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LAVANGA (SYZYGIUM AROMATICUM): A COMPREHENSIVE PHARMACOGNOSTIC, PHYTOCHEMICAL AND PHARMACOLOGICAL REVIEW WITH SPECIAL REFERENCE TO ITS AYURVEDIC THERAPEUTIC APPLICATIONS

Dr. Varsha Pathare[1]*, Dr. Indira S. Ujagare[2]

[1]Department of Rasashastra Evum Bhaishajya Kalpana, Tilak Ayurved Mahavidyalay, Pune, Maharashtra, India.
[2]Department of Rasashastra Evum Bhaishajya Kalpana, Tilak Ayurved Mahavidyalay, Pune, Maharashtra, India.

***Corresponding Author: Dr. Varsha Pathare**

Department of Rasashastra Evum Bhaishajya Kalpana, Tilak Ayurved Mahavidyalay, Pune, Maharashtra, India.

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ABSTRACT

Lavanga (Syzygium aromaticum (L.) Merr. & L.M. Perry, Family Myrtaceae), commonly known as clove, is a highly aromatic dried flower bud that occupies a distinctive position in both classical Ayurvedic therapeutics and contemporary pharmacological research. Described in Ayurvedic Nighantu literature as possessing Katu-Tikta Rasa, Laghu-Snigdha Guna, Sheeta Virya and Katu Vipaka, Lavanga is traditionally employed as a Deepana, Pachana, Kasahara, Shwasahara and Vedanasthapaka dravya, and forms a key ingredient of several classical formulations, including the fermented preparation Lavangarishta. Modern phytochemical investigations have identified eugenol as the principal bioactive marker of clove, accompanied by eugenyl acetate, β-caryophyllene, gallic acid, flavonoids and tannins, which together underline its well-documented antimicrobial, antioxidant, anti-inflammatory, analgesic, hepatoprotective and immunomodulatory activities. This review consolidates the botanical, phytochemical and pharmacological profile of Lavanga and correlates classical Ayurvedic indications with evidence generated through contemporary pharmacognostical and analytical techniques, including High-Performance Thin-Layer Chromatography (HPTLC)-based standardization and antibacterial screening of eugenol-rich formulations against Staphylococcus aureus and Escherichia coli. The available literature supports Lavanga as a scientifically validated, multi-target therapeutic drug with considerable scope for standardization, quality control and integration into evidence-based Ayurvedic and complementary pharmaceutical practice. Areas requiring further systematic clinical research, including dose-standardization, safety thresholds and formulation-specific bioavailability studies, are also highlighted.

KEYWORDS: Lavanga; Syzygium aromaticum; Clove; Eugenol; Ayurveda; Lavangarishta; Antimicrobial activity; Rasapanchaka.

1. INTRODUCTION

Medicinal plants continue to occupy a central place in global healthcare, with a substantial proportion of the world's population relying on traditional herbal systems, including Ayurveda, as a primary source of therapeutics. Among the aromatic dravyas described in Ayurvedic literature, Lavanga (Syzygium aromaticum), popularly known as clove, holds particular significance owing to its wide-ranging Deepana-Pachana, Kasahara, Shwasahara and Vedanasthapaka properties described across Nighantu and Yoga-grantha literature.[1] Clove is native to the Maluku Islands of eastern Indonesia and has, over several centuries, become one of the most extensively traded spices, valued equally in culinary, cosmetic and medicinal contexts.[2] While relatively less elaborated in the Brihattrayi, Lavanga finds detailed mention in later Yoga-granthas and is a principal ingredient of formulations such as Lavangadi Vati, Lavangadi Churna and the fermented Asava-Arishta preparation Lavangarishta, which is widely prescribed for Agnimandya, Aruchi, Chardi and related gastrointestinal disorders.

Contemporary pharmacological research has substantiated many of these classical indications, chiefly attributing the therapeutic potential of clove to eugenol, its principal phenylpropanoid constituent, which typically constitutes 70-90% of clove essential oil.[2] A

large and growing body of in vitro and in vivo evidence has demonstrated antimicrobial, antioxidant, anti-inflammatory, analgesic, hepatoprotective and immunomodulatory activities of clove extracts and its isolated phytoconstituents. This convergence between classical Ayurvedic experiential knowledge and modern experimental validation makes Lavanga an instructive model drug for integrative pharmacognostical research. The present review aims to systematically compile the botanical, Ayurvedic pharmacodynamic, phytochemical and pharmacological profile of Lavanga, and to correlate this evidence base with findings generated through standardization and antibacterial evaluation of the classical formulation Lavangarishta.

