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Essential oil from leaves of *Myrcianthes fragrans* (Myrtaceae) from Costa Rica. A new chemotype?

[Aceite esencial de las hojas de *Myrcianthes fragrans* (Myrtaceae) de Costa Rica. ¿Un nuevo quimiotipo?]

Carlos Chaverri & José F. Cicció

Escuela de Química & Centro de Investigaciones en Productos Naturales (CIPRONA), Universidad de Costa Rica. San José, Costa Rica
Contactos | Contacts: **José F. CICCIÓ** - ***E-mail address:*** **jfciccio@gmail.com**

Abstract: *Myrcianthes* is a Myrtaceous genus of flowering plants of about 30 to 40 species, distributed in the American continent. The aim of this work was to study the chemical composition of the foliar essential oil from *M. fragrans* growing wild in central Costa Rica. The essential oil was obtained through the steam distillation process in a Clevenger type apparatus. The chemical composition of the oil was performed by capillary gas chromatography with a flame detector (GC-FID) and gas chromatography-mass spectrometry (GC-MS) using the retention indices on a DB-5 type capillary column in addition to mass spectral fragmentation patterns. A total of 98 compounds were identified, accounting for 98.8% of the total amount of the oil. The major constituents in the leaf oil were (*E*)-methyl cinnamate (39.6%), limonene (34.6%), α-pinene (6.8%), and linalool (6.8%). This is the first report of (*E*)-methyl cinnamate occurring in oils of this plant genus. These findings appear to suggest a new chemotype of *M. fragrans*.

Keywords: *Myrcianthes fragrans*, Myrtaceae, essential oil, (E)-methyl cinnamate, limonene, chemotype.

Resumen: *Myrcianthes* (Myrtaceae) consta de 30 a 40 especies, distribuidas en el continente americano. El objetivo del presente trabajo consistió en identificar la composición química del aceite esencial contenido en las hojas de *M. fragrans*, planta que crece en forma silvestre en el Valle Central de Costa Rica. La extracción del aceite se efectuó mediante el método de hidrodestilación usando un equipo de Clevenger modificado. La composición química del aceite se analizó mediante las técnicas de cromatografía gaseoso-líquida con detector de ionización de llama (GC-FID) y de cromatografía gaseoso-líquida acoplada a un detector de masas (GC-MS). Se utilizaron índices de retención obtenidos en una columna capilar tipo DB-5 y se compararon con los patrones de iones de fragmentación de masas. Se identificaron en total 98 compuestos, correspondientes a un 98.8% de los constituyentes totales. Los componentes mayoritarios del aceite resultaron ser (*E*)-cinamato de metilo (39.6%), limoneno (34.6%), α-pineno (6.8%) y linalol (6.8%). Este es el primer informe de la aparición de (*E*)-cinamato de metilo en aceite de hojas de este género de plantas. Los datos obtenidos parecen sugerir un nuevo quimiotipo de *M. fragrans*.

Palabras clave: *Myrcianthes fragrans*, Myrtaceae, aceite esencial, (E)-cinamato de metilo, limoneno, quimiotipo.

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INTRODUCTION

The Myrtaceae is a family of flowering plants with about 142 genera and over 5500 species (Wilson, 2011) distributed throughout the world occurring predominantly in tropical and southern temperate regions (with low representation in Africa). This family is composed mainly of trees and shrubs with mostly southern hemisphere distribution, with the majority of genera occurring in Australia and South America. One of the characteristics of this family is the presence of oil glands that produce essential oils, mainly constituted by terpenoids.

Myrcianthes O. Berg is a genus composed by about 30 to 40 species ranging from southern Florida and Mexico to Bolivia and northern Argentina, Uruguay and north central Chile and the Caribbean (McVaugh, 1963; Tucker *et al*., 1992; Tucker *et al*., 2002). *Myrcianthes fragrans* (Sw.) McVaugh is a large shrub or tree of about 3 m to 30 m tall, with a distributional range from southern Florida, eastern Mexico, Mesoamerica, and the Caribbean Islands and northern South America (McVaugh, 1963). In Costa Rica, it is distributed in several habitats from (0-)600 to 2600 m of elevation, in tropical rainforests, in tropical montane forests and in oak forests, where the plant is commonly known as *albajaquillo*, *guayabillo* and *murta* (Barrie, 2007). The leaves are evergreen, elliptic to ovate, leathery and opposite, rounded, with a blunt tip or slightly notched at the apex, glossy above, paler and dotted with tiny oil glands on the underside. When the leaves are crushed they give off a scent with a sweet spicy aromatic flavor.

