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CHEMICAL COMPOSITION AND ANTI-INFLAMMATORY PROPERTIES OF ESSENTIAL OILS FROM *Peperomia dindygulensis* LEAVES

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The Piperaceae family, under the order Piperales, includes over 4000 species significant for culture, medicine, and commerce [1, 2]. Among its genera, *Peperomia*, with over 1600 species in tropical and subtropical regions, is notable for its decorative, lance-shaped leaves and slender stems [1–3]. *Peperomia*'s medicinal value stems from terpenes, alkaloids, flavonoids, and phenolics, offering antibacterial, anti-inflammatory, analgesic, diuretic, and antihypertensive benefits, plus aiding in wound healing, and gastrointestinal and respiratory health [4–6].

The chemical profiles of essential oils from various *Peperomia* species such as *P. leptostachya* and *P. inaequalifolia*, have been extensively studied for their medicinal uses. However, to our knowledge, no research exists on the essential oils of *P. dindygulensis*. This study reports, for the first time, the chemical composition and anti-inflammatory activities of *P. dindygulensis* leaf essential oils from samples collected in central Vietnam [7–14].

In January 2025, fresh leaves of *P. dindygulensis* Miq. were gathered from Cam Tuyen in Cam Lo, Quang Tri, Vietnam, at coordinates 16°46′53.5″N, 106°51′11.7″E.

Hydrodistillation of fresh *P. dindygulensis* Miq. leaves resulted in the extraction of a yellow essential oil with a yield of 0.1%. The chemical composition of this oil was predominantly characterized by monoterpene hydrocarbons at 47.4% and sesquiterpene hydrocarbons at 42.6%. Minor components included non-terpenic compounds at 4.8%, oxygenated sesquiterpenes at 3.6%, and oxygenated monoterpenes at 0.5%. Among the principal compounds, α-pinene was the most abundant at 27.6%, followed by (*E*)-caryophyllene at 20.3%, β-pinene at 14.6%, and germacrene D at 9.9%. Further analysis revealed significant levels of other phytochemicals such as *n*-nonane (3.6%), bicyclogermacrene (3.5%), limonene (1.8%), α-humulene (1.7%), β-myrcene (1.6%), and β-bourbonene (1.6%), all of which exceeded a concentration of 1.0%, contributing to the overall profile of the essential oil (Table 1).

Hydrodistilled Procedure. Fresh leaves from each plant (0.5 kg) were subjected to hydrodistillation for 4.5 h using a Clevenger apparatus with clean water, yielding yellow oils at 0.15%. These oils were then dried using anhydrous Na_2SO_4 prior to analysis.

A study investigating the inhibitory effects of *P. dindygulensis* leaf essential oil on nitric oxide (NO) production in lipopolysaccharide (LPS)-stimulated RAW 264.7 macrophage cells demonstrated a significant reduction in NO levels. The MTT assay revealed that the essential oil effectively suppressed NO production, with an IC_{50} value of 12.37 ± 0.51 μg/mL. This performance was comparable with the positive control, dexamethasone, which showed an IC_{50} of 13.18 ± 1.56 μg/mL, highlighting the notable anti-inflammatory potential of *P. dindygulensis* leaf oil in this model. Furthermore, its anti-inflammatory activity appears comparable with that of *P. leptostachya* leaf oil, which exhibited an IC_{50} of 15.15 ± 0.68 μg/mL in inhibiting NO production [14].

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TABLE 1. Essential Oils of Two Studied *Peperomia dindygulensis* Leaves

Compound	RI	%	Compound	RI	%
n-Nonane	897	3.6	α-Humulene	1455	1.7
α-Thujene	924	0.1	*allo*-Aromadendrene	1462	0.8
α-Pinene	931	27.6	Germacrene D	1483	9.9
Camphene	946	0.3	β-Selinene	1488	0.4
Sabinene	970	0.5	Bicyclogermacrene	1498	3.5
β-Pinene	975	14.6	α-Muurolene	1501	0.2
β-Myrcene	988	1.6	δ-Amorphene	1509	0.2
Limonene	1026	1.8	γ-Cadinene	1515	0.2
(*E*)-β-Ocimene	1045	0.1	δ-Cadinene	1525	0.8
γ-Terpinene	1056	0.1	Germacrene B	1559	0.2
Terpinolene	1087	0.7	(*E*)-Nerolidol	1565	0.4
Linalool	1099	0.1	Spathulenol	1580	0.4
Terpinen-4-ol	1176	0.1	Caryophyllene oxide	1586	1.0
α-Terpineol	1190	0.3	Viridiflorol	1594	0.1
n-Decanal	1204	1.1	Ledol	1606	0.3
(*Z*)-Cinnamyl alcohol	1258	0.1	1-*epi*-Cubenol	1631	0.1
Bicycloelemene	1338	0.4	*epi*-α-Cadinol	1645	0.4
α-Ylangene	1372	0.1	α-Muurolol	1649	0.1
α-Copaene	1376	0.2	Valerianol	1657	0.6
β-Bourbonene	1385	1.6	Eudesma-4(15),7-dien-1β-ol	1689	0.2
β-Elemene	1392	0.6	Total		98.9
(*Z*)-Caryophyllene	1408	0.6	Monoterpene hydrocarbons		47.4
(*E*)-Caryophyllene	1421	20.3	Oxygenated monoterpenes		0.5
β-Copaene	1430	0.3	Sesquiterpene hydrocarbons		42.6
γ-Elemene	1434	0.1	Oxygenated sesquiterpenes		3.6
6,9-Guaiadiene	1444	0.3	Non-terpenic compounds		4.8
Spirolepechinene	1450	0.2			

RI: retention indices relative to *n*-alkanes (C_7–C_{40}) on Equity-5 column.

The GC/FID-MS Analysis. The method used was identical to that described in our earlier publications [15, 16].

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