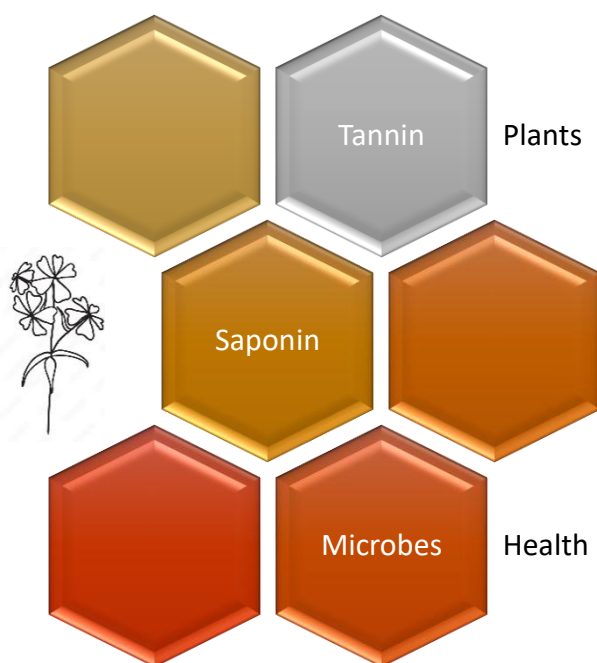


PLANTS & SECONDARY METABOLITES

VOLUME IV

Emdad Hossain • Bidhan Chandra Roy
Nibedita Jena • Sanjeet Kumar



Plants & Secondary Metabolites

Volume 4

Emdad Hossain
Bidhan Chandra Roy
Nibedita Jena
Sanjeet Kumar



Editors



Emdad Hossain

Department of Pharmaceutical Technology, Jadavpur University,
Kolkata, West Bengal, India

Bidhan Chandra Roy

Department of Botany, Dinabandhu Mahavidyalaya, Bongaon, West
Bengal, India

Nibedita Jena

Ambika Prasad Research Foundation, Odisha, India

Sanjeet Kumar

Ambika Prasad Research Foundation, Odisha, India

Title – Plants & Secondary Metabolites, Volume IV

ISBN: 978-81-973870-0-5

Published by: APRF Publishers, Odisha

An institutional publication of Ambika Prasad Research Foundation, India

Plants & Secondary Metabolites, Volume IV

First Edition: 2025

Copyright © Ambika Prasad Research Foundation

The content of this book is tried best to provide authenticated information. All the references necessary are listed. All attempts have been made to publish reliable information and acknowledge the copyright holders. If any copyright material(s) have not been acknowledged, please inform us so we may rectify it in our future reprints.

Cover Page: Block tiles of secondary metabolites

Price: Rs. 950/-

Citation: Hossain E, Roy BC, Jena N and Kumar S. (2025). Plants and Secondary Metabolites, Volume IV. Ambika Prasad Research Foundation, India.



CONTRIBUTORS

Alok Ranjan Sahu, Department of Botany, Vikash Degree College, Bargarh, Odisha, India

Arjun Patra, Department of Botany, P.K. College, Contai, West Bengal, India

Balkar Singh, Department of Botany, Arya P.G. College, Panipat, Haryana, India

Bhagwati Prashad Sharma, Department of Botany, Sidharth Government College Nadaun, Himachal Pradesh, India

Bidhan Chandra Roy, Department of Botany, Dinabandhu Mahavidyalaya, Bongaon, West Bengal, India

Binod Kumar Mahapatra, Post Graduate Department of Botany, P.N. College Autonomous, Khordha, Odisha, India

Debasmita Mahanta, Department of H & T, Government of Odisha, India

Divya Jain, Department of Botany, Sanatan Dharma College, Ambala Cantt, Haryana, India

Emdad Hossain, Department of Pharmaceutical Technology, Jadavpur University, Kolkata, West Bengal, India

