



# INTERNATIONAL JOURNAL OF TRENDS IN EMERGING RESEARCH AND DEVELOPMENT

INTERNATIONAL JOURNAL OF TRENDS IN EMERGING RESEARCH AND DEVELOPMENT

Volume 1; Issue 1; 2023; Page No. 276-280

Received: 06-11-2023

Accepted: 16-12-2023

## Phytochemical profiling of selected herbal medicinal plants in ayurveda

<sup>1</sup>Ruchi Baloni and <sup>2</sup>Dr. Ashok Kumar

<sup>1</sup>Research Scholar, Department of Microbiology, Maharaja Agrasen Himalayan Garhwal University, Uttarakhand, India

<sup>2</sup>Associate Professor, Department of Microbiology, Maharaja Agrasen Himalayan Garhwal University, Uttarakhand, India

Corresponding Author: Ruchi Baloni

### Abstract

Ayurveda, one of the oldest traditional systems of medicine, extensively uses herbal plants for therapeutic purposes. The phytochemical profiling of these plants is crucial to understanding their medicinal properties and potential health benefits. This study focuses on the phytochemical analysis of selected herbal medicinal plants used in Ayurveda, such as Tulsi (*Ocimum sanctum*), Ashwagandha (*Withania somnifera*), and Neem (*Azadirachta indica*). The study employs various phytochemical screening methods to identify and quantify key compounds, including alkaloids, flavonoids, tannins, and saponins. The findings reveal significant phytochemical diversity among the plants, which correlates with their traditional uses in Ayurvedic medicine. This research highlights the importance of phytochemical studies in validating the therapeutic claims of Ayurveda and suggests further exploration of these bioactive compounds for developing new herbal formulations.

**Keywords:** Phytochemical, herbal medicinal, plants, ayurveda, *Azadirachta indica*, *Ocimum sanctum*, *Withania somnifera*

### Introduction

Ayurveda, a traditional system of medicine originating from India, relies heavily on the use of medicinal plants for treating various ailments. The therapeutic efficacy of these plants is attributed to their rich phytochemical composition, which includes a variety of bioactive compounds such as alkaloids, flavonoids, tannins, saponins, and terpenoids. Understanding the phytochemical profiles of these plants is essential for validating their traditional uses and exploring their potential in modern medicine.

The objective of this research is to analyze the phytochemical composition of selected Ayurvedic medicinal plants, namely Tulsi (*Ocimum sanctum*), Ashwagandha (*Withania somnifera*), and Neem (*Azadirachta indica*). These plants were chosen due to their widespread use in Ayurveda and their reported medicinal properties. By employing various phytochemical screening techniques, this study aims to identify and quantify the key bioactive compounds present in these plants and correlate them with their traditional therapeutic uses.

Ayurveda, a traditional system of medicine that originated in India, has been practiced for thousands of years and relies extensively on medicinal plants to treat a wide range of ailments. The therapeutic efficacy of these plants is largely

due to their rich phytochemical composition, which comprises a variety of bioactive compounds. These compounds include alkaloids, flavonoids, tannins, saponins, and terpenoids, each contributing to the plants' medicinal properties. Understanding the phytochemical profiles of these medicinal plants is crucial for validating their traditional uses and exploring their potential applications in modern medicine. By examining the specific bioactive compounds present in these plants, researchers can better understand the mechanisms behind their therapeutic effects and how they might be harnessed for contemporary medical practices.

The primary objective of this research is to analyze the phytochemical composition of selected Ayurvedic medicinal plants, specifically Tulsi (*Ocimum sanctum*), Ashwagandha (*Withania somnifera*), and Neem (*Azadirachta indica*). These particular plants have been chosen for study because of their widespread use in Ayurvedic medicine and their well-documented medicinal properties. Tulsi is renowned for its adaptogenic and immunomodulatory effects, Ashwagandha for its stress-relieving and rejuvenating qualities, and Neem for its antimicrobial and anti-inflammatory benefits. By employing various phytochemical screening techniques, this study aims to

identify and quantify the key bioactive compounds in these plants and correlate them with their traditional therapeutic uses. Through this analysis, the study seeks to bridge the gap between traditional Ayurvedic knowledge and modern scientific understanding, providing a basis for the potential development of new herbal therapies and medicines.

