Chapter 2

Chemical Composition of Essential Oil of Genus *Pimenta* (Myrtaceae): Review

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Additional information is available at the end of the chapter

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Abstract

Myrtaceae Juss., the name derived from the genus *Myrtus communis*, is considered the eighth largest flowering plant family and of considerable importance on the ecological and economic area (by its production of essential oils). The species that belong to Myrtaceae with primarily tropical and subtropical distribution, with a greater diversity in the southern hemisphere, dispersed mainly in the regions of South America, Central America, Asia, East and Southwest of Australia and with a low representation in Africa. The Myrtaceae family includes more than 5500 species and approximately 150 genera, the genus *Pimenta* being one of the representatives of medicinal interest, which comprises 15 species (+6 varieties) located mainly in tropical America. Due to its economic and pharmacological importance, its best known species are *Pimenta dioica* and *P. racemosa*. *Pimenta* species can produce a volatile content of 1–5% from fresh leaves. To date, studies of this genus have been focused mainly on the content of volatile essences, used in formulation of cosmetics, analysis of chemical composition, and biological activities, such as antimicrobial, antioxidant, insecticidal, and anti-inflammatory activity, eugenol being the main compound responsible for their biological potential.

Keywords: essential oil, chemical composition, chemotypes, eugenol, *Pimenta*

1. Introduction

Plants are considered as one of the main natural resources of secondary metabolites for medicinal use, due to their biological potential, either to attack deadly diseases, endemics, or diseases that affect living beings, so, according to the World Health Organization, nearly

80% of the population in developing countries use them for their primary health-care needs, either because of cultural tradition or because there are no other options, due to the high cost of medicines for these populations [1].

The diverse nature of chemical compounds produced by species of the family Myrtaceae has allowed to locate it as one of the families of greater medicinal use, since some of its species are used to treat respiratory affections [2–5], to strengthen the gums, pains of tooth [3], gastrointestinal disorders [4, 6], skin conditions and snake bites [4–6], for rheumatic or muscular pain, neuralgia, migraine, nervous system disorders, fevers, diseases of the urinary system, diabetes [2, 4, 6], help in job of childbirth [7], and from the economic point of view by their wood and as a producer of spices and essential oils [8].

Genus *Pimenta*, one of the representatives of this family, comprises 21 species including several varieties, is typical of tropical America [9, 10], is considered of medicinal and economic interest, and is rich in a structural variety of volatile substances such as monoterpenes, sesquiterpenes, and phenylpropenes (present in the essential oils), can generate from fresh leaves, a content of volatile essences between 1 and 5% [11, 12].

Essential oils derived from plants, obtained by hydrodistillation, steam distillation, or by extraction with organic solvents, are complex mixture that may contain between 20 and 100 volatile substances of low-molecular weight belonging to different chemical classes, which are presented as liposoluble liquids at room temperature, generally colorless or pale yellow, light, hydrophobic (soluble in alcohol, non-polar or weakly polar solvents, waxes, and oils), and easily oxidizable by exposure to air, light, and heat [13], and they can be biosynthesized in different parts of the plant anatomy (in the leaves, in the flowers, in the fruits, in the pericarp of the fruit, in the seeds, in the bark, and in the rhizomes, whether they are stored in oil glands, glandular hairs, or dissolved in resins) [13, 14].

Interest in essential oils in recent years is based on the versatility of its use in different industrial areas (pharmaceutical, food, health, cosmetics, and perfumery), not only on the possibility of obtaining aromatic compounds (pleasant odor) but in its application as antioxidants, food preservatives, and medicines, and its application as protectors of crops and plants, incorporating them into the packaging material of the products, being less toxic than the synthetic antioxidants of greater use [14–16] or incorporated in dermocosmetic formulations aimed at the treatment and prevention of skin diseases mediated by oxidative stress [15, 17]. This is the case of essential oil obtained from *Pimenta racemosa* var. *racemosa*, which, for its aroma and antioxidant and antimicrobial activity, has been incorporated in perfumes, creams, formulations of aftershave lotions, soaps and hair treatments, as antifungal treatment for aquarium waters and flavorings of foods and products of confectionery, making it a very valuable ingredient for the cosmetic, pharmaceutical, and food industry [14–25].

