1, 2
Safrole	1280	1285	0.1	t	1, 2
Thymol	1290	1289	0.1	t	1, 2, 3
Carvacrol	1296	1298	0.1	nd	1, 2
Eugenol	1361	1356	72.8	74.7	1, 2, 3
β-Elemene	1389	1389	0.2	0.2	1, 2
Vanillin	1398	1393	nd	0.7	1, 2
β-Caryophyllene	1420	1417	8.2	0.2	1, 2, 3
Carvone hydrate	1425	1422	nd	t	1, 2

TABLE 1 (Continued)

Compound[a]	R.I.[b]	R.I.[c]	Leaf	Fruit	Identification Method[d]
β-Copaene	1 429	1 430	t	nd	1, 2
α-Humulene	1 452	1 452	nd	0.2	1, 2
(*E*)-Isoeugenol	1 453	1 448	nd	t	1, 2
Sesquisabinene	1 463	1 457	nd	0.1	1, 2
β-Chamigrene	1 472	1 476	0.3	0.1	1, 2
γ-Muurolene	1 475	1 478	t	nd	1, 2
α-Amorphene	1 480	1 483	t	nd	1, 2
Germacrene D	1 483	1 484	t	nd	1, 2
β-Selinene	1 487	1 489	0.7	0.4	1, 2
cis-Cadina-1,4-diene	1 495	1 495	t	nd	1, 2
α-Selinene	1 497	1 498	0.8	0.5	1, 2
α-Muurolene	1 500	1 500	t	t	1, 2
β-Bisabolene	1 505	1 505	nd	t	1, 2
δ-Amorphene	1 508	1 511	t	t	1, 2
γ-Cadinene	1 512	1 513	t	nd	1, 2
(*Z*)-γ-Bisabolene	1 513	1 514	t	nd	1, 2
δ-Cadinene	1 517	1 522	0.2	nd	1, 2
cis-Calamenene	1 525	1 528	t	nd	1, 2
Zonarene	1 531	1 528	t	nd	1, 2
(*Z*)-Nerolidol	1 536	1 531	t	nd	1, 2
α-Cadinene	1 540	1 537	t	nd	1, 2
α-Calacorene	1 545	1 544	t	nd	1, 2
(*E*)-Nerolidol	1 558	1 561	t	nd	1, 2
Caryophyllenyl alcohol	1 575	1 570	0.1	nd	1, 2
Caryophyllene oxide	1 582	1 582	0.4	3.3	1, 2
Humulene epoxide II	1 610	1 608	0.1	0.8	1, 2
Junenol	1 622	1 618	t	nd	1, 2
1-*epi*-Cubenol	1 628	1 627	t	nd	1, 2
γ-Eudesmol	1 632	1 630	0.1	nd	1, 2
Caryophylla-4(12),8(13)-dien-5β-ol	1 638	1 639	0.1	0.1	1, 2
epi-α-Cadinol	1 638	1 638	t	nd	1, 2
epi-α-Muurolol	1 643	1 640	0.1	nd	1, 2
α-Muurolol	1 644	1 644	t	nd	1, 2
Cubenol	1 645	1 645	nd	0.1	1, 2
β-Eudesmol	1 449	1 649	0.1	nd	1, 2
α-Cadinol	1 653	1 652	nd	0.1	1, 2
Selin-11-en-4α-ol	1 657	1 658	0.7	0.5	1, 2
Intermedeol	1 666	1 665	t	nd	1, 2
14-Hydroxy-9-*epi*-(*E*)-caryophyllene	1 670	1 668	0.1	0.6	1, 2
(*Z*)-α-Santalol	1 679	1 674	t	nd	1, 2
(2*E*,6*Z*)-Farnesal	1 709	1 713	t	nd	1, 2
(2*E*,6*Z*)-Farnesol	1 714	1 714	t	nd	1, 2
Coniferaldehyde	1 729	1 728	t	0.3	1, 2
(*E*)-Coniferyl alcohol	1 730	1 733	nd	0.2	1, 2
(2*E*,6*E*)-Farnesal	1 743	1 740	t	nd	1, 2
6,10,14-Trimethyl-2-pentadecanone	1 846	1 848[h]	t	nd	1, 2

TABLE 1 (Continued)

Compound[a]	R.I.[b]	R.I.[c]	Leaf	Fruit	Identification Method[d]
Compound classes			%	%	
Monoterpene hydrocarbons			7.8	1.1	
Oxigenated monoterpenes			3.3	1.8	
Sesquiterpene hydrocarbons			10.4	1.7	
Oxigenated sesquiterpenes			1.8	5.5	
Aromatics			72.9	75.9	
Others			0.6	0.1	
Identified compounds			96.8	86.1	

[a]Compounds listed in order of elution from poly(5% phenyl-95% methylsiloxane) column. [b]RI= Experimental retention index relative to a homologous series of *n*-alkanes. [c]RI= Lit.(Adams, 2007). [d]Method: 1 = Retention index on poly(5% phenyl-95% methylsiloxane) column; 2 = MS spectra; 3 = Standard; t = traces (<0.05%); nd: not detected. [e](Pino et al., 2006). [f](Jordán, Margaría, Shaw, & Goodner, 2002). [g](Hamm, Lesellier, Bleton, & Tchapla, 2003). [h](Gómez, Ledbetter, & Hartsell, 1993).