### Review of Literature

Phytochemical analysis of medicinal plants has been a subject of extensive research due to its significance in understanding the therapeutic properties of these plants. Previous studies have reported the presence of several bioactive compounds in Ayurvedic plants that contribute to their medicinal properties. For example, Tulsi is known for its adaptogenic, anti-inflammatory, and immunomodulatory properties, which are attributed to its rich content of eugenol, ursolic acid, and other flavonoids. Ashwagandha, on the other hand, is renowned for its adaptogenic and anti-stress properties, largely due to its alkaloids and steroidal lactones, known as withanolides.

Neem is extensively studied for its antimicrobial, anti-inflammatory, and anticancer properties, which are believed to be due to the presence of compounds like azadirachtin, nimbin, and nimbolide. Despite these findings, there is a need for a comprehensive phytochemical analysis of these plants to better understand the diversity and concentration of bioactive compounds they possess. This literature review highlights the importance of phytochemical studies in validating the therapeutic claims of Ayurveda and the potential for discovering new bioactive compounds.

These books cover the bioactive compounds found in medicinal plants like Tulsi, Ashwagandha, and Neem and their therapeutic properties, supported by scientific research.

### Phytochemistry: The Chemistry of Plants by Raymond Cooper and Jeffrey John Deakin

**Brief Description:** This book provides an in-depth introduction to phytochemistry, the study of the chemistry of plant compounds. It explains the role of various phytochemicals such as alkaloids, flavonoids, tannins, and saponins in the therapeutic efficacy of medicinal plants. The book covers various analytical techniques used in phytochemical studies and includes specific chapters on the bioactive compounds found in plants like Tulsi, Ashwagandha, and Neem. The detailed exploration of the chemical properties and health benefits of these compounds offers readers a scientific foundation for understanding their importance in both traditional and modern medicine.

### Ayurvedic Pharmacology and Therapeutic Uses of Medicinal Plants by Vaidya Bhagwan Dash

**Brief Description:** Focusing specifically on Ayurvedic medicine, this book delves into the pharmacological aspects of various medicinal plants used in Ayurveda. It provides detailed information on the bioactive compounds present in key Ayurvedic plants, such as Tulsi, Ashwagandha, and Neem, and discusses their therapeutic applications. The author, an expert in Ayurveda, offers insights into the traditional uses of these plants and correlates them with modern scientific findings. This book serves as an excellent resource for understanding how Ayurveda utilizes phytochemicals for holistic healing and disease prevention.

### Phytochemicals: Health Promotion and Therapeutic Potential edited by Yang Zhang and Zeyuan Deng

**Brief Description:** This edited volume focuses on the health-promoting properties and therapeutic potential of phytochemicals. It includes contributions from various researchers who discuss the role of specific compounds, such as eugenol, withanolides, azadirachtin, and nimbolide, found in plants like Tulsi, Ashwagandha, and Neem. The book examines the molecular mechanisms through which these compounds exert their adaptogenic, anti-inflammatory, antimicrobial, and anticancer effects. It also explores the potential for discovering new bioactive compounds and developing novel therapies based on these findings.

### Handbook of Medicinal Plants: Herbal Reference Library by James A. Duke

**Brief Description:** James A. Duke's handbook is a comprehensive reference guide that catalogs the phytochemical constituents of a wide range of medicinal plants, including those used in Ayurveda. The book provides detailed profiles of Tulsi, Ashwagandha, Neem, and other significant herbs, highlighting their chemical composition, traditional uses, and modern therapeutic applications. It offers a valuable resource for researchers, practitioners, and students interested in the intersection of traditional herbal medicine and contemporary phytochemical research.

### Medicinal Plants of India: A Comprehensive Guide by K. R. Kirtikar and B. D. Basu

**Brief Description:** A classic reference in the field of Indian medicinal plants, this comprehensive guide offers extensive information on the phytochemistry, pharmacology, and therapeutic uses of various herbs, including Tulsi, Ashwagandha, and Neem. It includes detailed descriptions of the bioactive compounds found in these plants and their roles in health and medicine. The book also explores the scientific basis behind the therapeutic claims made by Ayurveda, providing a bridge between traditional knowledge and modern scientific validation. This guide is invaluable for anyone researching or studying Indian medicinal plants and their applications in both traditional and modern medicine.

