

CHAPTER 5

DISTRIBUTION OF VOLATILE OILS IN DIFFERENT PLANT PARTS OF *Passiflora incarnata* L. AND USES IN FOLK MEDICINE

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INTRODUCTION

The name *Passiflora* is derived from the Latin word "Passio," which was originally found by Spanish explorers in 1529 and was identified as a symbol for "Christ's Passion." (Dhawan et al., 2004; Kinghorn, 2001). The largest genus in the Passifloraceae family, *Passiflora*, contains roughly 400 species (Montanher et al., 2007; Beninca et al., 2007). A sizable genus of herbaceous or woody tendril climbers that is primarily found in warm, temperate, and tropical climates worldwide (The Wealth of India, 2001), while they are far less common in Asia, Australia, and tropical Africa (Beninca et al., 2007). This genus of plants is known for its diverse active ingredients with medicinal efficacy and biological action against a number of ailments. Numerous pharmacological effects of these plants have been documented.

1. GENERAL CHARACTERISTICS OF *Passiflora incarnata* L.

Enlightened *Passiflora* other names include passion vines and passion flower. The passion flower is a perennial plant with a woody stem that can grow up to 10 meters. Only a flower is contained on the 8 cm long axillary pedicle. Flowers have a lined diameter ranging from 5 to 9 cm. The five sepals are white on the inside and gray on the outer. Contains an additional corolla inside the petals that is made up of a 4-fiber ring placed radially in the flower's axis and is both white on the inside and purple on the outside. Three carpels and three styles make up the ovary, which ends in a thick stigma.

The bases of the five stamens are bound. A number of reviews have also discussed the medicinal and traditional usage of these substances for the treatment of minor symptoms of mental stress and to promote sleep. Dosage information is only found in one reference (Lutomski et al., 1981), which also references data from Commission E and ESCOP. The length of use is not mentioned in any of the reviews. (Dhawan et al., 2003) presented a thorough analysis of the botany, chemistry, pharmacology, and clinical application of plants in the genus *Passiflora*, including *Passiflora incarnata*.



Figure 1: Flower morphology leaf and seed shape of the three *Passiflora*

1.1. CHEMICAL CONTENT of *Passiflora incarnata* L.

The genus is reported to contain alkaloids, phenols, glycosyl flavonoids, and cyanogenic chemicals.

All vascular plants contain flavonoids, which are chemical phenylbenzopyrones that are typically conjugated with sugars (Zanoli et al., 2000). According to reports, *P. incarnata*'s primary phyto-constituents are flavonoids. It primarily comprises C-glycosylflavones derived from luteolin and apigenin. Additionally, according to Poethke

et al. (1970), *P. incarnata* contains simple indole alkaloids with the carboline ring system, such as harman, harmol, harmine, harmalol, and harmaline.

Various other constituents which have been reported from *P. incarnata* include γ -benzo-pyrone derivative maltol (Aoyagi et al., 1974), carbohydrates such as raffinose, sucrose, D-glucose and D-fructose (Gavasheli et al., 1975); essential oil containing hexanol (1.4%), benzyl alcohol (4.1%), linalool (3.2%), 2-phenylethyl alcohol (1.2%), 2-hydroxy benzoic acid methyl ester (1.3%), carvone (8.1%), trans-anethol (2.6%), eugenol (1.8%), isoeugenol (1.6%), β -ionone (2.6%), α -bergamotol (1.7%) and phytol (1.9%); various constituents responsible for typical odor of *P. incarnata* such as limonene, cumene, α -pinene, prezizaene, zizaene, and zizanene (Buchbauer & Jirovetz, 1992), twenty one amino acids (Gavasheli et al., 1974), and a cyanogenic glycoside gynocardin (Dhawan et al., 2004).

The distribution of volatile oil components in different plant parts of *Passiflora incarnata* L. and their uses in folk medicine will be discussed.

2. MATERIALS AND METHODS

2.1. Plant material

In the study; Different parts of *Passiflora incarnata* L. (flesh, seeds, leaves, flowers) were used as study material.