Ganesh Kumar, Department of Botany, MLS Government Girls' College, Jaisalmer, Rajasthan, India

Gireesh Tripathi, Department of Pharmacy, Shri Krishna University, NH Sagar Road, Chhatarpur, Madhya Pradesh, India

J Jeline Rani, Department of Botany, Bishop Heber College, Tiruchirappalli, Tamil Nadu, India

Jyoti Chauhan, Department of Botany, Institute of Integrated and Honors Studies, Kurukshetra University, Kurukshetra, Haryana, India

Jyoti J Kshirsagar, Department of Botany, Saw K.S.K College Beed, Maharashtra, India

Kadambini Das, University Department of Botany, Babasaheb Bhimrao Ambedkar Bihar University, Muzaffarpur, Bihar, India

Manas Jyoti Kapil, Department of Pharmaceutics, Royal School of Pharmacy, The Assam Royal Global University, Guwahati, Assam, India

Manvi Malwal, Department of Botany, Post Graduate Govt College for Girls, Sector-11, Chandigarh, India

Neelakshi Sharma, Department of Pharmacognosy, Royal School of Pharmacy, The Assam Royal Global University, Guwahati, Assam, India

Nibedita Jena, Ambika Prasad Research Foundation, Odisha, India

Nihar Ranjan Nayak, Department of Botany, Maa Manikeshwari University, Bhawanipatna, Kalahandi, Odisha, India

Poonam Dilip Sable, Department of Dravyaguna Vigyana, Pharate Patil Ayurvedic Medical college, Mandavgan pharata, Pune, India

Priya Darshani, Department of Pharmacognosy, Institute of Teaching and Research in Ayurveda, Jamnagar, Gujarat, India

Rahul Uniyal, Department of Agroforestry, VCSG UUHF College of Forestry, Ranichauri, Tehri Garhwal, Uttarakhand, India

Rajesh Kumar Verma, Department of Dravyaguna, Naiminath Ayurvedic Medical College and Research Centre, Agra, Uttar Pradesh, India

Sanjeet Kumar, Ambika Prasad Research Foundation, Odisha, India

Shreya Pattanayak, Department of Biotechnology, Odisha University of Technology and Research, Bhubaneswar, Odisha, India

Shruti Rathore, Chouksey College of Pharmacy, Lalkhadan, Bilaspur, Chhattisgarh, India

Sohan Lal, School of Studies in Botany, Shaheed Mahendra Karma Vishwavidhyalaya, Bastar, Jagdalpur, Chhattisgarh, India

Sonalaxmi Thapa, Sravanti Serenity 2, Botanical Garden Road, Kondapur Hyderabad, Telangana, India

Subhalakshmi Rout, Ambika Prasad Research Foundation, Odisha, India

Suchitra Boxi, Department of Botany, Davangere University, Karnataka, India

Vikas Tailor, Department of Biology, Swami Vivekanand Government Model School, Block Asind, Bhilwara, Rajasthan, India

Preface

The book "Plants & Secondary Metabolites, Volume 4" presents a comprehensive overview of the phytochemical analysis and medicinal properties of various plant species. The volume comprises nine chapters, each focusing on a specific plant species, including *Cordia myxa*, *Shorea robusta*, *Boswellia serrata*, *Soyimida febrifuga*, *Eranthemum nervosum*, *Drimia indica*, *Symphorema involucratum*, *Vitex negundo*, and *Oroxylum indicum*. These plant species have been traditionally used in various cultures for their medicinal and therapeutic properties. The chapters in this volume provide an in-depth analysis of the phytochemical constituents present in each plant species, including alkaloids, flavonoids, phenolic acids, and terpenoids. The volume also discusses the medicinal properties and potential applications of each plant species, including their antioxidant, anti-inflammatory, antimicrobial, and anticancer activities. This book will serve as a valuable resource for researchers, scientists, and students in the fields of phytochemistry, pharmacology, and botany. The information presented in this volume will contribute significantly to our understanding of the phytochemical composition and medicinal properties of various plant species, and will pave the way for further research into the development of new drugs and therapies from natural sources.

