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A Review on Polyherbal Formulation of Neem and Tulsi

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Abstract: *Polyherbal formulations, a cornerstone of Ayurvedic medicine, involve the combination of two or more medicinal plants to enhance therapeutic efficacy and reduce toxicity. Ayurveda emphasizes both single-drug therapy and multi-drug formulations, with polyherbal therapy being widely accepted due to synergistic pharmacological effects. Neem (Azadirachta indica) and Tulsi (Ocimum sanctum) are two highly revered medicinal plants in the Indian traditional system of medicine, known for their extensive therapeutic potential. Neem flowers and leaves are rich sources of bioactive compounds such as flavonoids, terpenoids, glycosides, limonoids, and phenolics, exhibiting antioxidant, anti-inflammatory, antimicrobial, immunomodulatory, antidiabetic, anticancer, hepatoprotective, and cardioprotective activities. Tulsi, considered a sacred plant in India, contains essential oils and phytoconstituents like eugenol, ursolic acid, apigenin, and caryophyllene, which contribute to its antioxidant, antimicrobial, antistress, antidiabetic, antiviral, and antifertility properties. This review comprehensively discusses the pharmacological activities, phytochemistry, morphology, safety profile, and cultural significance of Neem and Tulsi. Additionally, the role of analytical techniques such as Thin Layer Chromatography (TLC) and UV–Visible spectroscopy in the evaluation, standardization, and quality control of Neem–Tulsi polyherbal formulations is highlighted. These techniques provide reliable and economical tools for authentication and assessment of herbal formulations, supporting their pharmaceutical and therapeutic relevance.*

Keywords: Polyherbal formulation, Neem, Tulsi, Pharmacological activity, TLC, UV–Visible spectroscopy.

I. INTRODUCTION

Herbal medicines have been used for centuries as primary healthcare remedies across the globe. In Ayurveda, drug formulation is based on two principles: the use of a single drug and the use of multiple drugs in combination. Formulations containing two or more herbs are termed polyherbal formulations. These formulations are preferred due to their synergistic action, improved efficacy, reduced toxicity, and broader therapeutic spectrum.

Neem (*Azadirachta indica*) and Tulsi (*Ocimum sanctum*) are among the most extensively studied medicinal plants in India. Their inclusion in polyherbal formulations is supported by traditional knowledge and modern scientific validation. The present review aims to consolidate available information on the pharmacological activities, chemical constituents, safety evaluation, and analytical assessment of Neem and Tulsi, emphasizing their role in polyherbal drug development.

NEEM (*Azadirachta indica*)

Botanical Description and Taxonomy

Neem belongs to the family Meliaceae and is a medium-sized to large evergreen tree, reaching heights of 15–30 meters. It has a deep taproot system and a wide spreading crown.

Taxonomical Classification:

Kingdom: Plantae
Order: Rutales

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Family: Meliaceae
Genus: *Azadirachta*
Species: *indica*

Synonyms:

Melia azadirachta L.
Melia indica A. Juss
Azadirachta indica var. minor Valeton

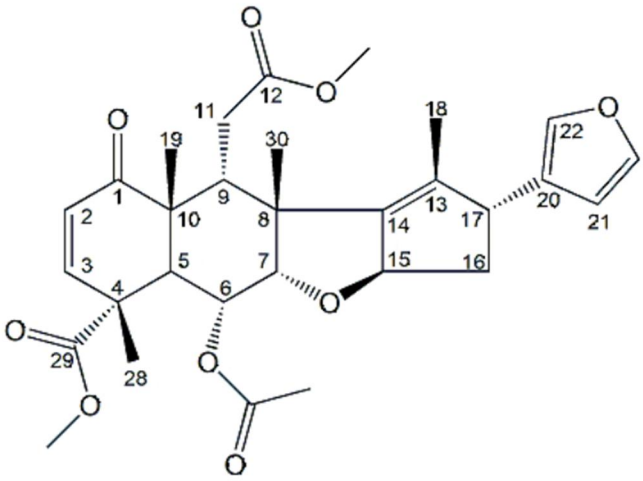
Morphology

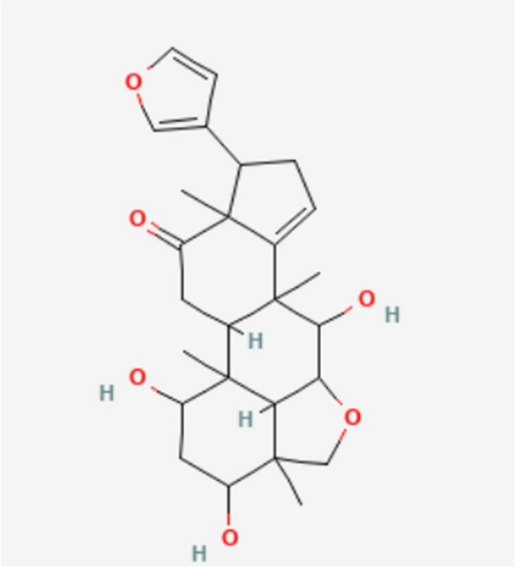
Neem has compound pinnate leaves, grayish-brown bark with fissures, and small white fragrant flowers. The fruit is an olive-like drupe containing a single seed. The bark exudes a sticky sap in humid conditions.

Chemical Constituents of Neem

Neem contains a wide array of bioactive compounds, including:
Limonoids: Azadirachtin, salannin, nimbin, nimbidin, nimbolide
Flavonoids: Quercetin
Sterols: β-sitosterol
Others: Gedunin, ascorbic acid, oleic and palmitic acids

Most active constituents: Nimbin and Nimbidin





Pharmacological Activities of Neem

Antimicrobial Activity

Neem extracts exhibit significant antibacterial, antifungal, and antiviral properties. Studies report effective inhibition against *Candida* species, dermatophytes, *Streptococcus mutans*, and HSV-1 virus.

Antioxidant Activity

Methanolic and ethanolic extracts of neem leaves, flowers, and bark show strong free radical scavenging activity due to high phenolic and flavonoid content.

Anti-inflammatory Activity

Nimbidin inhibits phagocytosis, nitric oxide, and prostaglandin E2 production, thereby reducing inflammatory responses.

Antidiabetic Activity

Neem leaf and root bark extracts significantly reduce blood glucose levels in diabetic animal models.

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Anticancer Activity

Azadirachtin and nimbolide induce apoptosis and cell cycle arrest in cancer cells through modulation of p53 and caspase pathways.

Hepatoprotective and Nephroprotective Effects

Neem extracts protect liver and kidney tissues against chemically induced toxicity by reducing oxidative stress and restoring enzyme levels.

Immunomodulatory Activity

Neem oil enhances cell-mediated immunity and antibody production.

Safety Evaluation of Neem

Although neem is generally safe at therapeutic doses, high doses of compounds such as nimbolide may exhibit cytotoxicity. Nimbidin and azadirachtin are reported to be practically non-toxic at normal doses. Long-term toxicity studies suggest caution during pregnancy and fertility-related use.

TULSI (*Ocimum sanctum*)

Botanical Description and Taxonomy

Tulsi belongs to the family Lamiaceae and is widely cultivated in India for medicinal and religious purposes.

Taxonomical Classification:

- Kingdom: Plantae
- Order: Lamiales
- Family: Lamiaceae
- Genus: *Ocimum*
- Species: *O. sanctum*

Types:

- Krishna Tulsi (Black)
- Rama Tulsi (Green)

Morphology

Tulsi is an erect, aromatic, herbaceous plant with hairy leaves and quadrangular stems. The leaves are elliptic, serrated, and possess a characteristic aroma.

Chemical Constituents of Tulsi

Major constituents include:

- Eugenol
- Ursolic acid
- Apigenin
- Caryophyllene
- Linalool
- Thymol

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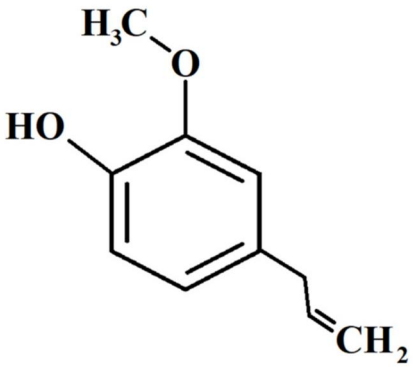
Most active constituent: Eugenol



Pharmacological Activities of Tulsi

Antimicrobial and Antiviral Activity

Tulsi essential oil exhibits strong antibacterial and antiviral effects against various pathogens.