2. TAXONOMICAL CLASSIFICATION AND VERNACULAR NOMENCLATURE

The systematic botanical position of Lavanga is presented in Table 1, and its vernacular names across major Indian languages are summarised in Table 2.[2]

Table 1: Taxonomical classification of Lavanga.

Taxonomic rank	Classification
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Myrtales
Family	Myrtaceae
Genus	Syzygium
Species	aromaticum (L.) Merr. & L.M. Perry
Part used	Dried unopened flower bud

Table 2: Vernacular nomenclature of Lavanga.

anguage	Name(s)
Sanskrit	Lavanga, Devakusuma, Shriprasuna, Chandanapushpaka, Varija
Hindi	Laung, Lavang
Marathi	Lavang
English	Clove
Kannada	Lavanga
Malayalam	Grambu, Karayampoo
Gujarati	Lavinga

3. BOTANICAL DESCRIPTION AND DISTRIBUTION

Lavanga is obtained from a small to moderately sized evergreen tree attaining a height of 8-15 metres, with simple, glossy, lanceolate leaves bearing numerous aromatic oil glands on their lower surface. The flower buds develop in terminal clusters, appearing pale initially and turning bright red upon maturity; they are harvested and dried prior to full flowering, yielding the characteristic nail-shaped dried bud that gives the drug its Latin descriptor (clavus, a nail).[2] The fruit is a fleshy purplish drupe enclosing a single oblong seed. Clove is now cultivated across Indonesia, Zanzibar, Madagascar, Sri Lanka and, in India, in the hilly tracts of Kerala, Karnataka and Tamil Nadu.

4. AYURVEDIC PHARMACODYNAMICS (RASAPANCHAKA) AND CLASSICAL THERAPEUTIC INDICATIONS

The classical pharmacodynamic attributes of Lavanga, as described in Ayurvedic Nighantu literature, are summarised in Table 3.[1] Some later compilations describe an Ushna Virya in regional practice, reflecting a degree of textual variation that merits further pharmacological correlation.

Table 3: Rasapanchaka of Lavanga.

Attribute	Description
Rasa (taste)	Katu, Tikta
Guna (properties)	Laghu, Snigdha, Tikshna
Virya (potency)	Sheeta (classically); Ushna in some regional texts
Vipaka (post-digestive taste)	Katu
Dosha karma	Kapha-Pittahara
Principal Karma	Deepana, Pachana, Ruchivardhaka, Amahara, Kasahara, Shwasahara, Vedanasthapana, Hrudya, Mutrala, Stanyashodhana, Jwaraghna, Vajikara

Classical texts recommend Lavanga in the management of Aruchi, Agnimandya, Ajeerna, Anaha, Adhmana, Grahani, Kasa, Shwasa, Chardi, Trishna, Hriddourbalya, Mutrakrichchhra, Amavata, Sandhigata Vata and

Jwara.[1] These indications map closely on to the modern pharmacological categories of digestive stimulant, antitussive, analgesic-anti-inflammatory, cardio-tonic, diuretic and antipyretic activity described below, illustrating a coherent line of continuity between experiential and experimental knowledge systems.

5. PHYTOCHEMISTRY

Clove buds and their essential oil contain a chemically diverse array of phytoconstituents, broadly classifiable into phenylpropanoids, monoterpenes, sesquiterpenes and flavonoid/phenolic derivatives. Eugenol (4-allyl-2-methoxyphenol) is the predominant constituent, typically comprising 70-90% of clove bud oil, followed by eugenyl acetate (approximately 15%) and β-caryophyllene.[2] Additional constituents of pharmacological interest include gallic acid, tannins, flavonoids such as kaempferol and rhamnetin, quercetin, triterpenoids (oleanolic acid), β-sitosterol, ascorbic acid, and minor volatile components including methyl salicylate, benzaldehyde and α- and β-humulene.[6] Eugenol itself is classified by the World Health Organization as a Generally Recognized as Safe (GRAS) and non-mutagenic compound, and its phenolic hydroxyl group and allyl side chain are considered central to its membrane-interactive antimicrobial and radical-scavenging properties.[7]

6. PHARMACOLOGICAL ACTIVITIES

6.1 Antimicrobial Activity

Clove extracts and eugenol have consistently demonstrated broad-spectrum antibacterial and antifungal activity against Gram-positive and Gram-negative organisms, including Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae and Helicobacter pylori, as well as substantial biofilm-inhibitory activity against multidrug-resistant pathogens.[8] Mechanistically, the lipophilic eugenol molecule partitions into and disorders the bacterial phospholipid bilayer, producing loss of membrane potential, K+/ATP efflux and collapse of the proton-motive force, which together account for its bactericidal action.[8] Clove essential oil and eugenol have similarly shown synergistic antifungal activity against Candida species when combined with conventional antimycotics.[5]

