IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

Healing with Frangipani: An Integrative Review of Phytochemicals and Therapeutic Benefits of Plumeria alba

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Abstract: *Plumeria alba, commonly known as white frangipani, has captivated cultures for centuries with its enchanting fragrance and remarkable healing properties. This integrative review embarks on a journey through the botanical wonderland of plants, exploring its rich phytochemical composition and unveiling the myriad therapeutic benefits it offers. Drawing from a tapestry of traditional wisdom and modern scientific inquiry, this review reveals the multifaceted nature of Plumeria alba's healing potential. Traditional healers across diverse cultures have revered white frangipani for its versatile applications in treating wounds, soothing skin maladies, alleviating respiratory discomfort, and easing the burden of pain. Their insights, passed down through generations, provide a timeless foundation for understanding the plant's medicinal prowess. In tandem with traditional knowledge, contemporary research endeavors have illuminated the intricate web of phytochemicals woven within Plumeria alba's petals and leaves. Alkaloids, flavonoids, terpenoids, and phenolic compounds dance harmoniously, bestowing upon the plant a treasure trove of pharmacological activities. From antioxidant fortification to anti-inflammatory resilience, from antimicrobial vigilance to analgesic relief, it emerges as a botanical powerhouse of healing. As we navigate through this verdant landscape of discovery, it becomes evident that white frangipani holds promise as a beacon of holistic health and wellness. Its phytochemical symphony orchestrates a chorus of therapeutic benefits, beckoning us to explore its potential applications in modern healthcare. By marrying ancient wisdom with contemporary science, we unlock the secrets of plant's healing alchemy and pave the way for its integration into evidence-based treatments. This stands as a testament to the enduring allure of Plumeria alba and as a guidepost for researchers, healthcare professionals, and nature enthusiasts alike. Together, let us embark on a voyage of healing with frangipani, embracing the beauty and bounty of nature's pharmacy.*

Keywords: Plumeria alba, phytochemicals, traditional medicine, antioxidant, anti- inflammatory, antimicrobial, holistic health

I. INTRODUCTION

Plumeria alba, is a botanical species belonging to the Apocynaceae family, native to tropical and subtropical regions. Plumeria, commonly known as the white frangipani, is a tropical tree celebrated for its exquisite beauty and captivating fragrance. This ornamental plant is native to regions of Central America, the Caribbean, and South America but has been cultivated and admired worldwide for centuries [1]. What sets Plumeria apart is not just its delicate blossoms but also the plethora of names it carries across different cultures and languages. Plumeria alba, commonly known as white frangipani, carries a multitude of names across different cultures and languages, reflecting its wide-reaching significance and cultural integration [2]. In Bengali, it is called Champa and Kath Golap in Bengal. Known as the Caterpillar Tree, Cagoda Tree, Pigeon Wood, and Nosegay Tree in various English-speaking regions, it also has diverse names in other languages. In French, it is referred to as Frangipanier à Fleurs Blanches, while in Thai it is known as Lee La Wa Dee. The Khmer people of Cambodia call it Châmpéi Sâ, and in Vietnamese, it is known as Hoa Chăm Pa. In Indonesia, it is called Kamboja, and in the Philippines, it is referred to as Kalatsútsing Putî. In Laos, it is known as Dok

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Champa, in Marathi-speaking regions of Maharashtra it is called Chafa, and in Sinhala, it is referred to as Sudu Araliya in Sri Lanka [3]. These diverse names underscore the plant's cultural importance and widespread recognition across the globe.