In the Caicos Islands the decoction of branch tips is used as a febrifuge, as a remedy for aches and pains, and also as a cosmetic to perfume the body (Morton, 1981; Austin, 2004).

In the literature, there are many studies on chemical composition of essential oils of diverse species of the genus *Myrcianthes* growing in different regions of America (Carmen *et al*., 1972; Taher *et al*., 1983; Ubiergo *et al*., 1986; Tucker *et al*., 1992; Zygadlo *et al*., 1997; Setzer *et al*., 1999; Pino *et al*., 2000; Lorenzo *et al*., 2001; Demo *et al*., 2002; Tucker *et al*., 2002; Malagon *et al*., 2003; Lopez-Arce *et al*., 2005; Apel *et al*., 2006; Toloza *et al*., 2006; Marín *et al*., 2008; Cole *et al*., 2008; Mora *et al*., 2009; Yáñez *et al*., 2014). Lorenzo *et al*. (2002) reported the characterization of the enantiomeric excess for some principal components of the oil of *M. cisplatensis* of Uruguayan origin. In general, the investigated oils were composed mainly by terpenoids, and the major constituents identified are summarized in Table 1. The oil of *Myrcianthes fragrans* has been the subject of study by few research groups, and the main compounds identified previously are tabulated in Table 2. The only previous report about the *M. fragrans* leaf essential oil composition from a Costa Rican origin (Monteverde), afforded mainly oxygenated sesquiterpenes (63.5%) and aromatic compounds (20.5%) virtually without the presence of monoterpenoids (Setzer *et al*., 1999).

In this paper, the chemical composition of the leaf essential oil of *M. fragrans* growing wild in the Central Valley of Costa Rica was investigated, and compared with the leaf-oil composition from other *Myrcianthes* reported in the literature.

Table 1
Major compounds present in *Myrcianthes* spp. essential oils

Species	Collecting site (Plant part)	Major constituents	References
M. callicoma McVaugh	Argentina	α-Pinene, limonene, and 1,8-cineole.	Carmen *et al*., 1972.
M. cisplatensis (Camb.) Berg	Argentina	1,8-cineole (13.5%), geraniol (8.4%).	Taher *et al*., 1983.
M. cisplatensis (Camb.) Berg	Argentina, Catamarca province.	1,8-Cineole (40.7%), limonene (22.1%), α-terpineol (7.7%), linalool (4.8%), and α-pinene	Zygadlo *et al*., 1997.

	(Air-dried leaves)	(4.3%).	
M. cisplatensis (Camb.) Berg	Uruguay, 'Cerros pelados', Canelones province. (Air-dried leaves)	1,8-Cineole (53.8%), α-pinene (16.6%), α-terpineol (4.2%), limonene (4.1%), and thujopsan-4α-ol (2.0%).	Lorenzo *et al*., 2001.
M. cisplatensis (Camb.) Berg	Uruguay	Enantiomeric distribution: (1*R*)-(+)-α-pinene (96.3%), (1*S*)-(-)-α-pinene (3.7%), (1*R*)-(+)-β-pinene (49.3%), (1*S*)-(-)-β-pinene (50.7%), (4*R*)-(+)-limonene (100%), (4*S*)-(-)-limonene (tr), (3*S*)-(+)-linalool (93.9%), (3*R*)-(-)-linalool (6.1%), (4*S*)-(+)-4-terpineol (49.9%), (4*R*)-(-)-4-terpineol (51.1%), (8*R*)-(+)-α-terpineol (64.0%), and (8*S*)-(-)-α-terpineol (36.0%).	Lorenzo *et al*., 2002.
M. cisplatensis (Camb.) Berg	Brazil, Rio Grande do Sul. (Fresh leaves)	1,8-Cineole (29.8%), limonene (10.9%), β-caryophyllene (10.8%), α-pinene (8.9%), α-terpineol (5.7%), guaiol (4.9%), globulol (4.8%), α-selinene (2.7%), aromadendrene (2.5%), and α-humulene (2.0%).	Apel *et al*., 2006.
M. cisplatensis (Camb.) Berg	Argentina (Dried leaves)	1,8-Cineole (45.7%), limonene (27.1%), α-terpineol (7.7%), linalool (4.8%), and α-pinene (4.3%).	Toloza *et al*., 2006.
M. coquimbensis (Barnèoud) L.R. Landrum et Grifo	Chile, La Serena. (Air-dried leaves)	Limonene (14.5%), carvone (8.7%), α-pinene (7.2%), β-pinene (5.7%), *p*-cymene (5.3%), *trans*-carveol (4.9%), *cis*-pinocarveol (4.3%), and linalool (4.1%).	Tucker *et al*., 2002.
M. gigantea (D. Legrand) D. Legrand	Brazil, Rio Grande do Sul. (Fresh leaves)	Spathulenol (28.9%), *iso*-spathulenol (9.5%), α-cadinol (7.0%), caryophyllene oxide (6.7%), limonene (4.5%), α-pinene (3.5%), β-pinene (2.8%), globulol (2.8%), α-copaene	Apel *et al*., 2006.