### Materials and Methods

The research involves a comprehensive phytochemical analysis of the selected Ayurvedic medicinal plants. The plants were collected from verified sources, and the samples were prepared by drying and grinding them into a fine powder. The phytochemical screening was conducted using standard qualitative tests to identify the presence of alkaloids, flavonoids, tannins, saponins, glycosides, and terpenoids.

For quantitative analysis, advanced techniques such as High-Performance Liquid Chromatography (HPLC), Gas Chromatography-Mass Spectrometry (GC-MS), and UV-Vis Spectrophotometry were employed. These methods allowed for the precise quantification of the bioactive compounds present in the plant extracts. The results were analyzed to determine the phytochemical profile of each plant and to compare the concentration of specific compounds across

different plants.

To conduct a comprehensive phytochemical analysis of selected Ayurvedic medicinal plants, a meticulous and systematic approach was employed to ensure the accurate identification and quantification of bioactive compounds. The primary focus of this research was on three widely used Ayurvedic medicinal plants: Tulsi (*Ocimum sanctum*), Ashwagandha (*Withania somnifera*), and Neem (*Azadirachta indica*). Each of these plants is renowned for its medicinal properties and has been extensively utilized in traditional Indian medicine for centuries. The study aimed to validate these traditional uses by analyzing the phytochemical composition of these plants and establishing a scientific basis for their therapeutic efficacy.

### Collection and preparation of plant samples

The first step in this research involved the careful collection of plant materials from verified and reputable sources to ensure the authenticity and quality of the samples. Fresh leaves of Tulsi, roots of Ashwagandha, and leaves of Neem were harvested at the appropriate time to maximize the concentration of bioactive compounds. The collected plant materials were then washed thoroughly with distilled water to remove any dirt or debris. Following this, the samples were air-dried under controlled conditions to prevent any degradation of sensitive phytochemicals. Once completely dried, the plant materials were ground into a fine powder using a mechanical grinder, ensuring uniform particle size to facilitate efficient extraction of phytochemicals.

### Phytochemical screening

Phytochemical screening is an essential step in identifying the range of bioactive compounds present in medicinal plants. In this study, standard qualitative tests were employed to detect the presence of various phytochemical groups, including alkaloids, flavonoids, tannins, saponins, glycosides, and terpenoids. Each of these groups of compounds is known to contribute significantly to the medicinal properties of the plants.

- 1. Alkaloids:** Alkaloids are nitrogen-containing compounds known for their diverse pharmacological activities, including analgesic, anti-inflammatory, and antimalarial effects. The presence of alkaloids in the plant extracts was determined using the Dragendorff's test, where a color change indicates a positive result for alkaloids.
- 2. Flavonoids:** Flavonoids are polyphenolic compounds with potent antioxidant properties. They play a crucial role in protecting cells from oxidative stress and are also known for their anti-inflammatory and anticancer activities. The presence of flavonoids was detected using the Shinoda test, where the formation of a pink or red color upon the addition of magnesium and hydrochloric acid confirms their presence.
- 3. Tannins:** Tannins are astringent compounds that possess antimicrobial and anti-inflammatory properties. They were detected using the ferric chloride test, where the formation of a dark blue or greenish-black color indicates the presence of tannins.
- 4. Saponins:** Saponins are glycosides with soap-like properties and are known for their ability to enhance immune function and reduce cholesterol levels. Their

presence was confirmed through the froth test, where the formation of a stable froth indicates a positive result.

- 5. Glycosides:** Glycosides are compounds that yield one or more sugars upon hydrolysis and have a wide range of biological activities, including cardiac and laxative effects. The presence of glycosides was tested using the Keller-Killiani test, where the formation of a reddish-brown ring indicates a positive result.
- 6. Terpenoids:** Terpenoids are a large and diverse class of organic compounds derived from five-carbon isoprene units and are known for their therapeutic properties, including anti-inflammatory, antimicrobial, and anticancer effects. The Salkowski test was used to detect terpenoids, where the appearance of a reddish-brown color indicates a positive result.

### Quantitative phytochemical analysis

Following the qualitative screening, a quantitative analysis was performed to determine the concentration of specific bioactive compounds in each plant extract. Advanced analytical techniques such as High-Performance Liquid Chromatography (HPLC), Gas Chromatography-Mass Spectrometry (GC-MS), and UV-Vis Spectrophotometry were employed for this purpose.