Taking into account that essential oils represent a therapeutic alternative in natural products against several pathogens that threaten public health and individual health of patients, it would be interesting to establish for genus *Pimenta*, if the chemical composition of its volatile essences has among their major components chemotypes that can classify the oils of the

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different species that constitute it and be responsible for their biological potential. This chapter provides information on all documents on *Pimenta* species reported between 1921 and 2018 with chemical composition of essential oils.

2. Myrtaceae family

Myrtaceae Juss., the name derived from the genus *Myrtus communis* [26], which comes from the Mediterranean region [27], is considered within the angiosperms as one of the largest families in the world, occupying the eighth place of flowering plants and of considerable importance in the ecological and economic area (by its production of essential oils), corresponds to the subclass Rosidae and to the order Myrtales [28]; it contains more than 5500 species separated by taxonomists in two subfamilies, Psiloxyloideae and Myrtoideae, 17 tribes and approximately 150 genera [9, 29–31]; its species are often difficult to identify and classify, so a high probability of plants that still remain undescribed is estimated [32].

The species that belong to this family have a primarily tropical and subtropical distribution, with a greater diversity in the southern hemisphere, dispersed mainly in regions of South America, Central America, Asia, east and southwest of Australia, and with a low representation in Africa [8, 9, 16, 33], having mostly shrubs and trees predominantly woody, ericoids, with evergreen leaves. Venezuela has 20 native genera, five genera introduced with several species in cultivation [34], and about 246 species, of which 34 species (+2 varieties) are endemic to the country [35, 36].

This family is very old. It is believed that it originated in the Cretaceous period [31], diversifying widely over time from the most primitive forms of rainy and humid forests to specialized forms in semi-arid, very dry regions, highly influenced by seasonal changes [37]; its diverse nature of chemical compounds produced by species of the family Myrtaceae has allowed to locate it as one of the families of source of substances with pharmacological activities [2–13], as a producer of woods, spices, and essential oils [9].

3. Genus *Pimenta*

Genus *Pimenta* Lindley belongs to family Myrtaceae, subfamily Myrtoideae, and to Myrteae tribe, comprises 15 species (+6 varieties) [38], was described by John Lindley in 1821 as the type species "*Pimenta officinalis*." Its name derives from the Latin pigmentum, "color" of the verb to paint, a name destined for spices, in association with the characteristics of the fruit of that type [40, 41]; it is characterized by fragrant shrubs or trees, with opposite leaves and glandular on both sides, simple hairs, more or less conspicuous collector nerve. Inflorescence in multiflora vertices, arranged in the upper armpits or subterminals, can have 3–15 flowers [9, 42]; its distribution is typical from tropical America [9, 38, 42, 43], being the majority of the species, native to the Caribbean and Central America, except the species *P. pseudocaryophyllus*

(Gomes) Landrum LR, which is endemic from Brazil [39, 40, 44, 45]. In Venezuela, it is only represented by *P. racemosa* (Mill.) JW Moore (*P. acris* Kostel) and is distributed in Falcón, Federal District, Lara, Mérida, Nueva Esparta, Táchira, Sucre, and Zulia states [35].

The species of this genus are used in several countries including Barbados, Brazil, China, Cuba, Dominican Republic, England, Haití, India, Kerala, Mangalore, Mexico, Middle East, Taiwan, USA, and Venezuela [45–56], in various areas, whether to build agricultural tools, houses, or living fences because of the resistance of its wood against termites, industrially for the production of condiments, flavors, perfumes, and cosmetics, or in the treatment of various pathologies of traditional medicine such as fever, rheumatism, toothache, abdominal pain, pneumonia, colds, pectoral angina, diarrhea, incontinence, stroke, anti-inflammatory, and analgesic properties [10, 12, 15, 57–59]. Among pharmacological effects reported for different *Pimenta* species include anticancer, antidermatophytic, antihemorrhagic bleeding, anti-inflammatory, antimicrobial, antimutagenic, antinociceptive, antioxidant, antipyretic, central nervous system depressant, cobra venom, hypoglycemic, hypotensive, inhibitor of histone acetyl transferase enzyme, inhibitor of enzyme histidine carboxylase, and insect repellent [10, 12, 15, 59].