Antidiabetic Activity

Aqueous extracts reduce blood glucose levels and improve insulin sensitivity.

Anti-stress and Adaptogenic Activity

Tulsi improves stress tolerance and normalizes physiological functions.

Antifertility Activity

Ursolic acid exhibits antifertility effects by reducing spermatogenesis.

Hepatoprotective and Anti-inflammatory Activity

Tulsi protects liver tissues and reduces inflammation via antioxidant mechanisms.

Cultural and Religious Importance of Tulsi

Tulsi is revered as a sacred plant in Hindu tradition and is worshipped daily in Indian households. It symbolizes purity, longevity, and spiritual well-being.

ANALYTICAL TECHNIQUES FOR POLYHERBAL EVALUATION

Thin Layer Chromatography (TLC)

TLC is a rapid and economical method used for separation, identification, and purity assessment of phytoconstituents.

Applications:

- Identification of compounds
- Quality control
- Herbal fingerprinting

Advantages: Simple, fast, cost-effective.

Limitations: Qualitative, sensitive to environmental conditions

UV–Visible Spectroscopy

UV–Vis spectroscopy measures absorbance in the 200–800 nm range and is widely used in herbal analysis.

Applications:

- Detection of chromophores
- Quantitative estimation
- Standardization of extracts

Advantages: Easy operation, low cost.

Limitations: Low specificity, interference from impurities

Paper Title	Authors	Year	Journal Name	Conclusion
Formulation and Evaluation of Polyherbal Gel containing	Jyoti Bhati, Anuj Mittal	2025	*Journal of Neonatal Surgery*	The polyherbal gel with Neem and Tulsi extracts showed significant

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***Azadirachta indica* (Neem), *Ocimum sanctum* (Tulsi), and *Trigonella foenum-graecum* (Fenugreek) for Antifungal Action**				antifungal activity, good physicochemical properties (pH, viscosity, spreadability), and promising potential as a natural alternative to synthetic antifungals. PHG4 (4% extract) exhibited optimal antifungal zone of inhibition close to standard fluconazole.
RESEARCH ON FORMULATION AND EVALUATION OF HERBAL BATH SOAP OF NEEM & TULSI	Ashish Shivaji Bagal et al.	2025	*International Journal of Science and Innovation Engineering (IJSCI)*	A Neem–Tulsi herbal soap was formulated with antimicrobial, skin-friendly properties. It exhibited a skin-compatible pH and antibacterial activity against common pathogens, supporting the use of natural ingredients in personal care products.
Formulation And Evaluation of Herbal Neem and Tulsi Soap for Enhanced Skin Care Applications	Tanvir Shaikh, Neha Jagdish Dhurekar, Sandip Pawar et al.	2024	*African Journal of Biomedical Research*	Herbal soap combining Neem and Tulsi powders demonstrated antimicrobial effects against dermatophytes and antimicrobial/skin health benefits, highlighting the synergy of the herbs in skincare formulations.
Formulation and evaluation of Polyherbal tablet using Neem, Tulsi, Turmeric and Ginger extract	Souvik Paul, Tanmoy Dey, Prabin Koirala et al.	2023	*Journal of Drug Delivery and Therapeutics*	A polyherbal tablet with Neem and Tulsi along with other herbs showed effective formulation properties and suggested enhanced therapeutic effects with reduced toxicity. This supports the benefit of multi-herb combinations in oral delivery.

The polyherbal formulation of *Azadirachta indica* and *Ocimum sanctum* demonstrates significant antimicrobial, antioxidant, and therapeutic potential. TLC and UV–Visible spectroscopy provide reliable, rapid, and economical tools for the evaluation and standardization of such formulations. The synergistic action of Neem and Tulsi supports their application as a natural, safe, and effective polyherbal formulation for pharmaceutical and medicinal use.

II. RESULTS AND DISCUSSION

The present review highlights the scientific rationale and therapeutic relevance of a polyherbal formulation containing *Azadirachta indica* (Neem) and *Ocimum sanctum* (Tulsi). Both plants possess a rich phytochemical profile and have been extensively validated for their pharmacological properties through traditional use and modern research.