Renowned for its fragrant flowers and ornamental value, Plumeria alba has also been deeply intertwined with traditional medicinal practices across various cultures. Its distinct characteristics, including funnel-shaped flowers and leathery leaves, have made it a subject of interest for botanical enthusiasts and researchers alike [4]. In traditional medicine systems, Plumeria alba has been revered for its diverse therapeutic properties, which have been documented over centuries. Indigenous communities have integrated this plant into their healing practices, utilizing it for a myriad of purposes [5]. From wound healing and skin infections to respiratory ailments and pain management, it has played a significant role in folk remedies. Its traditional use also extends to addressing inflammation, fever, and other common health issues. In recent years, scientific interest in white frangipani has surged, prompting researchers to explore its phytochemical composition and pharmacological activities in greater detail [6]. Through systematic investigations, scholars aim to uncover the bioactive compounds present in the flower and elucidate their mechanisms of action. By bridging traditional knowledge with modern scientific methods, researchers seek to validate the therapeutic potentials of flower and explore its applications in contemporary healthcare [7].

II. OBJECTIVE

This review paper aims to critically analyse the existing literature on Plumeria alba, focusing on its phytochemical constituents and pharmacological activities. Operating at the master's level of research, this review endeavours to synthesize findings from traditional and contemporary sources to provide a comprehensive understanding of the flower medicinal properties [8]. By examining the chemical composition and biological effects of Plumeria alba, this paper seeks to shed light on its therapeutic potentials and inform future research directions.

Through a thorough examination of peer-reviewed articles, ethnobotanical records, and experimental studies, this review aims to elucidate the molecular mechanisms underlying the medicinal properties of flower. Furthermore, it seeks to evaluate the quality of evidence supporting its traditional uses and explore potential avenues for further investigation. By contributing to the body of knowledge surrounding, this review endeavours to enhance our understanding of its medicinal value and pave the way for its integration into evidence-based healthcare practices [9].

III. TAXONOMIC CLASSIFICATION: UNVEILING THE BOTANICAL IDENTITY OF WHITE FRANGIPANI

The flower's classification provides insight into its taxonomic relationship with other plant species and highlights its botanical characteristics within the broader context of plant diversity [10]. It commonly known as white frangipani, belongs to the plant kingdom Plantae and the family ApocynaceaeHere's a detailed classification:

- Kingdom: Plantae
- Division: Magnoliophyta (Angiosperms)
- Class: Magnoliopsida (Dicotyledons)
- Order: Gentianales
- Family: Apocynaceae
- Genus: Plumeria
- Species: Plumeria alba

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Stems **Flowers** **Leaves**

Fig 1. Plumeria alba (White frangipani)

3.1 Subspecies and Varieties

Within the species of flower, there may be recognized subspecies or varieties based on variations in characteristics such as flower colour, leaf shape, and growth habit. Some examples include Plumeria alba var. acutifolia and Plumeria alba var. rosea [11].

3.2 Cultivars

Additionally, numerous cultivated varieties or cultivars of Plumeria alba exist, bred for specific flower colours, fragrances, and growth habits, enhancing its ornamental appeal in gardens and landscapes [12].

IV. GEOGRAPHICAL DISTRIBUTION

Plumeria alba is native to tropical and subtropical regions, with a distribution that spans various parts of the world. It is found in regions characterized by warm climates and adequate sunlight, where it thrives in well-drained soils [13]. Countries where plant is present include - Mexico, Central America, Caribbean islands, South America, Southeast Asia, Pacific Islands.

DOI: 10.48175/IJARSCT-27677

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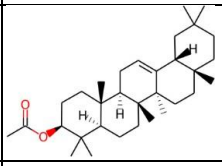
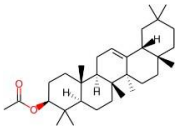
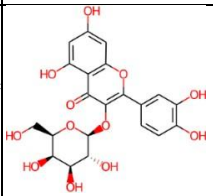
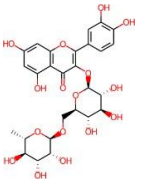
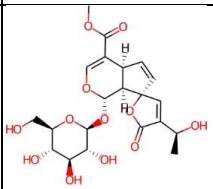
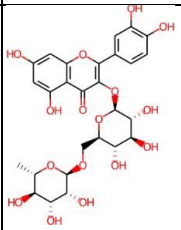
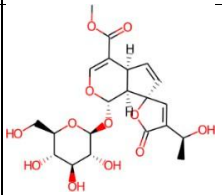
V. DISTRIBUTION OF PHYTOCHEMICALS ACROSS PLANTS PARTS