Chemistry studies of *Pimenta* species have led to the identification of a variety of secondary metabolites of the type: tannins, phenolic compounds, flavonoids, and a structural variety of volatile substances such as monoterpenes, sesquiterpenes, and phenylpropenes (present in essential oils), which could generate a content of volatile essences from fresh leaves between 1 and 5% [12, 13]. Essential oils of *P. racemosa* can present characteristic, aromatic, and pleasant odors, due to their major components; for example, a lemon smell due to the neral/geranial content (72%), an aniseed odor due to the presence of methylchavicol/methyleugenol (81%), and clove odor due to the presence of chavicol/eugenol (73%) [60].

Furthermore, the best-known species of this genus, due to its economic and pharmacological importance, are *P. dioica* (L.) Merrill and *P. racemosa* (Mill.) J. W. Moore [40, 41].

4. Chemical composition of essential oils of the genus *Pimenta*

Essential oils, also called essences, volatile oils, or etheric oils [13, 61], are from a chemical point of view complex mixtures of volatile substances that comprise between 20 and 100 or more components at various concentrations; in general, there are two or three major compounds, which are in concentrations between 20 and 70% in comparison with the other components of the oil that may be present in lower amounts or even in traces [14]. They are described frequently only as a product of "vegetable raw materials" [61, 62]; this oils are lipophilic, usually odoriferous, yellow pale, or colorless when recently extracted and liquid at room temperature [61]; they are oxidized by exposure to air, light, and heat [13] and produced by the plants as defense mechanism, signaling, or as part of their secondary metabolism [61, 63, 64]; they can be biosynthesized in different parts of the plant anatomy (in the leaves, in the flowers, in the fruits, in the pericarp of the fruit, in the seeds, in the bark, and in the rhizomes, whether stored in glands of oils, glandular hairs, or dissolved in resins) [13, 14], and almost always, they are endowed with aromas pleasant as the case of species from genus *Pimenta* with aromas at lemon, anise, or clove [60].

Plant species (origin)	Part of plant used	Extraction method	Main compounds (area %)	Reference
P. adenoclada (Cuba)	Leaves	Hydrodistillation	Caryophyllene oxide (15.4), α-muurolol (9.4), humulene epoxide II (7.6), trans-sabinol (5.6), β-pinene (5.3)	[67]
P. dioica (Jamaica)	Leaves	Steam distillation	Eugenol (66.38–79.24), β-caryophyllene (0.97–7.10)	[68]
P. dioica (México)	Berries	Steam distillation	Methyl-eugenol (48.3), myrcene (17.7), eugenol (17.3), β-caryophyllene (6.2)	[69]
P. dioica (México)	Berries	Hydrodistillation	Methyl-eugenol (62.7), myrcene (16.5), eugenol (8.3), 1,8-cineole (4.1)	[69]
P. dioica (México)	Berries	Supercritical CO_2 extraction	Methyl-eugenol (67.9), eugenol (14.9), myrcene (6.0), β-caryophyllene (5.2)	[69]
P. dioica (Cuba)	Leaves	Hydrodistillation	Eugenol (34.14), 1,8-cineole (14.69), α-humulene (10.12), γ-cadinene (5.49)	[70]
P. dioica (Australia)	Leaves	Supercritical CO_2 extraction	Eugenol (77.9), β-caryophyllene (5.1), squalene (4.1)	[71]
P. dioica (Australia)	Leaves	Hydrodistillation	Eugenol (45.4), β-caryophyllene (8.9), α-cadinol (5.9), α-humulene (5.4)	[71]
P. dioica (Antilles)	Leaves	Commercial (Robert et Fils, Montréal, QC, Canada)	Eugenol (47.78), myrcene (26.76), geraniol (10.40)	[72–73]
P. dioica (Jamaica)	Leaves	Commercial (Kurt Kitzing Co., Wallerstein, Germany, 800675)	Eugenol (76.02), methyl eugenol (7.14), β-caryophyllene (6.47)	[19]
P. dioica (Jamaica)	Leaves	Hydrodistillation	Eugenol (79.81–83.68)	[74]
P. dioica (Jamaica)	Berries	Commercial (Oshadhi Ltd., Cambridge, UK)	Eugenol (86.44), β-caryophyllene (7.70), methyl eugenol (3.87)	[75]
P. dioica (Jamaica)	Leaves	Commercial (Kurt Kitzing Co., Wallerstein, Germany, 800116)	Eugenol (76.0)	[76]
P. dioica	Berries	Steam distillation	Methyl-eugenol (62.7), eugenol (8.3), 1,8-cineole (4.1)	[77]