Editors

Background

Plants have been an integral part of human life since ancient times, providing food, shelter, clothing, and medicine. The medicinal properties of plants have been exploited for centuries, with many traditional systems of medicine relying heavily on plant-based remedies. In recent years, there has been a growing interest in the phytochemical analysis and medicinal properties of plants, driven by the need to develop new and effective treatments for various diseases. Despite the significant progress made in the field of phytochemistry, there is still a need for comprehensive and authoritative texts that provide detailed information on the phytochemical composition and medicinal properties of various plant species. This book aims to fill this knowledge gap by providing a comprehensive overview of the phytochemical analysis and medicinal properties of nine plant species. The book will serve as a valuable resource for researchers, scientists, and students in the fields of phytochemistry, pharmacology, and botany. This book will be useful for several reasons. Firstly, it provides a comprehensive overview of the phytochemical composition and medicinal properties of nine plant species, which will be valuable for researchers and scientists working in the field of phytochemistry. Secondly, the book discusses the potential applications of each plant species, which will be useful for industries involved in the development of herbal remedies and natural products. Finally, the book provides a detailed analysis of the phytochemical constituents present in each plant species, which will be valuable for students and researchers interested in the field of phytochemistry. The information presented in this book will contribute significantly to our understanding of the phytochemical composition and medicinal properties of various plant species. Future works should focus on isolating and characterizing the

bioactive compounds present in each plant species, as well as evaluating their pharmacological properties and potential applications. Additionally, further research is needed to explore the potential of these plant species in the development of new and effective treatments for various diseases.

CONTENTS

Chapters	Title	Author's Name	Page No.
Chapter 1	Qualitative analysis of secondary metabolites in <i>Cordia myxa</i> L. fruits: a multipurpose tree species	Arjun Patra, Emdad Hossain, Bidhan Chandra Roy, Sohan Lal, Nibedita Jena and Sanjeet Kumar	1-7
Chapter 2	Qualitative phytochemical analysis of fruits of <i>Shorea robusta</i> C.F. Gaertn.	Priya Darshani, Neelakshi Sharma, Manas Jyoti Kapil, Rahul Uniyal, Debasmita Mahanta, Nibedita Jena and Sanjeet Kumar	8-17
Chapter 3	Medicinal values and phytochemical screening of fruits of Indian franchincense (<i>Boswellia serrata</i>) Roxb.	Ganesh Kumar, Rajesh Kumar Verma, Poonam Dilip Sable, Sohan Lal, Nibedita Jena and Sanjeet Kumar	18-28
Chapter 4	Phytochemical investigation of fruits of <i>Soyimida febrifuga</i> (Roxb.) A. Juss.: a medicinally important tree species in India	Bidhan Chandra Roy, Vikas Tailor, Nibedita Jena and Sanjeet Kumar	29-39
Chapter 5	Phytochemical profiling of flowers of <i>Eranthemum nervosum</i> (Acanthaceae)	Kadambini Das, Balkar Singh, Jyoti Chauhan, Binod Kumar Mahapatra, Subhalakshmi Rout and Sanjeet Kumar	40-51

Chapter 6	Phytochemical and cytotoxic analysis of bulbs of <i>Drimia indica</i> (Jungli piyaz): a medicinal plant of Asparagaceae	J Jeline Rani, Gireesh Tripathi, Shreya Pattanayak, Suchitra Boxi, Subhalakshmi Rout, Sanjeet Kumar and Alok Ranjan Sahu	52-61
Chapter 7	Phytochemical and cytotoxicity analysis of flowers of <i>Symphorema involucratum</i> (Lamiaceae)	Kadambini Das, Nibedita Jena, Arjun Patra, Sanjeet Kumar and Shruti Rathore	62-78
Chapter 8	Phytochemical analysis of <i>Vitex negundo</i> L. (Lamiaceae): a biopesticide of India	Sonalaxmi Thapa, Divya Jain, Nibedita Jena and Sanjeet Kumar	79-90
Chapter 9	Analysis of secondary metabolites of seeds of <i>Oroxylum indicum</i> (L.) Kurz (Bignoniaceae)	Jyoti J Kshirsagar, Manvi Malwal, Nihar Ranjan Nayak, Bhagwati Prashad Sharma, Nibedita Jena and Sanjeet Kumar	91-100