		(2.6%), β-selinene (2.5%), and (*Z*)-hex-3-en-1-ol (2.4%).	
M. leucoxyla (Ortega) McVaugh	Colombia, Pamplona, Santander. (Dried leaves)	α-Pinene (28.4%), 1,8-cineole (15.7%), β-caryophyllene(8.8%), spathulenol (3.3%), guaiol (3.1%), β-humulene (3.0%), and caryophyllene oxide (3.0%).	Yáñez *et al*., 2013; Granados *et al*., 2014.
M. osteomeloides (Rusby) McVaugh	Bolivia, Cochabamba. (Fresh leaves)	1,8-Cineole (55.7%), α-pinene (17.9%), α-terpineol (8.5%), β-pinene (4.6%), limonene (4.1%), and terpinen-4-ol (1.3%).	Lopez-Arze *et al*., 2005.
M. pseudo-mato (Legr.) Mc.Vaugh	Argentina, Oran, Salta province. (Dried leaves)	1,8-Cineole (32.5%), β-caryophyllene (18.9%), sabinene (6.6%), α-pinene (6.5%), aromadendrene (5.4%), τ-muurolol (4.5%), (*E*)-nerolidol (3.5%), τ-cadinol (3.4%), spathulenol (3.3%), α-terpineol (2.7%), β-eudesmol (2.3%), and α-humulene (2.1%).	Demo *et al*., 2002.
M. pseudo-mato (Legr.) McVaugh	Bolivia, Cochabamba. (Fresh leaves)	1,8-Cineole (24.4%), α-pinene (17.1%), linalool (11.7%), limonene (8.5%), γ-terpinene (7.3%), *p*-cymene (3.9%), and α-terpineol (2.4%).	Lopez-Arze *et al*., 2005.
M. pungens (Berg) D. Legrand	Argentina (Leaves)	1,8-Cineole (13.5%), pulegone (9.4%), farnesol (9.0%), nerol (5.4%), and geraniol (4.5%%).	Ubiergo *et al*., 1986.
M. pungens (Berg) D. Legrand	Argentina, Catamarca province. (Air-dried leaves)	1,8-Cineole (45.9%), limonene (17.3%), α-terpineol (8.1%), α-pinene (3.3%), linalool (3.0%), and globulol (2.8%).	Zygadlo *et al*., 1997.
M. pungens (O. Berg) D. Legrand	Brazil, Rio Grande do Sul. (Fresh leaves)	β-Caryophyllene (10.1%), spathulenol (9.7%), β-elemene (9.1%), α-cadinol (8.0%), bicyclogermacrene (6.9%), globulol (6.2%), *epi*-globulol (4.7%), β-bisabolene (3.3%), (*E*)-γ-bisabolene (3.3%), β-selinene (3.1%), 1,8-cineole	Apel *et al*., 2006.