Plant species (origin)	Part of plant used	Extraction method	Main compounds (area %)	Reference
P. dioica (Brazil)	Fruits	Hydrodistillation	Eugenol (76.98), β-pinene (6.52), limonene (4.09)	[78]
P. dioica (Mexico)	Fruits	Hydrodistillation	Methyl-eugenol (48.7), eugenol (16.3), myrcene (17.1)	[79]
P. dioica (USA)	Leaves	Hydrodistillation	Eugenol (62.1), methyl-eugenol (22.9)	[80]
P. dioica (India)	Leaves	Hydrodistillation	Eugenol (47.80–55.35)	[81]
P. dioica (India)	Leaves	Hydrodistillation	Eugenol (68.4), chavicol (10.4), methyl-eugenol (6.1), 1-octen-3-ol (2.7)	[82]
P. dioica (México)	Leaves	Hydrodistillation	Eugenol (94.86), α-terpineol (2.45)	[83]
P. dioica (Sri Lanka)	Leaves	Hydrodistillation	Eugenol (85.33), β-caryophyllene (4.36), 1,8-cineole (4.19)	[84]
P. dioica (India)	Fruits	Commercial (Plant Lipids Ltd. India)	Eugenol (35.42), methyl-eugenol (28.02), β-caryophyllene (8.66), β-Mirtsen (8.55), 1,8-cyneole (5.62)	[85]
P. guatemalensis (Costa Rica)	Leaf	Hydrodistillation	Eugenol (72.8), β-caryophyllene (8.2), terpinolene (3.0).	[86]
P. guatemalensis (Costa Rica)	Fruits	Hydrodistillation	Eugenol (74.7), caryophyllene oxide (3.3).	[86]
P. haitiensis (Dominican Republic)	Leaves	Steam distillation	Methyl-chavicol (11.65–41.10), 1,8-cineole (11.35–16.63), linalool (16.03–17.81), trans-anethol (6.76–8.70), methyl-eugenol (0.61–24.39),	[87]
P. haitiensis (Dominican Republic)	Leaves	Hydrodistillation	Methyl-chavicol (19.94–32.83), 1,8-cineole (17.62–33.14), linalool (15.97–16.32), methyl-eugenol (0–14.95), trans-anethole (4.66–8.50)	[87]
P. jamaicensis (Jamaica)	Leaves	Steam distillation	Eugenol (61.79), 1,8-cineole (43.94–49.43), α-terpineol (0.34–18.02), limonene (10.33), 4-terpineol (6.37–7.17), p-cymene (2.25–10.25), β-caryophyllene (5.77)	[88]