2.2. Sample preparation and volatile oil analysis

Analysis was performed using a GC-MS Device (Shimadzu, Japan) outfitted with SPME. Ground plant samples weighing 1.00 g

were then put into a 10 mL vial and sealed with a silicone-rubber septum lid. In order to pre-condition the fiber, manufacturer guidelines were followed. The fiber was left in the headspace at equilibrium for one minute at room temperature. The fiber was placed into the needle after sampling and then moved to the injection port of the GC or GC-MS device. The column was a CP 5MS (30 m x 0.25 mm i.d., film thickness 0.25 μ m). The oven temperature was set to isothermal at 220 °C for 20 minutes after being scheduled to rise from 40 °C to 240 °C at 2 °C/min. As a carrier gas, helium was employed at a constant flow rate of 1 mL/min. The Wiley, NIST Mass Spectral, and aroma technique databases were used to determine the constituents of essential oils (Yurteri et al., 2021).

2.3. Data Analysis

The XLSTAT 2023 (Addinsoft, 2023) was used to perform Biplot Analysis. To visualize current variation in *Passiflora incarnata* L. plant portions examined for chemical variability, use a statistical program. Current data was used to produce scatter plot diagrams (Backhaus et al., 1989). Using the results of the GC-MS study, a separate biplot diagram was also produced..

3. RESULTS AND DISCUSSION

The aqueous extract solution of *Passiflora edulis* was analyzed using GC-MS. 44 compounds were found. Saturated fatty acids, volatile oils, sugar, carboxylic acids, and aldehydes were a few of the substances that were found (Table 1).

Table 1: Volatile oil composition of *Pasiflora incarnata* L. plant parts

Numeric	Compounds (%)	RI*	Flower	Fruit Peel	Seed	Leaf
1	Vinylbutanol	790	-	-	5.08	-
2	Pentanol <1-methyl->	792	-	-	7.99	-
3	Adipic ketone	793	-	-	9.38	-
4	Lactate <Ethyl->	798	8.81	-	18.34	-
5	Capronaldehyde	801	-	-	3.13	2.00
6	Piruvate <ethyl->	819	-	-	1.16	-
7	Furfural	831	-	-	-	-
8	Hex-3(E)-enol	832	-	-	9.11	-
9	Hexanol <n->	869	-	-	-	1.55
10	Formate <hexyl->	912	-	--	27.00	-
11	Vinyl amyl carbinol	980	-	-	-	1.91
12	Benzyl alcohol	1033	1.09	-	-	-
13	Hex-2(E)-enyl acetate	1036	-	12.82	-	-
14	Phenylacetaldehyde	1042	-	2.37	-	-
15	Butyrate <isoamyl->	1058	-	-	0.75	-
16	Pelargonaldehyde	1105	-	2.70	-	2.10
17	Acetate <octyl->	1142	-	-	3.50	-
18	β -Artemisia acetate	1184	0.84	-	-	6.49
19	Dodecane	1201	-	-	3.58	-
20	Pulegone	1221	-	3.04	-	-
21	Carvone <(E)-, dihydro->	1232	-	-	-	2.00
22	Tridecane	1301	-	-	6.44	-
23	Geranyl acetone	1454	-	3.72	-	-
24	Theaspirane <6-hydroxydihydro->	1464	-	-	-	4.27
25	β -Lonone (E)	1489	-	21.35	-	2.19
26	Pentadecane	1497	0.80	2.30	-	-
27	Citronellyl butyrate	1532	0.61	12.67	1.92	12.91
28	Nonanoate <isoamyl->	1543	-	2.58	-	-
29	Hexadecane	1600	0.50	3.62	-	2.08
30	α -Muurolol	1649	1.03	-	-	-
31	Heptadecane	1700	0.83	-	-	2.81
32	Myristate <methyl->	1726	1.39	-	-	1.84
33	Octadecane	1801	1.00	-	-	1.63
34	Salicylate <2-ethylexyl->	1810	-	2.92	-	-
35	Pyhtone	1847	3.93	-	-	-
36	Caffeine	1847	-	4.06	2.62	-
37	Phytone	1847	-	-	-	30.36
38	Cetyl alcohol	1891	-	8.74	-	-
39	Nonadecane	1901	1.86	-	-	-
40	Palmitate <methyl->	1927	13.62	11.86	-	17.00
41	Eicosane	2000	7.84	-	-	-
42	Heneicosane	2101	51.95	-	-	-
43	Phytol	2103	-	5.25	-	8.85
44	Docosane	2201	3.91	-	-	-

Volatile oil components detected only in flower parts were Benzyl alcohol (1.09 %), Capronaldehyde (28.7 %), α -Muurolol (1.03 %), Phytone (3.93 %), Nonadecane (1.86 %), Eicosane (7.84 %), Heneicosane (51.95 %) and Docosane (3.91).