Qualitative analysis of secondary metabolites in *Cordia myxa* L. fruits: a multipurpose tree species

Arjun Patra¹, Emdad Hossain^{2*}, Bidhan Chandra Roy³, Sohan Lal⁴, Nibedita Jena⁵ and Sanjeet Kumar⁵

¹Department of Botany, P.K. College, Contai, West Bengal, India

²Department of Pharmaceutical Technology, Jadavpur University, Kolkata, West Bengal, India

³Department of Botany, Dinabandhu Mahavidyalaya, Bongaon, West Bengal, India

⁴School of Studies in Botany, Shaheed Mahendra Karma Vishwavidhyalaya, Bastar, Jagdalpur, Chhattisgarh, India

⁵Ambika Prasad Research Foundation, Odisha, India

*Email-id: emdad@rediffmail.com; ORCID: <https://orcid.org/0000-0001-9110-6449>

DOI: <https://doi.org/10.5281/zenodo.14844592>



Licensed under a Creative Commons Attribution 4.0 International License

Abstract

Cordia myxa L., a widely used multipurpose tree species, has been employed in traditional medicine for its diverse therapeutic properties. The present study aimed to investigate the qualitative composition of secondary metabolites in *C. myxa* fruits. Phytochemical analysis of aqueous, methanol, and ethanol extracts revealed the presence of tannins, saponins, flavonoids, phenolic compounds, steroids, and alkaloids. The identified bioactive compounds suggest potential antioxidant, anti-inflammatory, antimicrobial, and antidiabetic properties, supporting the use of this plant in traditional medicine. This study provides a foundation for further research into the pharmacological and therapeutic applications of *C. myxa* fruits.

Keywords: Anti-inflammatory, antioxidant, multipurpose tree, pharmacological potential

Introduction

Cordia myxa L., a species of flowering plant in the Boraginaceae family, is a widely used multipurpose tree species found in various parts of the world (Aleem *et al.*, 2017). The plant has been used in traditional medicine for centuries, with its different parts being used to treat a range of ailments (Kumar *et al.*, 2021). Recent studies have shown that the studied plant possesses various biological activities, including antioxidant, anti-inflammatory, and antimicrobial properties (Singh *et al.*, 2022). The plant extract was helpful for treating cognitive dysfunction in rodents (Al-Musawi *et al.*, 2022; Kendir *et al.*, 2022). Secondary metabolites, such as alkaloids,

flavonoids, and phenolic acids, are known to play a crucial role in the medicinal properties of plants (Al-Khafaji *et al.*, 2021). Therefore, it is essential to investigate the preliminary qualitative composition of secondary metabolites in *C. myxa* fruits to understand their potential health benefits. The present study aims to investigate the preliminary qualitative composition of secondary metabolites in fruits of the studied plant using various solvent extracts. The study will provide valuable information on the phytochemical composition of *C. myxa* fruits, which can be used to develop new drugs and therapies. Additionally, the study will contribute to the conservation and sustainable use of *C. myxa*, a valuable multipurpose tree species.