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Plant species (origin)	Part of plant used	Extraction method	Main compounds (area %)	Reference
P. obscura (Jamaica)	Leaves	Steam distillation	1,8-cineole (16.84–25.11), ϱ-cymene (10.97–11.33), α-terpineol (6.71–8.13), limonene (5.31), β-eudesmol (5.29), 4-terpineol (4.92–9.80), α-phellandrene (6.33), Ledol (13.47), palustrol (7.64)	[89]
P. pseudocaryophyllus var. *pseudocaryophyllus* (Brazil)	Leaves	Hydrodistillation	Geranial (34.26), neral (27.85), linalol (5.18), geraniol (4.82), β-caryophyllene (4.40)	[90]
P. pseudocaryophyllus (Brazil)	Leaves (Cardoso isle)	Hydrodistillation	Eugenol (71.9)	[91]
P. pseudocaryophyllus (Brazil)	Leaves (Paranapiacaba)	Hydrodistillation	Methyl-eugenol (94.6)	[91]
P. pseudocaryophyllus (Brazil)	Leaves	Hydrodistillation	Eugenol (92.59)	[92]
P. pseudocaryophyllus (Brazil)	Leaves	Hydrodistillation	Chavibetol (70.9), methyl-eugenol (20.7), o-cymene (2.8)	[93]
P. pseudocaryophyllus (Brazil)	Leaves (Brazilian)	Hydrodistillation	(*E*)-methyl-isoeugenol (78.0–93.6), methyl-eugenol (3.1–18.1)	[11]
P. pseudocaryophyllus (Brazil)	Leaves (São Gonçalo do Abaeté)	Hydrodistillation	Geranial (36.5–47.2), neral (21.4–33.6), β-caryophyllene (0–6.1), caryophyllene oxide (0–13.5)	[11]
P. pseudocaryophyllus (Brazil)	Leaves	Hydrodistillation	Chavibetol (50.2–70.9), methyl-eugenol (15.4–20.7)	[94]
P. pseudocaryophyllus (Brazil)	Leaves	Hydrodistillation	Geranial (37.3–46.6), neral (25.8–28.7), spathulenol (0–6.1), caryophyllene oxide (0–5.5), β-caryophyllene (0–8.0), Bicyclogermacrene (0–5.7)	[95]
P. pseudocaryophyllus (Brazil)	Leaves	Hydrodistillation	(*E*)-methyl-isoeugenol (5.0–94.3), (β-caryophyllene (8.5–26.6), elemicin (5.8–11.7), δ-cadinene (0–9.2), α-copaene (0–5.7), (*E*)-asarone (0–65.5)	[95]
P. pseudocaryophyllus (Brazil)	Leaves (citral)	Hydrodistillation	Geranial (36.49), neral (27.59), caryophyllene oxide (8.88)	[96]

Plant species (origin)	Part of plant used	Extraction method	Main compounds (area %)	Reference
P. pseudocaryophyllus (Brazil)	Leaves	Hydrodistillation	(*E*)-methyl-isoeugenol (93.9)	[96]
P. pseudocaryophyllus (Brazil)	Leaves	Commercial (Lazlo Aromatologia Ltda., Brazil)	Eugenol (88.6), β-caryophyllene (4.8)	[97]
P. racemosa	Leaves	Steam distillation	Contenido de fenol (65–73)	[98]
P. racemosa	Leaves	Commercial	Eugenol (33.8), myrcene (21.3), 1,8-cineole (9.7), chavicol (8.9)	[99]
P. racemosa (Colombia)	Leaves	Steam distillation	Eugenol (96)	[100]
P. racemosa	Leaves (Bay)	Steam distillation	Eugenol (56.2), chavicol (21.6), myrcene (13.9)	[101]
P. racemosa	Leaves (anise)	Steam distillation	Methyl-eugenol (43.1), methyl-chavicol (31.6), myrcene (12.0)	[101]
P. racemosa	Leaves (lemon)	Steam distillation	Geranial (53.2), neral (32.6)	[101]
P. racemosa	Leaves	Hydrodistillation	Eugenol (56.9), myrcene (18.4), chavicol (12.2)	[101]
P. racemosa	Leaves	Commercial	Eugenol (45.5), myrcene (29.1), chavicol (12.0)	[101]
P. racemosa (Jamaica)	Leaves	Commercial (Kurt Kitzing Co., Wallerstein, Germany, 800116)	Eugenol (45.60), myrcene (24.97), chavicol (9.31)	[20]
P. racemosa (Cuba)	Leaves	Hydrodistillation	terpinen-4-ol (20.7), 1,8-cineole (20.4), eugenol (10.7), chavicol (10.1), α-terpineol (10.0), ϱ-cymene (8.0)	[102]
P. racemosa (Benin)	Leaves	Hydrodistillation	Eugenol (55.7–61.9), myrcene (12.5–22.3), chavicol (8.0–15.3)	[103]
P. racemosa (Jamaica)	Leaves	Commercial (Kurt Kitzing Co. Wallerstein, Germany, 800116)	Eugenol (45.6)	[76]
P. racemosa (Nigeria)	Aerial part	Hydrodistillation	Germacrene D (10.6), β-elemene (8.8), germacreno A (7.3), selin-11-en-4-α-ol (6.3), δ-cadinene (5.9), β-caryophyllene (5.8), germacreno B (5.3), α-copaene (5.2)	[22]