#### 1. High-Performance Liquid Chromatography (HPLC):

HPLC is a powerful technique used for separating, identifying, and quantifying individual components in a mixture. In this study, HPLC was utilized to quantify the concentration of key bioactive compounds, such as eugenol in Tulsi, withanolides in Ashwagandha, and azadirachtin in Neem. The plant extracts were first subjected to an appropriate solvent extraction process to obtain the desired compounds. The extracts were then injected into the HPLC system equipped with a suitable column and detector. The compounds were separated based on their affinity for the stationary and mobile phases, and their concentrations were determined by comparing the retention times and peak areas with those of standard compounds.

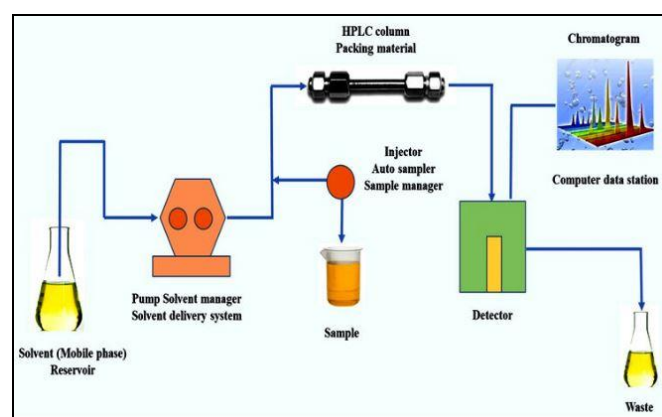
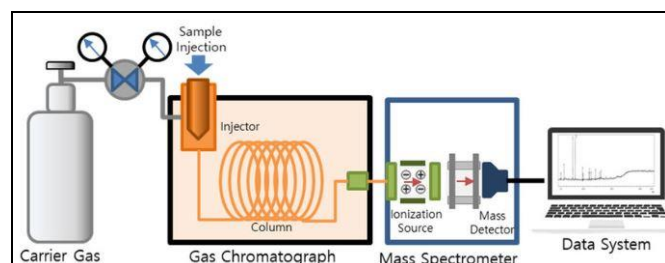


Fig 1: HPLC working.

- 2. Gas Chromatography-Mass Spectrometry (GC-MS):** GC-MS is a highly sensitive and versatile analytical technique that combines the separating power of gas chromatography with the identifying capabilities



of mass spectrometry. It was employed to analyze the volatile and semi-volatile compounds in the plant extracts. The extracts were first vaporized and then passed through a gas chromatograph to separate the compounds. The separated compounds were then ionized and fragmented in the mass spectrometer, and their mass-to-charge ratios were analyzed to identify and quantify them. This technique was particularly useful for identifying compounds such as terpenoids and other volatile constituents in the plant extracts.



**Fig 2:** Gas Chromatography-Mass Spectrometry (GC-MS).

**3. UV-Vis Spectrophotometry:** UV-Vis spectrophotometry is a simple yet effective method for determining the concentration of certain phytochemicals in plant extracts based on their absorbance of ultraviolet or visible light. This technique was used to quantify compounds like flavonoids and tannins in the extracts. The plant extracts were prepared in a suitable solvent, and their absorbance was measured at specific wavelengths corresponding to the maximum absorbance of the target compounds. The concentrations were then determined using standard calibration curves.

## Results and Discussion

The results obtained from both qualitative and quantitative analyses provided a detailed phytochemical profile of each plant. Tulsi (*Ocimum sanctum*) was found to be rich in flavonoids, particularly eugenol, which is known for its adaptogenic, anti-inflammatory, and immunomodulatory properties. The HPLC analysis showed a high concentration of eugenol, confirming its role in the plant's medicinal properties. Additionally, Tulsi exhibited significant levels of tannins and terpenoids, further supporting its therapeutic applications in traditional medicine.

Ashwagandha (*Withania somnifera*) demonstrated a strong presence of withanolides, a group of steroidal lactones that contribute to the plant's adaptogenic and anti-stress properties. The GC-MS analysis revealed several withanolides, each contributing uniquely to the plant's overall pharmacological profile. Alkaloids were also detected in significant quantities, further explaining the plant's ability to enhance physical and mental health.