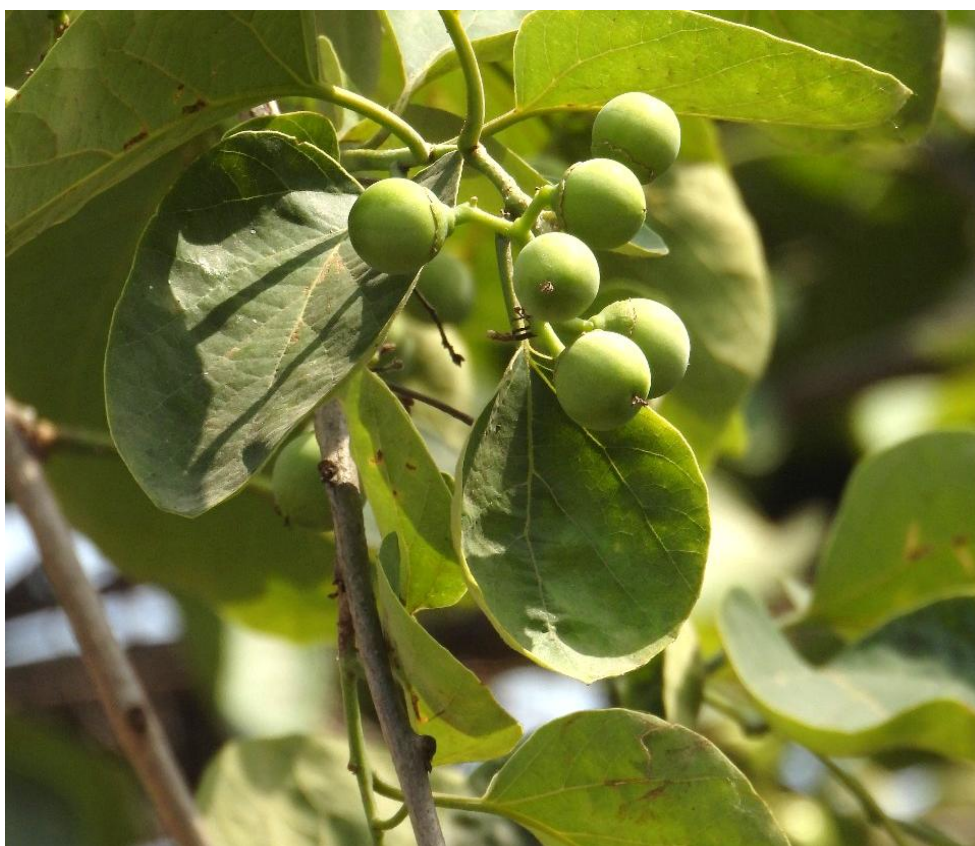


Figure 1: Fruits of *C. myxa*

Materials and methods

The fruits of *C. myxa* were collected from the bank of Mahanadi River areas in Cuttack district of Odisha in October 2024 (Figure 1; Kumar *et al.*, 2021).

Authors have identified the plant specimen. Fruit extracts of aqueous, ethanol, and methanol were prepared, and nine different bioactive compounds were detected using standard methods (Devi *et al.*, 2023; Marndi *et al.*, 2024; Devi *et al.*, 2024).

Detection of nine secondary metabolites was conducted using standard methods and as followed by previous work of our laboratories (Kokate *et al.*, 2006; Jena *et al.*, 2024; Pradhan *et al.*, 2024).

Test for tannin: About 1 ml of the fruit extract was taken. 3-5 drops of 10% lead acetate solution were added to it. The gelatinous precipitate formation confirmed the presence of tannin.

Test for saponin: About 1 ml of the fruit extract was taken and 1 ml of distilled water was added and shaken well. The formation of persistent froth was observed confirming the presence of saponin.

Test for flavonoids: About 1 ml of the fruit extract was taken. 2 ml of 2% NaOH solution and 3 to 4 drops of dilute hydrochloric acid were added to it. The colour initially turned to an intense yellow colour with NaOH solution and later became colourless. This colour change appearance confirmed the presence of flavonoids.

Test for terpenoids: About 1 ml of the filtrate was added with 6 drops of chloroform and placed in the water bath for a few minutes. Then 6 drops of concentrated H₂SO₄ were added. The reddish- brown interface confirmed the presence of terpenoids.