S. NO.	Parts of plants	Phytochemical compounds	CanonicalSMILE structures	Phytochemical 3D structure	References
1.	flower	beta-D-Glucose	C(C1C(C(C(C(C(O1)O)O)O)O)O)O		[57]
2.	root	beta-D-Glucose	C(C1C(C(C(C(C(O1)O)O)O)O)O)O		[58]
3.	flower	Hyperoside	C1=CC(=C(C=C1C2=C(C(=O)C3=C(C=C(C=C3O2)O)O)OC4C(C(C(C(O4)CO)O)O)O)O)O		[59]
4.	flower	Rutin	CC1C(C(C(C(C(O1)OCC2C(C(C(C(O2)OC3=C(OC4=CC(=CC(=C4C3=O)O)O)C5=CC(=C(C=C5)O)O)O)O)O)O)O)O)O		[60]
5.	Leaf	Plumieride			[61]
6.	Leaf	Rutin	CC1C(C(C(C(C(O1)OCC2C(C(C(C(O2)OC3=C(OC4=CC(=CC(=C4C3=O)O)O)C5=CC(=C(C=C5)O)O)O)O)O)O)O)O)O		[62]
7.	Stem	Plumieride	CC(C1=CC2(C=CC3C2C(OC=C3C(=O)OC)OC4C(C(C(C(O4)CO)O)O)O)OC1=O)O		[63]

DOI: 10.48175/IJARSCT-27677

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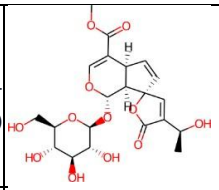
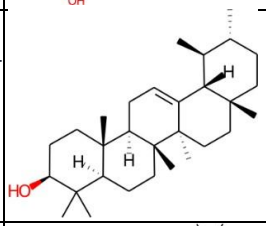
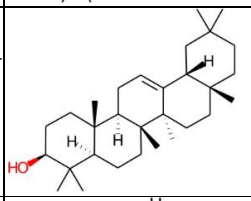
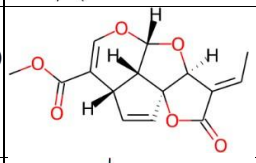
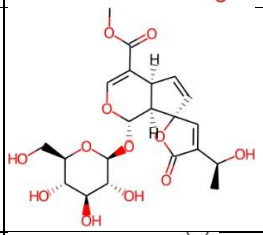
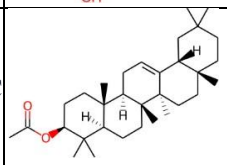
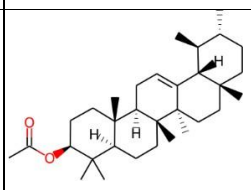
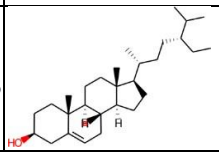
8.	Bark	Plumieride	CC(C1=CC2(C =CC3C2C(OC =C3 C(=O)OC)OC4 C(C(C(C(O4)C O)O) O)O)OC1=O)O		[64]
9.	Bark	alpha-Amyrin	CC1CCC2(CC C3(C(=CCC4C 3(CCC5C4 (CCC(C5(C)C) O)C)C)C2C1C) C)C		[65]
10.	Bark	beta-Amyrin	CC1(CCC2(CC C3(C(=CCC4C 3(CCC5C4 (CCC(C5(C)C) O)C)C)C2C1)C)C)C		[66]
11.	root	Plumericin	CC=C1C2C3(C =CC4C3C(O2) OC=C4C(=O) OC)OC1=O		[67]
12.	Root	Plumieride	CC(C1=CC2(C =CC3C2C(OC =C3C(=O)OC) OC4C(C(C(C(O4)CO)O)O)O)OC1=O)O		[68]
13.	Bark	beta-Amyrin acetate	CC(=O)OC1C CC2(C(C1(C)C)CCC3(C2 CC=C4C3(CC C5(C4CC(CC5)(C)C)C)C)C)C		[69]
14.	Bark	alpha-Amyrenyl acetate	CC(=O)O[C@ H]1CC[C@]2([C@H](C1(C)C)CC[C@@]1([C@@H]2CC= C2[C@@]1(C) CC[C@@]1([C @H]2[C@@H] (C)[C@H](C)C C1)C)C)C		[70]
15.	Bark	beta-Sitosterol	CCC(CCC(C)C 1CCC2C1(CC C3C2CC=C4C 3 (CCC(C4)O)C) C)C(C)C		[71]