Plant species (origin)	Part of plant used	Extraction method	Main compounds (area %)	Reference
P. racemosa (Benin)	Leaves	Hydrodistillation	Eugenol (52.7), myrcene (29.4), chavicol (9.3)	[23]
P. racemosa (USA)	Leaves	Hydrodistillation	Eugenol (64.0), myrcene (14.6)	[80]
P. racemosa (India)	Leaves	Hydrodistillation	Eugenol (72.9–92.9), myrcene (0–9.6), chavicol (0–7.7)	[104]
P. racemosa (Jamaica)	Leaves	Hydrodistillation	Eugenol (64), myrcene (14.6), chavicol (7.7), β-caryophyllene (4.9)	[105]
P. racemosa var. *racemosa* (Dominican Republic)	Leaves	Steam distillation	Eugenol (44.41–68.93), myrcene (0–16.17), chavicol (0–15.51), methyl-eugenol (0–11.88), β-caryophyllene (0–7.24)	[106]
P. racemosa var. *racemosa* (Guadeloupe)	Leaves (bay)	Hydrodistillation	Eugenol (56.1), chavicol (17.1), myrcene (6.4), linalool (6.0)	[60]
P. racemosa var. *racemosa* (Guadeloupe)	Leaves (lemon)	Hydrodistillation	Geranial (40.3), neral (31.7), limonene (5.3), myrcene (4.6)	[60]
P. racemosa var. *racemosa* (Guadeloupe)	Leaves (anise)	Hydrodistillation	Methyl-eugenol (48.1), methyl-chavicol (32.8), myrcene (12.8), linalol (6.0)	[60]
P. racemosa var. *racemosa* (Benin)	Leaves	Hydrodistillation	Eugenol (52.7), myrcene (26.6), chavicol (6.3)	[107]
P. racemosa var. *racemosa* (Venezuela)	Leaves	Hydrodistillation	Eugenol (48.7), limonene (13.6), 1,8-cineole (12.7)	[108]
P. racemosa var. *racemosa* (Venezuela)	Leaves (light oil)	Hydrodistillation	Eugenol (60.4) myrcene (11.7), chavicol (6.0), limonene (5.4), linalool (4.4)	[12, 15, 59]
P. racemosa var. *racemosa* (Venezuela)	Leaves (heavy oil)	Hydrodistillation	Eugenol (82.9), chavicol (9.3)	[12, 15, 59]
P. racemosa var. *grisea* (Dominican Republic)	Leaves	Steam distillation	Trans-methyl-isoeugenol (85.08–86.32), methyl-eugenol (0–92.60), geraniol (0–85.52)	[106]
P. racemosa var. *grisea* (Dominican Republic)	Leaves	Hydrodistillation	4-metoxi-isoeugenol (75.23)	[50, 109]
P. racemosa var. *hispaniolensis* (Dominican Republic)	Leaves	Steam distillation	Methyl-eugenol (7.08–63.88), methyl-chavicol (5.13–22.61), 1,8-cineole (17.57–37.96), 4-terpineol (16.21–28.98), timol (0–44.02), γ-terpinene (0–16.67), ϱ-cymene (0–8.59)	[106]