Test for phenolic groups: About 1 ml of the filtrate extract was taken. A few drops of 5% Ferric chloride solution were added. The dark bluish-black appearance confirmed the presence of phenolic compounds.

Test for reducing sugars: About 1 ml of the fruit extract was taken and 2 drops of Fehling's solution A followed by Fehling's solution B were added and kept in the water bath for some time. The presence of red-orange precipitate confirmed the presence of reducing sugar.

Test for steroids: About 1 ml of the fruit extract was taken. 1 ml of chloroform and 1 ml of concentrated sulphuric acid was added gently into it touching test tube mouth. The appearance of upper red and lower yellow with green fluorescence provides the presence of steroids.

Test for alkaloids: About 1 ml of the fruit extract was taken and added 3 to 4 drops of Dragendroff's reagent. The formation of a reddish-brown precipitate confirmed the presence of alkaloids.

Test for carbonyl compounds: About 1 ml of the fruit extract was taken and added 3 to 4 drops of 2,4- Dinitrophenylhydrazine (DNPH) reagent. The formation of yellow crystal confirmed the presence of carbonyl compounds.

Results and discussion

The phytochemical analysis of *C. myxa* fruits revealed the presence of various bioactive compounds. The aqueous extract contained tannins, saponins, flavonoids, phenolic compounds, steroids, and alkaloids (Table 1; Figure 2). The methanol extract contained saponins, flavonoids, phenolic compounds, and steroids, but no tannins or alkaloids. The ethanol extract contained saponins, flavonoids, phenolic compounds, steroids, and alkaloids, but no tannins (Figure 3). The presence of these bioactive compounds suggests that *C. myxa* fruits may have various pharmacological properties (Tak *et al.*, 2024). The saponins, flavonoids, and phenolic compounds present in all three extracts may have a major pharmacological role in treating various health problems. Table 1 provides a comprehensive overview of the phytochemical analysis of *C. myxa* fruits. The table shows that the different extracts (aqueous, methanol, and ethanol) contain varying levels of bioactive compounds.

Table 1: Qualitative phytochemical analysis of *C. myxa* using different extracts

Bioactive compounds	Extracts		
	Aqueous	Methanol	Ethanol
Tannin	+ve	-ve	-ve
Saponin	+ve	+ve	+ve
Flavonoids	+ve	+ve	+ve
Terpenoids	-ve	-ve	-ve
Phenolic compounds	+ve	+ve	+ve
Reducing sugars	-ve	-ve	-ve
Steroids	+ve	+ve	+ve
Alkaloids	+ve	-ve	+ve

Carbonyl compounds	-ve	-ve	-ve
--------------------	-----	-----	-----

(+ve: Positive; -ve: Negative)