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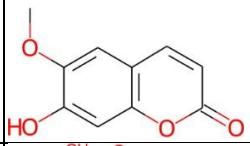
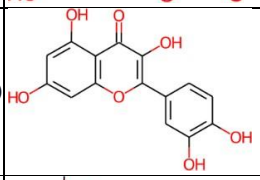
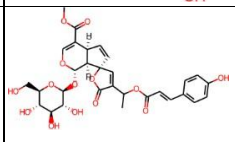
16.	Bark	Scopoletin	COC1=C(C=C 2C(=C1)C=CC (=O)O2)O		[72]
17.	flower	Quercetin	C1=CC(=C(C= C1C2=C(C(=O)C3=C(C=C (C=C3O2)O)O) O)O)O		[73]
18.	Root	methyl (1S,4aS,7R,7aS)-4'-[1-[(E)-3-(4-hydroxyphenyl)prop -2-enoyl]oxyethyl]-5'-oxo-1-[(2S,3R,4S,5S,6R)-3,4,5-trihydroxy-6-(hydroxymethyl)oxa n-2-yl]oxyspiro[4a,7a-dihydro-1H-cyclopenta[c]pyran- 7,2'-furan]-4-carboxylate	CC(C1=CC2(C =CC3C2C(OC =C3C(=O)OC) OC4C(C(C(C(O4)CO)O)O)O)OC1=O)OC(= O) C=CC5=CC=C (C=C5)O		[74]

Table – 01 (Distribution of Phytochemicals Across white frangipani Parts including its canonical SMILE structure and 3D structure)

VI. GENETIC DIVERSITY, REPRODUCTION, AND CYTOLOGY

Plumeria alba is celebrated for its aesthetic allure and therapeutic significance. Investigating its genetic diversity, reproductive mechanisms, and cytological features is imperative for biodiversity conservation, breeding endeavors, and comprehending its evolutionary trajectory. The genetic diversity, reproduction, and cytology of plants underscore its ecological adaptation, evolutionary dynamics, and management in horticulture [14]. Conservation initiatives must prioritize the preservation of genetic variability, while breeding programs can leverage reproductive mechanisms to cultivate improved varieties. Sustained exploration in these domains is pivotal for the sustainable utilization and conservation of this culturally significant species [15].

6.1 Genetic Diversity

Research into the genetic diversity of Plumeria alba has unveiled substantial variation within populations. Utilizing molecular markers like SSRs (Simple Sequence Repeats) and AFLPs (Amplified Fragment Length Polymorphisms) has facilitated the evaluation of genetic diversity, aiding in the identification of distinct genotypes and population structure. Variables such as geographical distribution, reproductive strategies, and human-mediated dispersal have been found to influence genetic diversity significantly [16].

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6.2 Reproduction

Plumeria alba exhibits a spectrum of reproductive strategies encompassing both sexual and asexual modes. Sexual reproduction predominantly relies on cross-pollination facilitated by various vectors like insects, birds, or wind, culminating in genetic recombination and seed production [17]. Conversely, asexual reproduction, primarily through stem cuttings, enables clonal propagation, ensuring genetic uniformity and perpetuating desirable traits.