		(2.7%), caryophyllene oxide (2.3%), α-pinene (2.1%), α-humulene (2.0%), τ-muurolol (2.1%), and δ-cadinene (2.0%).	
M. pungens (O. Berg) D. Legrand	Brazil, Pelotas, Rio Grande do Sul. (Cultivated, fresh edible and ripped fruits)	β-Caryophyllene (32.7%), germacrene D (14.2%), bicyclogermacrene (11.2%), β-eudesmol (8.1%), furfural (7.7%), *epi*-globulol (3.9%), elemol (3.8%), α-humulene (3.3%), γ-eudesmol (2.5%), and α-eudesmol (2.5%).	Marín *et al*., 2008.
M. rhopaloides (Kunth) McVaugh	Ecuador, Cerro el Villonaco, Loja. (Fresh leaves)	Geranial (33.7%), neral (25.0%), β-pinene (9.0%), α-pinene (6.9%), geranyl acetate (3.0%), and geraniol (2.3%).	Malagon *et al*., 2003.
M. rhopaloides (Kunth) McVaugh	Costa Rica, Chomogo, Monteverde. (Fresh leaves)	Linalool (17.7%), α-cadinol (14.4%), spathulenol (11.1%), τ-cadinol (9.6%), 1-epicubenol (6.9%), α-muurolol (5.5%), cyclocolorenone (4.9%), α-terpineol (3.5%), eudesma-4(15),7-dien-1β-ol (3.4%), caryophyllene oxide (3.3%), tetradecan-1-ol (3.3%), *trans*-calamenene (2.5%), and δ-cadinene (2.2%).	Cole *et al*., 2008.
M. rhopaloides (Kunth) McVaugh	Costa Rica, Brillante, Monteverde. (Fresh leaves)	(*E*)-Hex-2-enal (46.1%), 1,8-cineole (12.5%), linalool (9.1%), α-cadinol (6.7%), α-terpineol (4.4%), τ-muurolol (2.6%), and terpinen-4-ol (2.0%).	Cole *et al*., 2008.
M. sp. nov. ‘black fruit’	Costa Rica, Monteverde. (Fresh leaves)	1,8-Cineole (52.8%), α-pinene (11.8%) α-terpineol (11.7%), heptan-2-ol (11.1%), β-pinene (8.4%), and limonene (4.3%).	Cole *et al*., 2008.
M. sp. nov. ‘black fruit’	Costa Rica, Monteverde. (Fresh leaves)	1,8-Cineole (38.3%), α-terpineol (21.2%), heptan-2-ol (15.5%), terpinen-4-ol (4.2%), and β-pinene (3.8%).	Cole *et al*., 2008.

Table 2
Main compounds present in several essential oils from *Myrcianthes fragrans*.

Collecting site	Plant part	Major constituents	References
Jamaica, Douglas Castle, St. Ann.	Air-dried leaves.	Limonene (56.0%), α-terpineol (10.9%), 1,8-cineole (7.1%), α-pinene (6.9%), and β-pinene (2.0%).	Tucker *et al.*, 1992.
Cuba, Pinar del Río.	Leaves and stalks.	α-Pinene (41.8%), limonene (30.0%), 1,8-cineole (6.5%), α-terpineol (5.7%), and *cis*-piperityl acetate (2.1%).	Pino *et al*., 2000.
Costa Rica, Monteverde.	Fresh leaves.	1,3,5-Trimethoxybenzene (15.7%), α-cadinol (10.4%), (*Z*)-hex-3-en-1-ol (10.0%), eudesma-4(15),7-dien-1β-ol (9.0%), caryophyllene oxide (7.8%), spathulenol (7.5%), muurola-4,10(14)-dien-1β-ol (4.7%), caryophylla-4(12),8(13)-dien-5β-ol (4.2%), humulene epoxide II (3.9%), τ-muurolol (3.5%), α-muurolol (3.2%), and (*E*)-methylisoeugenol (2.5%).	Cole *et al*., 2008.
Venezuela, Aldea Llanetes, Táchira.	Fresh leaves.	β-Caryophyllene (11.5%), myrcene (8.9%), phellandrene/ limonene (8.7%), α-humulene (6.7%), α-copaen-8-ol (6.7%), globulol (4.9%), viridiflorol (4.7%), bicyclogermacrene (4.4%), α-copaene (3.5%), δ-cadinol (2.8%), δ-cadinene (2.6%), linalool (2.3%), and τ-cadinol (2.1%).	Mora *et al*., 2009.