P. guatemalensis gave oils which were predominantly aromatic in nature with a terpenic fraction, and several aliphatic and aromatic compounds as trace components.

DISCUSSION

The leaf oil was rich in the phenylpropanoid compound eugenol (72.8%) accompanied by a little quantity of safrole (0.1%). This oil contained also terpene hydrocarbons (18.2%) being the main components β-caryophyllene (8.2%) and terpinolene (3.0%). The remaining monoterpenes and sesquiterpenes were each one less than 0.9%. Other monoterpenes in the oil were *p*-cymene (0.9%), (*E*)-β-ocimene (0.9%), myrcene (0.6%), α-phellandrene (0.6%), γ-terpinene (0.5%) and limonene (0.4%), accompanied by the sesquiterpene hydrocarbons α-selinene (0.8%) and β-selinene (0.7%). Oxygenated terpenoids were not particularly abundant, with the most prominent members being terpinen-4-ol (1.0%), linalool (0.8%) and selin-11-en-4-α-ol (0.7%). The oil of *P. guatemalensis* resembles leaf oils of *P. dioica* from Jamaica with 66.4 to 79.2% of eugenol (Tucker et al., 1991a). The leaf oil of *P. dioica* from Cuba contained a minor amount of eugenol, 54.3% (Pino & Rosado, 1996). One commercial sample of leaf oil from Jamaica contained 76.0% of eugenol and 7.1% of methyl eugenol (Jirovetz et al., 2007), compound not detected in our study nor in the two aforementioned studies on *P. dioica*.

The fruit oil also was rich in eugenol (74.7%), accompanied by lesser amounts of the benzenoid vanillin (0.7%), the phenylpropanoids coniferaldehyde (0.3%) and (*E*)-coniferyl alcohol (0.2%), together with traces of safrole and (*E*)-isoeugenol. This oil resembles the fruit oil composition of *P. dioica* from Jamaica (Pino, 1999), where the main constituent was eugenol, 68.6-87.0%. A comparison of our results with those obtained by García Fajardo et al. (1997), from samples of Mexican berries, indicate both qualitative and quantitative differences in the constituents. The Mexican berries contain high quantities of methyl eugenol (48.3-62.7%) and myrcene (16.5-17.7%) and low quantity of eugenol (8.3-17.3%). The absence of methyl eugenol and the presence of the minor benzenoid and phenylpropanoids above mentioned appears to be a fact that could differentiate the oil of *P. guatemalensis* from other oils of *P. dioica* studied previously. However, to try to chemically differentiate between *P. guatemalensis* and *P. dioica*, it would be necessary to conduct a study with a larger number of wild specimens from various geographic areas of Costa Rica.

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RESUMEN

Aceites volátiles de hojas y frutos de *Pimenta guatemalensis* **(Myrtaceae) de Costa Rica.** *Pimenta* es un género de plantas perteneciente a la familia Myrtaceae que contiene cerca de 15 especies, la mayoría ubicadas en las regiones del Caribe del Continente Americano, donde es utilizado con propósitos culinarios y medicinales. Las especies comerciales mejor conocidas son "pimienta de Jamaica" (*P. dioica* o *P. officinalis*) y "*bay-rum*" (*P. racemosa*) y existe muy poca información científica acerca de la especie *P. guatemalensis*. Cuando las hojas y frutos son triturados, desprenden un aroma de composición desconocida. El objetivo del presente estudio fue identificar la composición química de los aceites esenciales de las hojas y frutos de *P. guatemalensis*. La extracción de los aceites esenciales de *P. guatemalensis*, una especie arbórea silvestre en Costa Rica, se efectuó mediante el método de hidrodestilación a presión atmosférica, empleando un aparato de vidrio de tipo Clevenger. Se analizó la composición química de los aceites esenciales mediante cromatografía de gases con detector de ionización de flama (GC/FID) y cromatografía de gases acoplada a un detector de masas (GC/MS) y, utilizando índices de retención en una columna cromatográfica capilar tipo DB-5. En los aceites de hojas se identificaron 103 y en los de frutos 63 compuestos, correspondiendo a 96.8% y 86.1%, respectivamente, de los constituyentes totales. El aceite de las hojas está constituido principalmente por compuestos de naturaleza fenilpropanoide (72.9%) y de hidrocarburos monoterpénicos y sesquiterpénicos (18.2%). Los componentes mayoritarios del aceite de las hojas se identificaron como eugenol (72.8%), β-cariofileno (8.2%) y terpinoleno (3.0%). El aceite de los frutos está constituido principalmente por eugenol (74.7%), monoterpenos y sesquiterpenos oxigenados (7.3%) principalmente óxido de cariofileno (3.3%). Este es el primer informe acerca de la composición química de aceites esenciales obtenidos a partir de esta especie vegetal.

Palabras clave: *Pimenta guatemalensis*, Myrtaceae, aceite esencial, composición química, eugenol, β-cariofileno, óxido de cariofileno, terpinoleno, Costa Rica.

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