6.3 Cytology

Cytological investigations offer valuable insights into the chromosomal makeup and reproductive biology of plant. Typically, the species demonstrates a diploid chromosome count, although variations have been documented among different accessions [18]. Detailed examination of pollen morphology, ovule development, and embryo formation enriches our comprehension of reproductive processes and breeding compatibility.

VII. BOTANICAL CHARACTERSTICS

Plumeria alba is distinguished by its unique botanical traits and therapeutic properties. Understanding these characteristics is pivotal for appreciating its ornamental value and medicinal significance. The botanical characteristics and medicinal attributes of plant underscore its dual significance as an ornamental plant and a valuable resource in traditional medicine [19]. Appreciating these features enhances our understanding of its cultural importance and potential applications in various domains.

7.1 Botanical Characteristics:

7.1.1 Flowers:

Plumeria alba features fragrant, white flowers with distinctively shaped petals arranged in clusters, emitting a sweet aroma that makes them sought-after for perfumery and floral decorations [20].

7.1.2 Leaves:

The leaves of Plumeria alba are thick, leathery, and glossy green, typically lanceolate or elliptic in shape, arranged spirally at branch tips, and provide an appealing contrast to the flowers [21].

7.1.3 Stem:

Smooth and succulent stems characterize Plumeria alba, often with a greyish bark, exuding the milky latex when incised, which can cause skin irritation in sensitive individuals [22].

7.1.4 Height and Growth Habit:

Plumeria alba adopts a small to medium-sized tree form, reaching heights of 4 to 8 meters, with spreading, irregular branches forming an open canopy [23].

7.1.5 Fruit:

The fruit of Plumeria alba is an elongated pod-like structure filled with winged seeds, although it is not primarily valued for ornamental purposes and is rarely utilized in landscaping [24].

VIII. PHYTOCHEMICAL COMPONENTS: A COMPEREHENSIVE ANALYSIS

Plumeria alba is a botanical species revered for its aesthetic beauty and therapeutic potential. With its widespread traditional use in various cultures and increasing scientific interest, it has emerged as a subject of comprehensive phytochemical analysis. This review aims to provide an in-depth exploration of the diverse array of phytochemical components present in plants, shedding light on their structural diversity, pharmacological properties, and potential therapeutic applications [25]. By elucidating the intricate chemistry of white frangipani, this analysis seeks to deepen our understanding of its medicinal value and pave the way for further research and development in natural product-based healthcare. Through a systematic examination of peer-reviewed literature and scientific studies, this review aims

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to offer valuable insights into the bioactive compounds inherent in plants and their implications for human health and well-being [26].

8.1 Alkaloids

Plumeria alba boasts a diverse array of alkaloids, including plumerine and isoplumerine, which are pivotal bioactive compounds contributing to its medicinal properties. These alkaloids exhibit multifaceted pharmacological activities, ranging from antimicrobial to anti-inflammatory and analgesic effects [27]. Plumerine, has been studied for its antimicrobial properties, showing efficacy against a broad spectrum of microorganisms, including bacteria and fungi. Isoplumerine, on the other hand, demonstrates promising anti-inflammatory activity by modulating key inflammatory mediators and cytokines. The presence of these alkaloids underscores the traditional use of this plant in various folk remedies and highlights its potential as a source of novel therapeutic agents [28].

8.2 Flavonoids

Plumeria alba is rich in flavonoids, a class of polyphenolic compounds known for their antioxidant and anti-inflammatory properties. Compounds such as quercetin and kaempferol are prominent among the flavonoids found in white frangipani and have garnered attention for their diverse pharmacological activities. Quercetin, for instance, exhibits potent antioxidant effects by scavenging free radicals and reducing oxidative stress-induced damage to cells and tissues [29]. Kaempferol, on the other hand, demonstrates anti-inflammatory properties by inhibiting pro-inflammatory cytokines and enzymes involved in the inflammatory cascade. The abundance of flavonoids in white frangipani underscores its potential as a natural remedy for oxidative stress-related disorders and inflammatory conditions [30].