MATERIALS AND METHODS

Plant Materials

The leaves of *Myrcianthes fragrans* were collected during the fruiting stage of the plant in the locality of San Luis de Santo Domingo, Province of Heredia (10º00’47’’N, 84º01’29”W), Costa Rica, in a tropical Pre-montane Wet Forest life zone (Holdridge, 1987), at an elevation of 1330 m. A voucher specimen was deposited in the Herbarium of the University of Costa Rica (USJ 96619).

Isolation of the essential oils

The oil was isolated by hydrodistillation at atmospheric pressure, for 3 h using a Clevenger-type apparatus. The distilled oil was collected and dried over anhydrous sodium sulfate, filtered and stored between 0 °C and 10 °C in the dark, until further analysis. The yield of the pale yellowish oil was 0.5 % (v/w) in fresh plant material.

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

Gas chromatography-mass spectrometry (GC-MS)
The analysis by gas chromatography coupled to mass selective detector (GC-MS) was carried out using a Shimadzu GC-17A gas chromatograph coupled with a GCMS-QP5000 apparatus and CLASS 5000 software with Wiley 139 and NIST computerized databases. The data were obtained on a 5% phenyl-/95% dimethylpolysiloxane fused silica capillary column (30 m x 0.25 mm; film thickness 0.25 μm), (MDN-5S). The operating conditions used were: carrier gas He, flow 1.0 mL/min; oven temperature program: (60 to 280) °C at 3 °C/min; sample injection port temperature 250 °C; detector temperature 260 °C; ionization voltage: 70 eV; ionization current 60 μA; scanning speed 0.5 s over 38 to 400 amu range; split 1:70.

Compound identification
Identification of the oil components was performed using the retention indices which were calculated in relation to a homologous series of *n*-alkanes, on a 5% phenyl-/95% dimethylpolysiloxane type column (van den Dool & Kratz, 1963), and by comparison of their mass spectra with those published in the literature (Stenhagen, *et al*., 1974; Swigar & Silverstein, 1981; MacLafferty, 1993; Adams, 2007), and those of our own database, or comparing their mass spectra with those available in the computerized databases (NIST 107 and Wiley 139) or in a web source (Stein, 2014). To obtain the retention indices for each peak, 0.1μL of *n*-alkane mixture (Sigma, C_8-C_{32} standard mixture) was injected under the same experimental conditions reported above. Integration of the total chromatogram (GC-FID), expressed as area percent, without correction factors, has been used to obtain quantitative compositional data.

RESULTS AND DISCUSSION
The chemical composition of the leaf oil of *Myrcianthes fragrans* from central Costa Rica (Central Valley) is summarized in Table 3. This oil consisted largely of monoterpene hydrocarbons (44.0%) and phenylpropanoids (39.6%), with lesser amount of oxygenated monoterpenes (7.6%), see Figure 1. The major constituents of *M. fragrans* leaf oil were methyl (*E*)-cinnamate [methyl (*E*)-3-phenylprop-2-enoate] (39.6%), limonene (34.6%), α-pinene (6.8%), and linalool (6.8%).

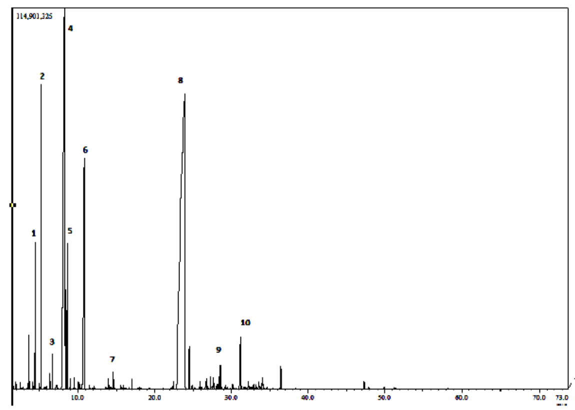

Figure 1
GC-MS chromatogram (TIC) of *Myrcianthes fragrans* leaf oil (1. Heptan-2-ol; 2. α-pinene; 3. myrcene; 4. limonene; 5. (*E*)-β-ocimene; 6. linalool; 7. α-Terpineol; 8. methyl (*E*)-cinnamate; 9. δ-cadinene; 10. caryophyllene oxide).

