

The chemistry, biological activities and possible industrial applications of *Plumeria rubra* (Rainbow flower) Essential Oil

Adekemi T. Alade^{1,2}, Sherifat A. Aboaba², Philip A. Idowu³ , Olusegun Ekundayo² and William N. Setzer⁴

¹Department of Chemical Sciences, Joseph Ayo Babalola University, Osun State, Nigeria

²Department of Chemistry, University of Ibadan, Oyo State, Nigeria

³Department of Pharmaceutical Microbiology, University of Ibadan, Oyo State, Nigeria

⁴Aromatic Plant Research Center, 230 N 1200 E, Suite 102, Lehi, UT 84043, USA

Abstracts

Background: The benefits of flowering plants to human go beyond beautifying environments and oxygen replenishing. Generally, plants are nature’s gifts that contain chemicals that have many industrial applications. Although, many of them are yet to be exploited. Understanding the chemistry of plants’ extracts would be of great help to solving the problem of under-utilizing these plants. Therefore, this research was designed to evaluate the chemical components, cytotoxicity, antimicrobial (antibacterial and antifungal) and antioxidant properties of essential oils (EOs) hydrodistilled from the leaves and flower of Pink Plumeria rubra.

Methodology: Gas chromatography coupled with Mass spectrometry (GC/MS), Brine Shrimps Lethality Test (BSLT), Agar diffusion method and DPPH radical scavenging assay were used to analyse and evaluate the biological activities of the essential oils. The results were subjected to descriptive and statistical analysis.

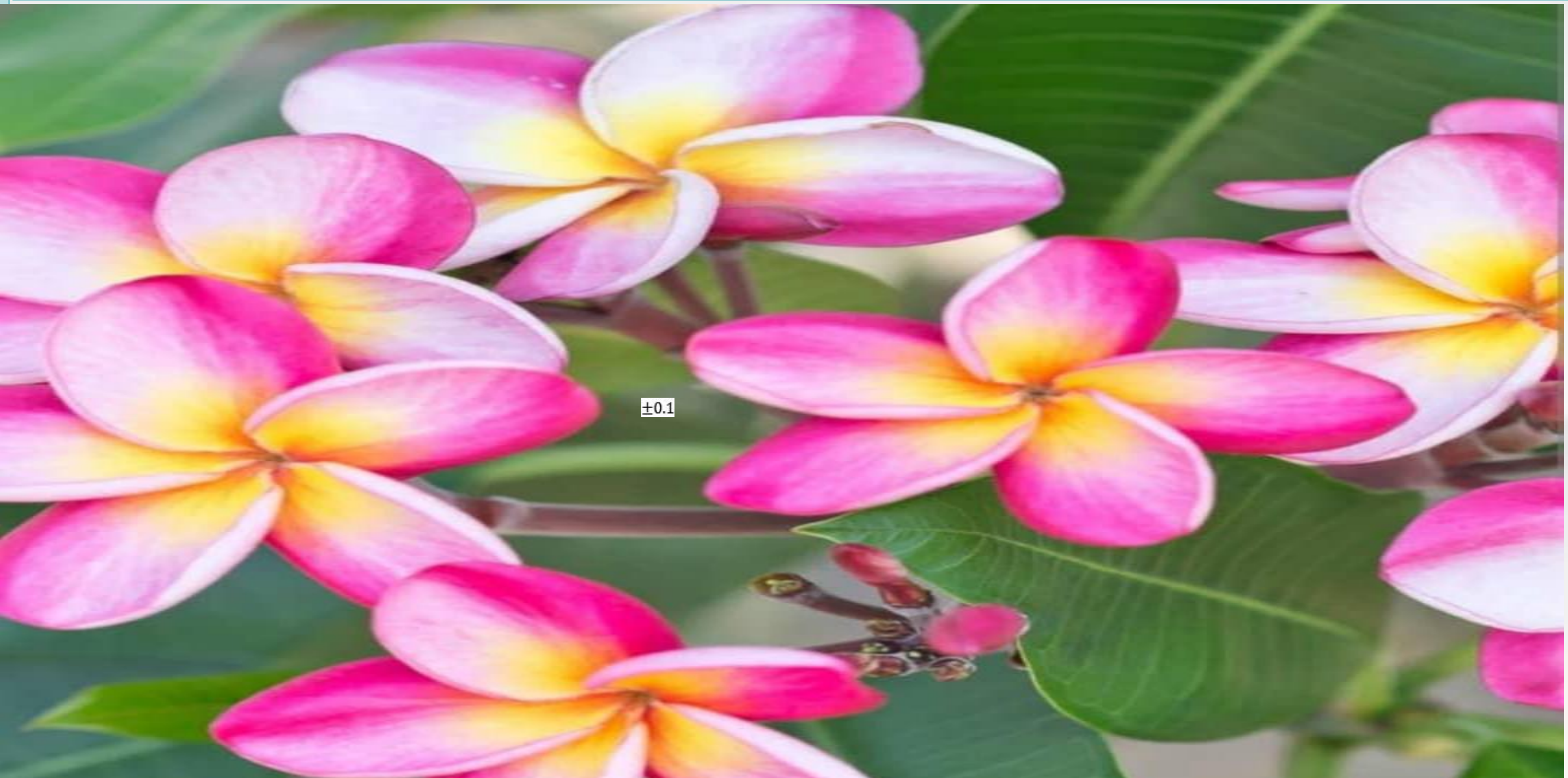
Results: Both oils have greater proportion of non-terpenes than terpenes. The leaf and flower oils were dominated by pentadecanal (51.2%) and 1-docosanol (34.6%) respectively. The BSLT gave LC50 of 2.5636ppm (leaf) and 24.8631ppm (flower), indicating they are toxic and hence biologically active. Both oils possess insignificant antibacterial activity but notable anti-fungi potential when compared with standard drug Ketoconazole. Statistical analysis showed no significant difference in the activity of both leaf and Ketoconazole. The EOs have moderate free-radical scavenging ability (IC50, Leaves, 528.23ppm; Flower,299.17ppm) compared with that of α-Tocopherol (81.54ppm).