8.3 Triterpenoids

Plumeria alba harbors a wealth of triterpenoid compounds, including lupeol and betulinic acid, which contribute significantly to its pharmacological profile. These triterpenoids exhibit a wide range of biological activities, including anti-inflammatory, antioxidant, and anti-tumor effects. Lupeol, for instance, has demonstrated potent anti-inflammatory properties by inhibiting pro-inflammatory mediators and pathways, thereby attenuating inflammation-associated tissue damage [31]. Additionally, lupeol exhibits antioxidant activity by scavenging free radicals and preventing oxidative stress- induced cellular damage. Betulinic acid, another prominent triterpenoid found in Plumeria alba, has garnered attention for its anti-tumor properties, showing promising results in inhibiting the growth of cancer cells and inducing apoptosis. The presence of these triterpenoids underscores the therapeutic potential of the plant in combating inflammatory diseases, oxidative stress-related disorders, and certain types of cancer [32].

8.4 Phenolic Compounds

It is rich in phenolic compounds, including phenolic acids and flavanols, which contribute to its antioxidant and anti-inflammatory properties. Phenolic acids such as caffeic acid and ferulic acid exhibit potent antioxidant activity by scavenging free radicals and preventing oxidative damage to cellular components [33]. These compounds also possess anti-inflammatory effects by inhibiting the production of pro- inflammatory cytokines and mediators. Flavanols, such as rutin and quercetin, further enhance the antioxidant capacity of plant, thereby protecting cells from oxidative stress-induced injury. Moreover, flavanols exert anti-inflammatory effects by modulating inflammatory signaling pathways and reducing the expression of inflammatory genes [34]. The synergistic action of these phenolic compounds contributes to the overall medicinal properties of white frangipani, making it a valuable resource in traditional and complementary medicine for the management of oxidative stress and inflammatory disorders [35].

IX. EXPLORING THE THERAPEUTIC POTENTIAL

Plumeria alba is renowned not only for its visual splendor but also for its intriguing medicinal properties attributed to a diverse array of bioactive compounds. This review delves into the intricate chemistry of these compounds, shedding light on the medicinal potential inherent in this botanical wonder [36]. The chemistry and bioactive compounds of

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Plumeria alba unveil their potential as a valuable source of natural medicines. With its diverse array of alkaloids, flavonoids, triterpenoids, and essential oils, it offers a rich pharmacological repertoire with implications for various therapeutic applications. Further exploration of these compounds is imperative for harnessing the full therapeutic potential of this botanical gem and advancing natural product-based drug discovery efforts [37].

S.NO.	Phytochemical Component	Potential Benefits	Conditions/Diseases	Common Plant Parts
1.	Alkaloids	Anti-inflammatory, analgesic	Arthritis, general inflammation	Bark, leaves, roots, seeds
2.	Flavonoids	Antioxidant, anti- cancer, anti- inflammatory	Cardiovascular diseases, certain cancers, inflammation	Fruits, vegetables, seeds, bark
3.	Glycosides	Antimicrobial, anti- cancer	Infections, certain cancers	Leaves, flowers, roots, seeds
4.	Triterpenoids	Anti-inflammatory, antimicrobial	Arthritis, infections	Leaves, bark, roots, fruits
5.	Tannins	Antioxidant, antimicrobial	Cardiovascular diseases, infections	Bark, leaves, fruits, seeds
6.	Essential Oils	Antimicrobial, anti-inflammatory, analgesic, antioxidant	Skin conditions, infections, general inflammation, chronic diseases	Leaves, flowers, stems, seeds

TABLE - 02 (Phytochemical component and their therapeutic potential)