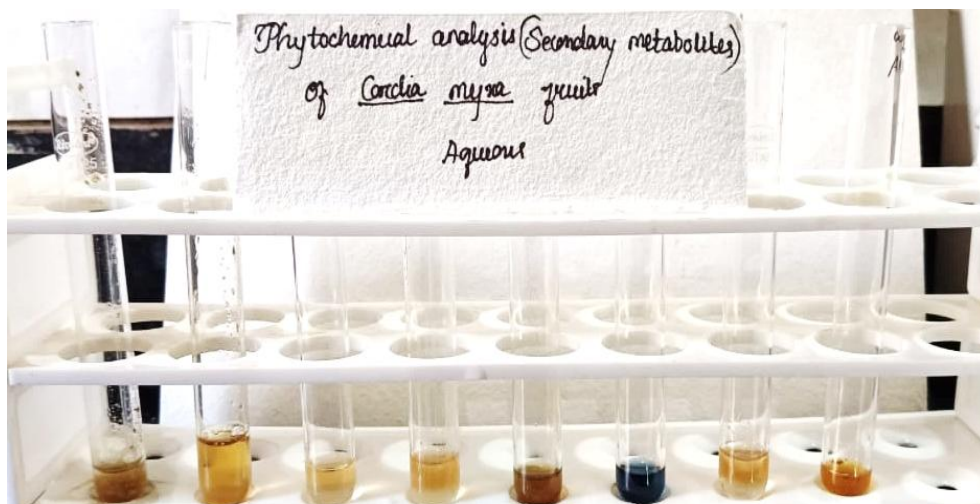


Figure 2: Detection of secondary metabolites of *C. myxa* using aqueous extract



Figure 3: Detection of secondary metabolites of *C. myxa* using ethanol extract

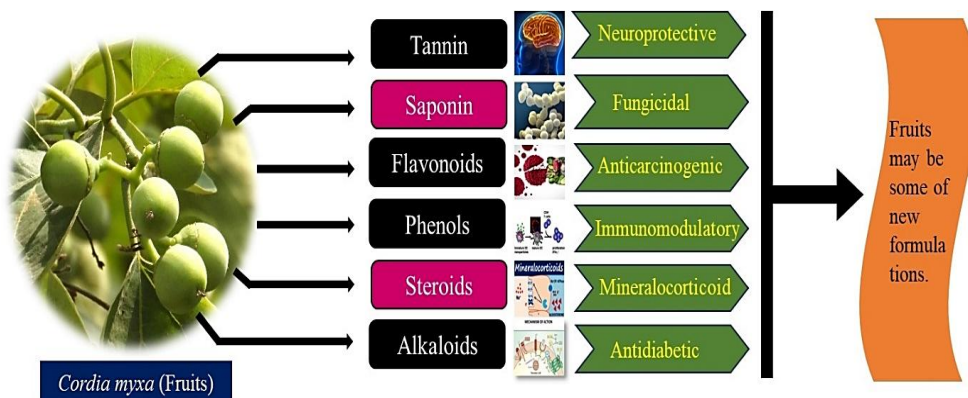


Figure 4: Pharmacological potentials of *C. myxa* fruits

The result suggests that the choice of extract may be important for specific applications. Table 1 and Figure 4 show that the fruits may have a range of biological activities, including neuroprotective, fungicidal, anticarcinogenic, immunomodulatory, and antidiabetic effects. This suggests that fruits may be a valuable source of bioactive compounds with potential therapeutic applications. The presence of tannins, saponins, flavonoids, phenolic compounds, steroids, and alkaloids in the fruit extracts suggests that *C. myxa* may possess antioxidant, anti-inflammatory, antimicrobial, and antidiabetic properties, among others (Figure 4). The fruits are edible. With high nutrition and medicinal value, the fruits can be utilized as functional fruit (Tak *et al.*, 2024).

Conclusion

The present study has successfully identified and characterized the secondary metabolites present in *C. myxa* fruits, revealing a diverse range of bioactive compounds with potential therapeutic applications. These findings provide a scientific basis for the traditional use of *C. myxa* in medicine and highlight its potential as a valuable source of natural products for the development of new drugs and therapies.

References

Aleem ERA, Seddik FEF, Samy MN and Desoukey SY. (2017). Botanical studies of the leaf of *Cordia myxa* L. Journal of Pharmacognosy and Phytochemistry. 6(6): 2086-2091.