A number of 8 volatile oil components, namely Hex-2(E)-enyl acetate (12.82 %), Phenylacetaldehyde (2.37 %), Pulegone (3.04 %), Geranyl acetone (3.72 %), β -Lonone (E) (21.35 %), Pentadecane (2.30 %), Salicylate <2-ethylexyl-> (2.92 %) and Cetyl alcohol (8.74 %) were only detected in fruit peel. In seeds, 10 volatile oil components were present: Vinylbutanol (5.08 %), Pentanol <1-methyl-> (7.99 %), Adipic ketone (9.38 %), Piruvate <ethyl-> (1.16 %), Formate < hexyl-> (27.00 %), Butyrate <isoamly-> (0.75 %), Acetate <octyl-> (3.50 %), Dodecane (3.58 %), Tridecane (6.44 %) and Caffeine (2.62 %).

The leaf parts contained 10 volatile oil components, respectively Hexanol <n-> (1.55 %), Vinyl amyl carbinol (1.91 %), β -Artemisia acetate (6.49 %), Carvone <(E)-, dihydro - > (2.00 %), Theaspirane <6-hydroxydihydro-> (4.27 %), β -Lonone (E) (2.19 %), Heptadecane (2.81 %), Myristate <methyl-> (1.84 %), Octadecane (1.63 %) and Phytone (30.36 %). Volatile oil components detected in highest amounts in different plant parts were Heneicosane (51.95 %) in flower parts, β -Lonone (E) (21.35 %) in fruit peel, Formate < hexyl-> (27.00 %) in seeds and Phytone in leaf parts.

Dülger et al. (2018) detected hexanal (1.4%), benzyl alcohol (4.1%), linalool (3.2%), 2-phenylethyl alcohol (1.2%), 2- hydroxy benzoic acid methyl ester (1.3%), carvone (8.1%), trans-anethole (2.6%), eugenol (1.8%), isoeugenol (1.6%), β -ionone (2.6%), α -

bergamotol (1.7%), palmitic acid (7.2%) and oleic acid (6.3%) in flowers of *Passiflora incarnata* L..

The chemical composition of the essential oils of *Passiflora sexocellata* and *Passiflora trifasciata* (Passifloraceae, subgenus Decaloba) were studied. For *P. sexocellata* leaves, 33 compounds (75% of the total oil composition) and 29 (74% of the total oil composition) in flowers were detected. Regarding *P. trifasciata*, 35 compounds (76% of the total oil composition) were detected in leaves and 32 (71% of the total oil composition) in flowers (della Cuna et al., 2021).

Calevo et al. (2016) investigated the chemical composition of the volatile oil from flowers and leaves of new *Passiflora* hybrids. Several compounds were identified, with a peculiar distribution in the hybrids: benzyl alcohol (7.6%), geraniol (13.7%), phytol (14,3%), eugenol (3.9%), 2-phenylethanol (4.7%), cis-3-hexenal (2.8%) and palmitic acid (2%) were the main compounds of the essential oil of fresh leaves of the hybrid P. ‘FSO-040711’; the highest percentages of benzyl alcohol (12.2%) and 2-phenylethanol (13.6%) were found in fresh flowers of P. ‘FSO-130913’ and the highest amount of phytol (38.5%) was present in the fresh leaves of P. ‘FSO-080415’.

In oils from *Passiflora sexocellata* the oil was dominated by pentadecanoic acid (9.6%), dodecanoic acid (8.7%), (Z)-2-hexenal (7.0%), hexanal (2.2%), 1-eicosene (7.0%) and 3-tetradecene (1.5%). In the flower oil the same species α -humulene (47.5%), β -caryophyllene (3.6%), pentadecanoic acid (14.4%), 9-tricosene (10.4%), 3-tetradecene (1.7%), 4-vinylguaiaicol (3.0%) and 1-nonanol (1.7%) were detected.

In *Passiflora incarnata* L., hexanol (1.4%), benzyl alcohol (4.1%), linalool (3.2%), 2-phenylethyl alcohol (1.2%), 2-hydroxy benzoic acid methyl ester (1.3%), carvone (8.1%), trans-anethol (2.6%), eugenol (1.8%), isoeugenol (1.6%), β -ionone (2.6%), α -bergamotol (1.7%) and phytol (1.9 %) were detected by Buchbauer & Jirovetz (1992).