Plant species (origin)	Part of plant used	Extraction method	Main compounds (area %)	Reference
P. racemosa var. *ozua* (Dominican Republic)	Leaves	Steam distillation	1,8-cineole (47.24–55.93), 4-terpineol (5.05–15.67), α-terpineol (6.68–15.12), limonene (9.32–30.07)	[106]
P. racemosa var. *terebinthina* (Dominican Republic)	Leaves	Hydrodistillation	α-Terpineol acetato (27.0), α-terpineol (20.0), 4-metoxi-eugenol (12.6), terpinen-4-ol (5.95)	[50, 109]

Table 1. Main compounds of essential oils from genus *Pimenta* (L).

The composition of essential oils contributes significantly to the determination of the pharmacological potential attributed to the plant species (indicated mainly by the major compounds) and is constantly being transformed, due to factors external to the biology of the plants (edaphic or environmental) and/or intrinsic to the biology of plants (physiological and genetic) [14, 65, 66].

Essential oils of *Pimenta* are characterized by the presence of monoterpenes, sesquiterpenes, and phenylpropanoids, and due to medicinal and economic interest, many researchers in different latitudes of the planet have been dedicated to carrying out studies to their chemical composition (**Table 1**), using basically three methods of extraction: steam distillation, hydrodistillation, and supercritical CO_2 extraction, with gas chromatography coupled to mass spectrometry (GC-MS) as analysis technique.

The subsequent text is reflected in **Table 1**; the chemical composition for species of genus *Pimenta* is analyzed by GC-MS and reported in the study consulted from 1921 to the present. All the information collected was organized taking into account plant species, origin, part of plant used, extraction method, and main compounds (area %).

According to the data reported in **Table 1**, the important qualitative and quantitative differences in the chemical composition of the essential oils of genus *Pimenta* can be estimated; the leaves have been the most studied part of the plant, followed by fruits and aerial parts. The conventional technique and the most used was the hydrodistillation using Clevenger apparatus. Of all the known species from genus *Pimenta* in South America, only *P. pseudocaryophyllus*, *P. racemosa*, and *P. dioica* have been collected. GC/MS analysis demonstrated the presence of volatile compounds with a content higher than 20% (area peak), such as eugenol (*P. dioica*, *P. haitiensis*, *P. jamaicensis*, *P. pseudocaryophyllus*, and *P. racemosa*), methyleugenol (*P. dioica*, *P. haitiensis*, *P. pseudocaryophyllus*, *P. racemosa*, *P. racemosa* var. *grisea*, *P. racemosa* var. *hispaniolensis*, and *P. racemosa* var. *racemosa*), 1,8-cineole (*P. dioica*, *P. haitiensis*, *P. jamaicensis*, *P. obscura*, *P. pseudocaryophyllus*, *P. racemosa*, *P. racemosa* var. *hispaniolensis*, *P. racemosa* var. *ozua*, and *P. racemosa* var. *racemosa*), and myrcene (*P. dioica*, *P. racemosa*, *P. racemosa* var. *hispaniolensis*, and *P. racemosa* var. *Racemosa*). It can also be seen that these compounds are mainly derivatives of phenylpropanoids and monoterpenes.

5. Conclusions and future perspectives

According to the study, the analysis of the chemical composition of the essential oils of *Pimenta* species collected in 16 countries revealed a high content of phenolic compounds, highlighting eugenol and methyl-eugenol as the major constituents. When comparing the major compounds of the essential oils among the 12 analyzed species of genus *Pimenta*, it is evident that there are variations between different species and between the same species with different origin. In addition, taking into account that eugenol can be considered a chemotaxonomic marker for the species *P. dioica*, *P. haitiensis*, *P. jamaicensis*, *P. pseudocaryophyllus*, and *P. racemosa* and that essential oils with a high content of eugenol exhibit antimicrobial, antioxidant, and insecticide activities, it can be said that the essential oils of the genus *Pimenta* have a therapeutic potential for the treatment of many pathologies. Therefore, the economic importance of essential oils from genus *Pimenta* around the world is unquestionable.

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