X. SECONDORY METABOLITES AND THEIR MEDICINAL SIGNIFICANCE

Plumeria alba, renowned for its ornamental beauty and therapeutic potential, harbors a diverse array of secondary metabolites that contribute to its pharmacological arsenal. This review delves into the multifaceted world of secondary metabolites in plants shedding light on their medicinal significance and potential applications in healthcare. The secondary metabolites of the plant constitute a pharmacological treasure trove, offering a myriad of therapeutic possibilities for healthcare [38]. With their diverse array of bioactive compounds, including phenolic acids, coumarins, and saponins, Plumeria alba emerges as a promising candidate for natural product-based drug discovery. Further exploration of these secondary metabolites is essential for unlocking the full therapeutic potential of this botanical gem and advancing pharmaceutical research and development efforts [39].

In addition to alkaloids, flavonoids, triterpenoids, and essential oils, it boasts a rich reservoir of other secondary metabolites, each with unique pharmacological properties and therapeutic potentials. These include phenolic acids, coumarins, and saponins, among others [40].

10.1 Phenolic Acids

Compounds such as caffeic acid and ferulic acid, classified as phenolic acids, exhibit potent antioxidant activities, mitigating oxidative stress and bolstering cellular defense mechanisms [41]. Their ability to scavenge free radicals holds promise for combating oxidative damage associated with various diseases.

10.2 Coumarins

Umbelliferone and scopoletin, prominent coumarins found in Plumeria alba, demonstrate anti-inflammatory and analgesic properties, offering relief from pain and inflammation. Their pharmacological effects make them valuable allies in managing inflammatory conditions [42].

10.3 Saponins

Diosgenin and tigogenin, representative saponins present in Plumeria alba, exhibit a broad spectrum of pharmacological activities, including anti-cancer, anti-inflammatory, and antimicrobial effects [43]. These versatile compounds hold potential for addressing a wide range of health concerns

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

XI. PHARMACODYNAMIC EFFICACY: COMPREHENSICE INSIGHTS FROM EXPERIMENTAL STUDIES

The plant embodies not only botanical beauty but also a reservoir of pharmacologically active compounds. This comprehensive review aims to delve into the multifaceted pharmacodynamic efficacy of Plumeria alba, drawing from an array of experimental studies to illuminate its therapeutic potential and mechanisms of action. The amalgamation of experimental findings elucidates the multifaceted pharmacodynamic efficacy of plants, encompassing anti-inflammatory, antioxidant, wound healing, and antimicrobial activities [44]. These insights not only validate its traditional uses but also pave the way for its integration into modern therapeutic approaches. Further interdisciplinary research is imperative to unravel the intricate mechanisms underlying Plumeria alba's pharmacological actions and realize its full therapeutic potential in clinical settings [45].

11.1 Anti-inflammatory Activity

Experimental investigations have extensively elucidated the anti-inflammatory properties of white frangipani. Conducted in vitro assays demonstrating the inhibitory effects of the plant extracts on key inflammatory mediators, including prostaglandins and cytokines [46]. Moreover, animal studies corroborated these findings, revealing significant attenuation of inflammation upon treatment with white frangipani extracts.

11.2 Antioxidant Properties

Plumeria alba's antioxidant prowess has been meticulously explored in various experimental setups. Identified and quantified the phenolic and flavonoid content of plant essential oil, attributing its antioxidant activity to these bioactive constituents. Through in vitro assays, they demonstrated the scavenging ability of white frangipani against free radicals, underscoring its potential in combating oxidative stress-related ailments [47].

11.3 Wound Healing Potential

Experimental evidence highlights the plant’s proficiency in promoting wound healing. In a study by topical application of Plumeria alba extracts accelerated wound closure in animal models, accompanied by enhanced collagen deposition and angiogenesis [48]. These findings underscore the plant's regenerative properties and its therapeutic utility in cutaneous wound management.