The leaf essential oil composition from other *M. fragrans* reported in the literature is listed in Table 2. Three of the previous studied samples from Jamaica, Cuba and Venezuela, contained monoterpenoids like α-pinene, limonene, 1,8-cineole, linalool, and α-terpineol (some of them as major compounds) that are present also in our oil sample (except 1,8-cineole) and appear to be widespread compounds in oils from this genus of plants. This result differs markedly from that reported previously for one sample of *M. fragrans* from Monteverde tropical rainforest, in the Tilarán mountain range in northwestern Costa Rica, where the leaf oil consisted mainly of sesquiterpenoids (66.0%) and aromatics (20.5%), with 1,3,5-trimethoxybenzene (15.7%), (*Z*)-

hex-3-en-1-ol (10.0%), α-cadinol (10.4%), eudesma-4(15),7-dien-1β-ol (9.0%), caryophyllene oxide (7.8%), and spathulenol (7.5%) as major constituents and without the presence of monoterpenoids (Cole *et al*., 2008). Our sample does not contain the first two major products listed, while the others are in small amounts or at a trace level. The presence of (*E*)-methyl cinnamate is characteristic of this new sample, not being in any of the oils of *Myrcianthes* species previously studied (see Tables 1 and 2). (*E*)-Methyl cinnamate is a colorless crystalline solid (*mp* 36.5 °C) with a fruity, sweet-balsamic odor component of volatile aroma of cinnamon and strawberries (Surburg & Panten, 2006). This compound is found in great amounts (35-80%) in the oils of some species and varieties of *Ocimum* (basil) which defined the chemotype of that cultivars (Viña & Murillo, 2003), and in a high percentage (*ca*. 99%) in the oil of *Eucalyptus olida* L.A.S. Johnson & K.D. Hill, 'strawberry gum' (Gilles *et al*., 2010). This compound (annual output of 10 to 100 t) is used worldwide as a fragrance ingredient for fine perfumes, toilet soaps, shampoos, antiperspirants and other toiletries, and for household cleaners (Bhatia *et al*., 2007). The presence of aromatics and phenylpropanoids seems to be quite restricted in the oils of this genus of plants. Among the samples studied to date, only *M*. *fragrans* from Cuba presented a small quantity of (*Z*)-anethole (0.3%) (Pino *et al*., 2000), *M*. *coquimbensis* from Chile presented traces of 2-phenylethanol (Tucker *et al*., 2002), *M*. *rhopaloides* from Ecuador a small quantity of methyl eugenol (0.2%) (Malagon *et al*., 2003), and *M*. *fragrans* from Monteverde a significant quantity of 1,3,5-trimethoxybenzene (15.7%) and minor quantities of phloroacetophenone 2,4-dimethyl ether (1.8%), methyl (*E*)-isoeugenol (2.5%), and methyl (*Z*)-isoeugenol (0.5%) (Cole *et al*., 2008). The benzenoid 1,3,5-trimethoxybenzene is a very specific compound present only in the sample from Monteverde, Costa Rica (Cole *et al*., 2008), and is one of the major scent components of *Rosa chinensis* cv. Old Blush, and with phloroacetophenone 2,4-dimethyl ether (xanthoxylin) is probably biosynthesized from phloroglucinol (Scalliet *et al*., 2002; Achkar *et al*., 2005). The Costa Rican oil samples of *Myrcianthes fragrans* studied up the present time seem to suggest a greater presence of aromatic compounds (benzenoids and/or phenylpropanoids) than oils of plants of this genus that grow in other latitudes of the American continent. Our findings corroborate the presence of 44 compounds previously reported (Tucker *et al*., 1992; Pino *et al*., 2000; Cole *et al*., 2008; Mora *et al*., 2009), indicated by asterisk* in Table 3, whereas 54 are newly reported in the composition of the leaf oil of *M*. *fragrans*. Comparing the results obtained in this study with those from the literature (see Tables 1 and 2) it could be seen that oils of *Myrcianthes* displays a wide chemical diversity even in different samples from the same species (Cole *et al*., 2008).