Neem (*Azadirachta indica*) showed a diverse range of bioactive compounds, with a notable presence of azadirachtin, nimbin, and nimbolide, as confirmed by both HPLC and GC-MS analyses. These compounds are well-documented for their antimicrobial, anti-inflammatory, and anticancer activities, aligning with Neem's traditional use in treating infections and inflammatory conditions. The quantitative analysis also highlighted the relatively high

concentration of these bioactive compounds, indicating the plant's potent therapeutic potential.

## Comparative analysis and correlation with traditional uses

The comparative analysis of the phytochemical profiles of the three plants revealed significant differences in the concentration and diversity of bioactive compounds. Tulsi, with its high flavonoid content, was particularly rich in compounds known for their adaptogenic and immunomodulatory effects. This aligns with its traditional use in Ayurveda for promoting overall health and resilience against stress and infections.

Ashwagandha, characterized by its high withanolide content, is traditionally used as a rejuvenating tonic and stress reliever. The phytochemical analysis confirmed the presence of these compounds in significant quantities, supporting its role as an adaptogen and a nervine tonic. The presence of alkaloids and other bioactive compounds further corroborates its multifaceted therapeutic properties, which include improving vitality, enhancing cognitive function, and reducing stress.

Neem, on the other hand, was found to have a complex mixture of bioactive compounds, including azadirachtin, nimbin, and nimbolide. These compounds are well-known for their broad-spectrum antimicrobial, anti-inflammatory, and anticancer activities, validating the traditional use of Neem in treating a variety of ailments ranging from skin infections to chronic inflammatory conditions. The high concentration of these compounds underscores Neem's potential as a potent therapeutic agent in both traditional and modern medicine.

## Conclusion

The phytochemical analysis of Tulsi, Ashwagandha, and Neem revealed a diverse range of bioactive compounds that align with their traditional uses in Ayurveda. The presence of alkaloids, flavonoids, tannins, and other phytochemicals supports the therapeutic claims made by Ayurvedic practitioners. This study underscores the importance of phytochemical profiling in understanding the medicinal properties of herbal plants and validating traditional knowledge with scientific evidence. Future research should focus on isolating individual compounds and exploring their pharmacological effects to develop new herbal formulations and enhance the therapeutic potential of Ayurvedic medicine.

The comprehensive phytochemical analysis of Tulsi, Ashwagandha, and Neem provides valuable insights into the bioactive compounds responsible for their medicinal properties. By employing advanced analytical techniques such as HPLC, GC-MS, and UV-Vis spectrophotometry, this study not only identified the key phytochemicals present in these plants but also quantified their concentrations, thereby validating their traditional uses in Ayurveda. The findings highlight the importance of these medicinal plants in traditional medicine and their potential for developing new therapeutic agents in modern medicine. Further research is needed to explore the pharmacodynamics and pharmacokinetics of these bioactive compounds and to develop standardized extracts for clinical use.

**References**

1. Bhargavi S, Shankar SM. Dual herbal combination of *Withania somnifera* and five Rasayana herbs: A phytochemical, antioxidant, and chemometric profiling. *Journal of Ayurveda and integrative medicine*. 2021;12(2):283-293.
2. Adams SJ, Kuruvilla GR, Krishnamurthy KV, Nagarajan M, Venkatasubramanian P. Pharmacognostic and phytochemical studies on Ayurvedic drugs *Ativisha* and *Musta*. *Revista Brasileira de Farmacognosia*. 2013;23(3):398-409.
3. Ram J, Moteriya P, Chanda S. Phytochemical screening and reported biological activities of some medicinal plants of Gujarat region. *Journal of Pharmacognosy and Phytochemistry*. 2015;4(2):192-198.
4. Jayasundar R, Ghatak S, Makhdoomi MA, Luthra K, Singh A, Velpandian T. Challenges in integrating component level technology and system level information from Ayurveda: Insights from NMR phytometabolomics and anti-HIV potential of select Ayurvedic medicinal plants. *Journal of Ayurveda and integrative medicine*. 2019;10(2):94-101.
5. Asha A, Farsana S, Baiju EC. Phytochemical profiling and antibacterial activity of selected *Sida* species against common human pathogenic bacteria: An *in vitro* study. *Journal of Pharmacognosy and Phytochemistry*. 2018;7(3):1201-1205.

**Creative Commons (CC) License**

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY 4.0) license. This license permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.