11.4 Antimicrobial Activity

Plumeria alba exhibits broad-spectrum antimicrobial activity against various pathogens, as demonstrated in numerous experimental studies. Conducted genetic diversity analyses of this plant, revealing its adaptability to diverse ecological niches. Additionally, in vitro assays showcased the inhibitory effects of white frangipani extracts against bacterial and fungal pathogens, suggesting its potential as a natural antimicrobial agent [49].

XII. MEDICINAL PLANT FORMULATIONS AND THEIR THERAPEUTICS

Plumeria alba, known for its medicinal properties, is used in traditional medicine and herbal formulations rather than mainstream pharmaceutical products (50). Here are some examples of its uses in traditional medicine and herbal remedies:

1. Topical Preparations:

1.1. Ointments and Creams: Extracts from Plumeria alba leaves, bark, or flowers are incorporated into ointments and creams for treating skin conditions such as wounds, ulcers, and infections due to their antimicrobial and anti-inflammatory properties [51].

1.2. Poultices: Crushed leaves or bark are used in poultices to reduce inflammation and pain in conditions like arthritis and insect bites.

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Volume 5, Issue 4, June 2025
Impact Factor: 7.67

2. Infusions and Decoctions:

2.1. Teas and Infusions: Leaves or flowers are used to make herbal teas or infusions believed to have anti-inflammatory and antioxidant effects, which can be consumed for general wellness or specific conditions like colds and coughs [52].

2.2. Decoctions: Decoctions made from the bark are used traditionally to treat gastrointestinal issues, fevers, and infections.

3. Essential Oils:

3.1. Aromatherapy: Essential oils extracted from Plumeria alba flowers are used in aromatherapy for their calming and relaxing properties. They may also have mild analgesic and anti-inflammatory effects [53].

3.2. Massage Oils: Essential oils are blended into carrier oils for use in massage therapy to relieve muscle pain and tension.

4. Herbal Supplements:

4.1. Capsules and Tablets: Some traditional medicine systems use powdered Plumeria alba bark or leaves in capsule or tablet form for their purported health benefits, such as improving immune function and reducing inflammation [54].

5. Traditional Medicinal Formulations:

5.1. Ayurvedic Medicine: In Ayurvedic medicine, various parts of Plumeria alba are used to balance doshas and treat ailments like skin diseases, respiratory issues, and digestive problems [55].

5.2. Traditional Chinese Medicine (TCM): In TCM, Plumeria alba is sometimes used for its cooling properties to treat heat-related conditions.

While these uses are based on traditional practices, it is important to note that scientific validation and clinical trials are necessary to confirm the efficacy and safety of these preparations [56]. Always consult with a healthcare professional before using herbal remedies.

XIII. CONCLUSION

In conclusion, Plumeria alba, commonly known as the white frangipani, is a remarkable plant with significant therapeutic potential. This integrative review has highlighted the diverse phytochemicals present in P. alba, including alkaloids, flavonoids, triterpenoids, and essential oils, each contributing to the plant's pharmacological properties. Experimental studies have demonstrated the plant's efficacy in exhibiting anti- inflammatory, antioxidant, wound healing, and antimicrobial activities. These findings not only validate its traditional medicinal uses but also suggest its potential for integration into modern therapeutic approaches. Future interdisciplinary research is essential to further elucidate the intricate mechanisms underlying P. alba's pharmacological actions and to fully realize its therapeutic potential in clinical settings.

ACKNOWLEDGMENT

I would like to thank God for providing me with the strength and wisdom to complete this review. I express my deepest gratitude to Dr. Mala Trivedi from the Amity Institute of Biotechnology at Amity University, Lucknow Campus, for her invaluable guidance and support throughout this research. I also thank the research staff and Lab Assistants at Amity Institute of Biotechnology for their assistance in sourcing relevant literature. My heartfelt appreciation goes to my families and friends for their constant encouragement and understanding.

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Volume 5, Issue 4, June 2025
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IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

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