Phytochemical and Pharmacological Findings

Neem was found to be rich in limonoids (azadirachtin, nimbin, nimbidin, nimbolide), flavonoids such as quercetin, sterols, and phenolic compounds. These constituents collectively contribute to its broad-spectrum pharmacological activities, including antimicrobial, antioxidant, anti-inflammatory, antidiabetic, anticancer, hepatoprotective, nephroprotective, and immunomodulatory effects. The presence of nimbin and nimbidin as major active constituents plays a crucial role in anti-inflammatory and antimicrobial responses by inhibiting mediators such as nitric oxide and prostaglandins.

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Tulsi contains essential oils and bioactive phytoconstituents such as eugenol, ursolic acid, apigenin, caryophyllene, and linalool. These compounds are responsible for its antimicrobial, antiviral, antioxidant, antistress, antidiabetic, hepatoprotective, and adaptogenic properties. Eugenol, the most active constituent, is particularly associated with antimicrobial and anti-inflammatory activity, while ursolic acid contributes to hepatoprotective and antifertility effects.
When combined, Neem and Tulsi exhibit **synergistic pharmacological activity**, enhancing therapeutic efficacy while potentially reducing toxicity. This synergy supports the Ayurvedic principle that polyherbal formulations are more effective than single-drug therapy.

Analytical Evaluation Using TLC and UV–Visible Spectroscopy

Thin Layer Chromatography (TLC) was identified as an effective qualitative analytical technique for the separation and identification of phytoconstituents present in the Neem–Tulsi polyherbal extract. TLC fingerprinting revealed the presence of multiple bioactive compounds, confirming the complexity and polyherbal nature of the formulation. The technique also aids in authentication, detection of adulteration, and quality control of herbal formulations.
UV–Visible spectroscopy further supported the presence of flavonoids, phenolics, and essential oils by exhibiting characteristic absorption maxima in the UV–visible region. This method proved useful for preliminary qualitative and quantitative estimation of phytochemicals and for standardization of the extract. Although UV–Vis spectroscopy has limitations such as low specificity and interference from impurities, its simplicity, cost-effectiveness, and reproducibility make it suitable for routine herbal analysis.

Evidence from Recent Polyherbal Formulation Studies

Recent formulation-based studies (2023–2025) demonstrate successful incorporation of Neem and Tulsi in various dosage forms such as gels, soaps, and tablets. These formulations consistently showed antimicrobial and antifungal activity, acceptable physicochemical parameters, and improved skin or therapeutic benefits. The findings from these studies confirm that Neem–Tulsi combinations are suitable for topical as well as oral polyherbal formulations and validate their use in pharmaceutical and cosmeceutical applications.

SAFETY CONSIDERATIONS

Safety evaluation indicates that Neem and Tulsi are generally safe at therapeutic doses. While certain Neem constituents like nimbolide may show cytotoxicity at higher concentrations, compounds such as nimbidin and azadirachtin are reported to be practically non-toxic. Tulsi is also considered safe but should be used cautiously for antifertility-related effects. Overall, the combination appears safe when used within recommended limits.

III. CONCLUSION

The polyherbal formulation of *Azadirachta indica* (Neem) and *Ocimum sanctum* (Tulsi) demonstrates significant antimicrobial, antioxidant, anti-inflammatory, antidiabetic, and therapeutic potential due to the presence of diverse and potent bioactive phytoconstituents. The synergistic interaction between Neem and Tulsi supports the traditional Ayurvedic concept that polyherbal formulations offer enhanced efficacy and reduced toxicity compared to single-herb formulations. Analytical techniques such as Thin Layer Chromatography (TLC) and UV–Visible spectroscopy were found to be reliable, rapid, and economical tools for the evaluation, authentication, and standardization of Neem–Tulsi polyherbal formulations. These methods aid in ensuring quality, purity, consistency, and safety of herbal products. Based on the reviewed literature and analytical findings, Neem–Tulsi polyherbal formulations can be considered promising natural alternatives for the management of microbial infections and oxidative stress-related disorders. Further studies involving advanced analytical techniques, in-vivo pharmacological evaluation, and clinical trials are recommended to fully establish their therapeutic efficacy and commercial applicability.

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