Table 3
Chemical composition of the essential oil obtained from the leaves of *Myrcianthes fragrans* from central Costa Rica

Compound[a]	RI[b]	Lit. RI[c]	Class	%	Identification method[e]
(*E*)-Hex-3-en-1-ol	848	844	A	0.5	1,2
(*E*)-Hex-2-en-1-ol	856	854	A	0.1	1,2
(*Z*)-Hex-2-en-1-ol	860	859	A	0.1	1,2
Heptan-2-one	889	889	A	t[d]	1,2
Heptan-2-ol	890	894	A	2.0	1,2
α-Thujene*	923	924	M	0.1	1,2
α-Pinene*	**930**	932	M	**6.8**	1,2,3
α-Fenchene	944	945	M	t	1,2
Camphene*	946	946	M	t	1,2,3
(*E*)-Hept-2-enal	947	947	A	t	1,2
Benzaldehyde*	956	952	B	t	1,2,3

Heptan-1-ol	959	959	A	t	1,2
Hexanoic acid	968	967	A	t	1,2,3
β-Pinene*	973	974	M	0.1	1,2,3
Myrcene*	987	988	M	0.3	1,2
δ-2-Carene	1002	1001	M	t	1,2
α-Phellandrene*	1004	1002	M	0.1	1,2
α-Terpinene	1014	1014	M	t	1,2
p-Cymene*	1024	1020	M	0.1	1,2
Limonene*	1029	1024	M	**34.6**	1,2,3
2-Heptyl acetate	1037	1038	A	0.4	1,2
(*E*)-β-Ocimene	1045	1044	M	1.7	1,2
γ-Terpinene*	1055	1054	M	0.1	1,2
cis-Linalool oxide (furanoid)*	1069	1067	OM	0.1	1,2
p-Mentha-2,4(8)-diene	1086	1085	OM	0.1	1,2
trans-Linalool oxide (furanoid)*	1087	1084	OM	t	1,2
Nonan-2-one	1089	1087	A	t	1,2
Linalool*	1097	1095	OM	**6.8**	1,2,3
Perillene	1100	1102	Misc	t	1,2
endo-Fenchol*	1113	1114	OM	t	1,2
Methyl octanoate	1122	1123	A	t	1,2
cis-Limonene oxide	1131	1132	OM	t	1,2
cis-*p*-Mentha-2,8-dien-1-ol	1132	1133	OM	t	1,2
trans-Pinocarveol*	1136	1135	OM	t	1,2
cis-β-Terpineol	1136	1140	OM	t	1,2
Camphene hydrate	1144	1145	OM	t	1,2
(*Z*)-Non-2-enal	1148	1144	A	t	1,2
Borneol*	1166	1165	OM	t	1,2,3
Terpinen-4-ol*	1175	1174	OM	0.1	1,2,3
α-Terpineol*	1189	1186	OM	0.2	1,2,3
cis-Dihydrocarvone	1102	1191	OM	0.1	1,2
trans-Carveol*	1218	1215	OM	0.1	1,2
Nerol	1229	1227	OM	0.1	1,2
cis-*p*-Menta-1(7),8-dien-2-ol	1228	1227	OM	t	1,2
Neral	1236	1235	OM	t	1,2
Carvone	1239	1239	OM	t	1,2,3
Carvotanacetone	1243	1244	OM	t	1,2
Geraniol	1248	1249	OM	0.1	1,2
(*E*)-2-Decenal	1260	1260	A	t	1,2
Geranial	1267	1264	OM	t	1,2
trans-Linalool oxide acetate (pyranoid)	1288	1287	OM	t	1,2
Limonen-10-ol	1289	1288	OM	t	1,2
Methyl (*Z*)-cinnamate	1297	1299	PP	t	1,2
α-Cubebene*	1345	1345	S	t	1,2
Neryl acetate	1359	1359	OM	t	1,2
α-Ylangene	1368	1373	S	t	1,2
α-Copaene*	1373	1374	S	0.1	1,2