6.2 Antioxidant Activity

The phenolic hydroxyl group of eugenol confers potent free-radical scavenging and metal-chelating activity, demonstrated across DPPH, ABTS and xanthine-oxidase based assay systems, and clove extracts are considered among the most potent natural antioxidant sources evaluated to date.[2]

6.3 Anti-inflammatory and Analgesic Activity

Eugenol and clove oil inhibit pro-inflammatory mediators and cyclo-oxygenase pathways, producing measurable reduction of carrageenan-induced paw oedema in experimental models, and clove oil has long been used topically as an analgesic in dentistry for the relief of odontalgia.[3] Immunomodulatory activity, evidenced by modulation of both humoral and cell-mediated immune responses, has also been reported for clove essential oil.[6]

6.4 Hepatoprotective Activity

A eugenol-rich fraction of clove has been shown to reverse biochemical and histopathological markers of thioacetamide-induced liver cirrhosis in experimental animals, reducing oxidative stress and inhibiting hepatic cell proliferation, supporting a protective role of clove-derived eugenol against chronic hepatic injury.[9]

6.5 Other Reported Activities

Additional pharmacological effects documented for clove and its phytoconstituents include antidiabetic, anticancer (cytotoxic activity against several tumour cell lines), antidepressant, digestive-stimulant and antipyretic actions, along with the classically described Vajikarana (aphrodisiac) effect, which recent experimental studies in animal models have correlated with improved reproductive performance parameters.[2]

7. LAVANGA IN CLASSICAL AYURVEDIC FORMULATIONS: CORRELATION WITH CONTEMPORARY ANALYTICAL RESEARCH

Lavanga is a key ingredient in numerous classical formulations, including Lavangadi Vati, Lavangadi Churna, Himasagara Taila, Bala Taila and the fermented Asava-Arishta preparation Lavangarishta, which is traditionally indicated in Agnimandya, Aruchi, Grahani and related digestive disorders. In an experimental pharmaceutico-analytical study on Lavangarishta undertaken as part of postgraduate Ayurvedic research, sequential fermentation batches were monitored for physicochemical parameters (pH, specific gravity and alcohol content), and eugenol was confirmed as the principal phytochemical marker by High-Performance Thin-Layer Chromatography, resolving at an Rf value of approximately 0.476-0.479. The optimally fermented batch, corresponding to the fortieth day of Sandhana, exhibited the lowest pH and the highest generated alcohol content among the samples evaluated. The same batch demonstrated measurable antibacterial activity against Staphylococcus aureus and Escherichia coli, corroborating the eugenol-dependent antimicrobial mechanism described in the pharmacological literature above and providing an analytical rationale for the use of eugenol content as a chemical marker for standardizing Lavanga-based Asava-Arishta preparations. Such standardization work is essential for bridging classical quality parameters described in texts such as the Sharangdhara Samhita with objective, reproducible analytical benchmarks suitable for regulatory and pharmacopoeial acceptance.[10]

8. SAFETY AND TOXICOLOGICAL CONSIDERATIONS

While eugenol is classified as GRAS at culinary levels of

exposure, concentrated clove oil and isolated eugenol can produce dose-dependent hepatotoxicity, mucosal irritation and, rarely, central nervous system depression on excessive or undiluted use, particularly in paediatric populations.[2] Judicious dosing, in accordance with classical Ayurvedic posology (clove powder 1-2 g/day; clove oil 1-2 drops), and further systematic toxicological and clinical evaluation are warranted before recommending higher therapeutic doses.

9. CONCLUSION

Lavanga (Syzygium aromaticum) exemplifies a rational convergence between classical Ayurvedic dravyaguna description and modern pharmacognostical and pharmacological validation. Its Katu-Tikta Rasa, Laghu-Snigdha Guna and Kapha-Pittahara action correspond closely with the demonstrated Deepana-Pachana, antimicrobial, antioxidant, anti-inflammatory and hepatoprotective properties attributable principally to eugenol and associated phenolic constituents. Standardization approaches employing eugenol as a chemical marker, as demonstrated in HPTLC-based analytical evaluation of Lavangarishta, offer a practical model for the quality assurance of Lavanga-containing classical formulations. Further well-designed clinical trials, dose-toxicity studies and multi-centric pharmacopoeial standardization efforts are recommended to fully translate the substantial preclinical evidence base into validated, evidence-supported therapeutic protocols.

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