Some *Passiflora* species have been widely investigated for the presence of bioactive compounds in all the plant organs, including leaves, flowers, fruits and seeds, and a series of flavonoids, glycosides, alkaloids, and phenols have been reported (Chassagne et al., 1998; Bendini et al., 2006; Patil, 2010; Zeraik et al., 2010; Patel et al., 2011; . Zucolotto et al., 2012; Argentieri et al.; 2015; Dos Santos et al., 2016; Farag et al., 2016)

Volatile oil components with a content over 10 % Lactate <Ethyl>, Hex-2(E)-enyl acetate, β -Lonone (E), Citronellyl butyrate, Phytone, Palmitate <methyl-> and Heneicosane were used to create Biplot Analysis (Figure 2).

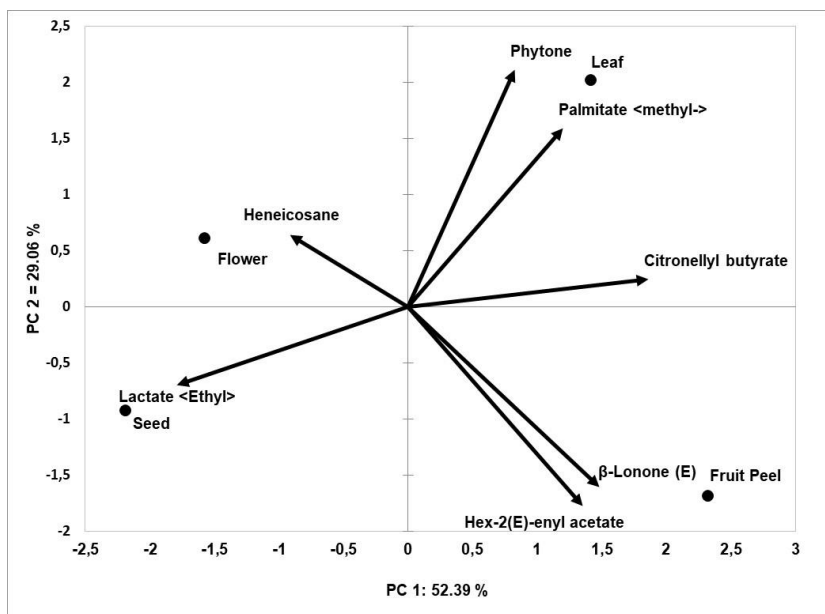


Figure 2: Biplot analysis of volatile oil composition of investigated *Passiflora incarnata* L. plant parts.

Totally 81.45 % of the present total variation could be explained using the first two principal components. Based on evaluated volatile oil it can be said that the plant parts of this investigated plant differed based on their chemical content and all parts could be differentiated from each other.

The investigations about the volatile oil composition of different plant parts of *Passiflora incarnata* L. is given in the scientific literature. Based on obtained results we can declare that the findings of the present study were different from given literature and different from volatile oil contents of different *Passiflora* species.

The use of therapeutic ethnomedical items has been proven in recent years, however there have been side effects. *Passiflora incarnata*

is a nutraceutical that is rich in bioactive chemicals that have been used for many years as traditional medicine and may help in the treatment and prevention of a variety of diseases. To evaluate whether *Passiflora incarnata* plant parts might be used in the pharmaceutical industries, more research is necessary.

4. CONCLUSION

For thousands of years, nature has served as a source for therapeutic agents, and an astounding number of contemporary drugs have been separated from natural sources, many as a result of their traditional medical applications. Many civilizations have employed plants from the genus *Passiflora* in traditional medicine. The main phyto-components of the *Passiflora* species have been identified as flavonoids, glycosides, alkaloids, phenolic compounds, and volatile constituents.

Passiflora species and hybrids are particularly desirable for the horticulture business as well as for the herbal and medicinal industries due to their exotic allure, natural adaptability, and great inter and intraspecific genetic variability. Passion flowers display a variety of distinctive floral characteristics, such as numerous series of vividly colored corona filaments, varied operculum morphology, a prominent androgynophore, and ornate nectary structures. They are also surrounded by dyed sepals and elaborate bracts. These plants are highly sought-after in the global wellness industry due to their captivating blossoms, luxuriant foliage, tasty fruits, and presence of valuable bioactive ingredients.

Numerous opportunities for research still exist in the somewhat more recent domains of these plants' functionality and their medicinal applications. Therefore, these plants' phytochemicals and minerals will make it possible to utilise them for therapeutic purposes. Therefore, additional research may be done to demonstrate the potential of these plants. Due to the fact that this species is currently becoming an endangered species, more effort can be put into improving the agricultural and climatic circumstances for this plant.

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