Methyl (*E*)-cinnamate	1379	1376	PP	**39.6**	1,2
β-Caryophyllene*	1416	1417	S	0.6	1,2,3
β-Duprezianene	1426	1421	S	0.1	1,2
α-Humulene*	1451	1452	S	0.1	1,2,3
*Allo*aromadendrene*	1459	1458	S	t	1,2
Ethyl (*E*)-cinnamate	1466	1465	PP	t	1,2
γ-Muurolene*	1475	1478	S	0.2	1,2
α-Amorphene*	1486	1483	S	0.2	1,2
Germacrene D*	1487	1484	S	t	1,2
β-Selinene*	1489	1489	S	0.1	1,2
cis-Cadina-1,4-diene	1495	1495	S	0.2	1,2
α-Selinene*	1497	1498	S	0.1	1,2
α-Muurolene	1499	1500	S	t	1,2
(*E*,*E*)-α-Farnesene*	1504	1505	S	0.1	1,2
γ-Cadinene*	1513	1513	S	0.1	1,2
δ-Cadinene*	1518	1522	S	0.3	1,2,3
cis-Calamenene	1529	1528	S	t	1,2
trans-Cadina-1,4-diene	1531	1533	S	t	1,2
α-Cadinene	1535	1537	S	0.1	1,2
α-Calacorene	1539	1544	S	t	1,2
Germacrene B	1558	1559	S	0.1	1,2
(*E*)-Nerolidol*	1560	1561	OS	t	1,2,3
Spathulenolv	1578	1577	OS	0.1	1,2
Caryophyllene oxide*	1580	1582	OS	0.7	1,2
Globulol*	1588	1590	OS	0.1	1,2
Cubeban-11-ol	1596	1595	OS	t	1,2
Guaiol	1599	1600	OS	t	1,2
Ledol	1602	1602	OS	t	1,2
β-Oplopenone	1608	1607	OS	0.1	1,2
Humulene epoxide II*	1607	1608	OS	0.1	1,2
1,10-di-*epi*-Cubenol	1619	1618	OS	t	1,2
Junenol*	1619	1618	OS	0.2	1,2
1-*epi*-Cubenol*	1626	1627	OS	0.1	1,2
epi-α-Cadinol (T-cadinol)*	1640	1638	OS	0.1	1,2
epi-α-Muurolol (T-muurolol) *	1640	1640	OS	0.1	1,2
α-Muurolol (Torreyol) *	1643	1644	OS	t	1,2
α-Cadinol*	1652	1652	OS	0.2	1,2
Selin-11-en-4α-ol	1658	1658	OS	0.1	1,2
Eudesma-4(15),7-dien-1β-ol*	1689	1687	OS	t	1,2
Eudesm-7(11)-en-4-ol	1698	1700	OS	t	1,2
(2*E*,6*Z*)-Farnesal	1712	1713	OS	0.2	1,2
Group components					
Monoterpene hydrocarbons (M)				44.0	
Oxygenated monoterpenes (OM)				7.6	
Sesquiterpene hydrocarbons (S)				2.4	
Oxygenated sesquiterpenes (OS)				2.1	

Aliphatics (A)				3.1	
Phenyl propanoids (PP)				39.6	
Bencenoids (B)				t	
Others (Misc)				t	
Identified components (%)				**98.8**	

[a]Compounds listed in order of elution from 5% phenyl-/95% dimethylpolysiloxane type column. [b]RI = Retention index relative to C_8-C_{32} *n*-alkanes on the 5% phenyl-/95% dimethylpolysiloxane type column. [c]Lit. RI = J&W, DB-5 (Adams, 2007). [d]t = Traces (<0.05%). [e]Method: 1 = Retention index on 5% phenyl-/95% dimethylpolysiloxane type column; 2 = MS spectra; 3 = Standard. [*]Compounds previously identified (Tucker *et al*., 1992; Pino *et al*., 2000; Cole *et al*., 2008; Mora *et al*., 2009).

CONCLUSIONS

The leaves of *Myrcianthes fragrans* growing wild in Central Costa Rica produce a mixed phenylpropanoid and terpenoid-rich essential oil whose composition is dominated by methyl (*E*)-cinnamate (39.6%), limonene (34.6%), α-pinene (6.8%), and linalool (6.8%). In addition, a total of 98 compounds have been identified in the oil.

This new oil differs from all previously studied oils from other species of *Myrcianthes* in that for this location, the major component appears to be different from those of samples previously studied, because it contains large amounts of the shikimate component (*E*)-methyl cinnamate (39.6%), and in conjunction with limonene (34.6%) it could suggest the existence of a new chemotype of *M. fragrans*. However, to try to support the hypothesis of a new chemotype of this species of *Myrcianthes* it would be necessary to conduct a new study with a larger number of wild specimens from various geographic areas of Costa Rica. To the best of our knowledge, this is the first report of (*E*)-methyl cinnamate occurring in leaf oils from this genus of plants.

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