Conclusion: This study revealed the chemistry of the EOs and their potentials as a natural antioxidant and antifungal agents which could be useful in the cosmetic, food and pharmaceutical industries.

Key words: Pink Plumeria rubra, chemical components, cytotoxicity, antibacterial, antifungal, antioxidant

Table 2:Antimicrobial activity of Plumeria rubra essential oils

Essential oils	Conc (µL/mL)	Inhibition zones diameter (mm)				
		<i>E. coli</i>	<i>S. aureus</i>	<i>C. albicans</i>	<i>A. niger</i>	<i>F. solani</i>
Leaf	100	0.0	2.0±0.1	5.9±0.1	8.1±0.1	8.0±0.1
	10	0.0	0.0	2.1±0.1	5.9±0.1	6.0±0.1
	1	0.0	0.0	0.0	4.1±0.1	4.0±0.2
Flower	100	0.0	1.9	8.0±0.1	7.9±0.1	0.0
	10	0.0	0.0	5.9±0.1	5.9±0.1	0.0
	1	0.0	0.0	3.9±0.1	4.0±0.1	0.0
Positive control		9.0±1.4	11.5±0.1	21.0±1.4	10.5±0.1	10.3±0.4
Negative control		0.0	0.0	0.0	0.0	0.0
0.0= no inhibition, Positive control= Gentamycin (10 µL/mL) and Ketoconazole (200 µg) for antibacterial and antifungi assay respectively; Negative control= DMSO; Inhibition zones diameter value approximately 1 decimal place mean±SD.						



Plumeria rubra Plant

(https://www.masterclass.com/articles/plumeria_x0002_plant-care-guide)

Table 3: Brine shrimp lethality Assay result of *P. rubra* Essential oils

Plant Tissue	LC ₅₀	LC limit	UC limit	CL
Leaves	2.5636	2.8246	27.8879	0.2070
Flower	24.8631	13.200	42.4256	0.1542

LC-Lower confidence UC-Upper confidence IC50- Conc at which there is 50% mortality

Table 4: IC50 values Indicating Radical-Scavenging Activity of the Essential oil

Sample	IC ₅₀
Leaf	528.23
Flower	359.05
α-Tocopherol	81.58
BHA	45.11

Reference

Bihani, T. (2021). Plumeria rubra L.– A review on its ethnopharmacological, morphological, phytochemical, pharmacological and toxicological studies. Journal of Ethnopharmacology 264 (2021) 122811. <https://doi.org/10.1016/j.jep.2020.122811>

Table 1: Chemical Compositions of Plumeria rubra (Rainbow flower)

Constituents	RI	% Composition		Constituents	RI	% Composition	
		Leaf	Flower			Leaf	Flower
Methylcyclohexane	718	0.1	-	β-Bisabolene	1504	0.1	-
Octane	798	0.1	-	Tridecanal	1507	0.4	-
Hexanal	800	0.4	-	γ-Cadinene	1509	0.1	-
Styrene	890	0.1	-	δ-Cadinene	1514	0.9	-
(4Z)-Heptenal	898	0.8	-	(E)-γ-Bisabolene	1523	0.1	-
Heptanal	901	0.6	-	10-epi-Cubenol	1526	0.2	-
α- pinene	930	0.1	-	(E)-Nerolidol	1557	0.1	-
Benzaldehyde	960	tr	-	Spathulenol	1573	0.1	-
β-pinene	975	tr	-	Caryophyllene oxide	1578	0.2	-
1-Octen-3-ol	976	0.1	-	Humulene epoxide II	1606	0.1	-
6-Methyl-5-hepten-2-one	981	0.1	-	Tetradecanal	1609	2.6	-
2-Pentylfuran	987	1.2	-	τ-Cadinol	1638	0.1	-
p-Cymene	1022	0.1	-	τ-Muurolol	1640	0.1	-
Limonene	1027	0.2	-	Cadalene	1669	0.1	-
2,2,6-trimethylcyclohexanone	1032	0.1	-	1-Tetradecanol	1673	0.2	-
1-Octanol	1068	0.1	-	(2Z,6Z)-Farnesal	1690	1.3	-
Linalool	1097	0.7	-	2-Pentadecanone	1694	0.3	-
Nonanal	1103	0.4	-	Heptadecane	1700	0.1	1.6
(2E,6Z)-Nonadienal	1150	1.9	-	Pentadecanal	1713	51.2	10.1
(3E,6Z)-Nonadienol	1153	0.4	-	Benzyl benzoate	1762	-	2.3
(2E)-Nonenal	1157	1.0	-	(2E)-Pentadecenal	1771	0.3	-
(2E,6Z)-Nonadien-1-ol	1162	0.1	-	1-Pentadecanol	1775	0.1	-
(2E)-Nonen-1-ol	1165	0.1	-	(9Z)-Hexadecenal	1789	0.1	-
(6E)-Nonen-1-ol	1167	0.1	-	Hexadecanal	1813	0.2	-
1-Nonanol	1169	0.1	-	Phytone	1837	0.3	-
2,5-dimethylstyrene	1182	0.4	-	2-Methylbenzyl benzoate	1850	-	3.9
Methyl salicylate	1189	0.1	-	1-Hexadecanol	1876	0.2	-
α-Terpineol	1193	0.1	-	(Z)-Hexadecatrienal	1882	0.7	-
Safranal	1196	tr	-	(E)-Hexadecatrienal	1886	1.9	-
Decanal	1204	0.1	-	Heptadecenal	1889	1.8	-
(2E,4E)-Nonadienal	1213	0.1	-	Nonadecane	1900	0.2	16.3
β-Cyclocitral	1216	0.2	-	(5E,9E)-Fernesyl acetone	1904	0.2	-
Carvacrol methyl ether	1236	0.1	-	Heptadecanal	1915	0.5	-
β-Cyclohomocitral	1253	0.1	-	Methyl palmitate	1920	0.5	-
(2E)-Decenal	1260	0.1	-	Palmitic acid	1959	9.0	-
(2E,4E)-Decadienal	1316	0.2	-	Heneicosane	2100	-	12.5
Eugenol	1348	0.1	-	(E)-Phytol	2103	7.4	-
α-Copaene	1373	0.8	-	Methyl stearate	2121	0.3	-
β-Elmene	1386	0.4	-	Oleic acid	2130	0.4	-
Methyleugenol	1396	0.4	-	Eicosanal	2221	-	11.2
β-Caryophyllene	1416	0.3	-	Tricosane	2300	0.1	2.7
E-α- Bergamotene	1429	0.4	-	Tetracosane	2400	0.1	-
Geranyl acetone	1444	0.1	-	1-Docosanol	2484	-	34.6
(E)-β-Farnesene	1449	0.4	-	Pentacosane	2500	0.2	4.9
α-Humulene	1452	0.1	-	Percentage identified		97.9	100.0
allo-Aromadendrene	1457	0.1	-	Monoterpene Hydrocarbons		0.4	-
Z-Cadina-1(6),4-diene	1459	tr	-	Oxygenated Monoterpenes		1.4	-
Ishwarane	1466	0.1	-	Sesquiterpene Hydrocarbons		4.3	-
γ-Muurolene	1471	0.1	-	Oxygenated Sesquiterpenes		2.4	-
(E)-β-Ionone	1475	0.6	-	Diterpenes		0.9	-
Germacrene D	1477	0.1	-	Apocarotenoids		7.4	-
β-Selinene	1485	0.1	-	Non-terpenes		80.5	100
α-Selinene	1493	0.1	-	Number identified		94	10
α-Muurolene	1495	0.1	-	Total Identified		97.3	100

RI- Retention indices from the analyses value.