- Al-Khafaji SA, Alsaadawi MA, Yasari AMA and Al-Saadawe MA. (2021). Article review: *Cordia myxa* L.: the gift of the nature, a review. Basrah Journal of Agricultural Sciences. 34(2): 267-277.
- Al-Musawi MH, Ibrahim KM and Albukhaty S. (2022). *In vitro* study of antioxidant, antibacterial, and cytotoxicity properties of *Cordia myxa* fruit extract. Iranian Journal of Microbiology. 14 (1): 97-103.
- Devi RS, Satapathy KB and Kumar S. (2023). Validation of tribal claims for formulation of future drugs through evaluation of ethno-pharmacological values of *Ludwigia adscendens*. Medicinal Plants. 15(4): 691-697.
- Devi RS, Satapathy KB, Manjula BL, Sharma BP and Kumar S. (2024). Evaluation of ethnopharmacological potential of *Oenanthe javanica* DC. Annals of Biology. 40(1): 135-139.
- Jena N, Rout S, Devi RS and Kumar S. (2024). Phytochemical and cytotoxicity analysis of fruits of *Zanthoxylum asiaticum* (L.) Appelhans, Groppo & J. Wen: a minor fruit plant of Odisha, India. E-planet. 22(1): 62-70.
- Kendir G, Bae HJ, Kim J, Jeong Y, Bae HJ, Park K, Yang X, Cho YJ, Kim JY, Jung SY, Köroğlu A, Jang DS and Ryu JH. (2022). The effects of the ethanol extract of *Cordia myxa* leaves on the cognitive function in mice. BMC Complementary Medicine and Therapies. 22:215. DOI: 10.1186/s12906-022-03693-z.
- Kokate CK, Purohit AP, and Gokhale SB. (2006). Pharmacognosy. 35th Ed. Nirali Prakashan, Pune.
- Kumar SN, Mishra S and Kumar S. (2021). Documentation of indigenous traditional knowledge (ITK) on commonly available plants in Koira range, Bonai Forest Division, Sundargarh, Odisha, India. Asian Plant Research Journal. 8(4): 83-95.
- Marndi S, Barik M and Kumar S. (2024). Phytochemical and cytotoxicity analysis of *Eulophia explanata* Lindl. (Tuber extracts). African Journal of Biological Sciences. 6(4): 2751-2756.
- Pradhan I, Rani JJ, Pattanayak S, Jacob M, Rout S, Kumar S, and Hossain E (2024). Phytochemical profiling and cytotoxic evaluation of *Schrebera swietenoides* fruits. In: Sharma BP, Suple SD, Mishra S and Rath SK. Plants & Secondary Metabolites, Volume 3, Ambika Prasad Research Foundation, India.
- Singh V, Sood A, Pruthi S, Singh M, Saini B, Singh TG and Kumar A. (2022). Chemical constituents and biological activities of *Cordia myxa* L.: a review. The Natural Products Journal. 12(2): 30-41.
- Tak Y, Samota MK, Meena NK, Kaur G, Jain MC, Kumar R, Kaur M and Amarowicz R. (2024). Underutilized fruit lasoda (*Cordia myxa* L.): review on bioactive compounds, antioxidant potentiality and applications in health bioactivities and food. Fitoterapia. 175: 105898. DOI: 10.1016/j.fitote.2024.105898.

Qualitative phytochemical analysis of fruits of *Shorea robusta* C.F. Gaertn.

Priya Darshani¹, Neelakshi Sharma², Manas Jyoti Kapil³, Rahul Uniyal⁴, Debasmitha Mahanta⁵, Nibedita Jena⁶ and Sanjeet Kumar^{6*}

¹Department of Pharmacognosy, Institute of Teaching and Research in Ayurveda, Jamnagar, Gujarat, India

²Department of Pharmacognosy, Royal School of Pharmacy, The Assam Royal Global University, Guwahati, Assam, India

³Department of Pharmaceutics, Royal School of Pharmacy, The Assam Royal Global University, Guwahati, Assam, India

⁴Department of Agroforestry, VCSG UHF College of Forestry, Ranichauri, Tehri Garhwal, Uttarakhand, India

⁵Department of H & T, Government of Odisha, India

⁶Ambika prasad Research Foundation, Odisha, India

*Email-id: sanjeetaprf@gmail.com

DOI: <https://doi.org/10.5281/zenodo.14844698>



Licensed under a Creative Commons Attribution 4.0 International License

Abstract

This study aimed to report the bioactive compounds available in the fruits of *Shorea robusta* C.F. Gaertn. A qualitative phytochemical analysis was conducted using different extracts (aqueous, methanol, and ethanol). The results revealed the presence of various bioactive compounds, including tannins, saponins, flavonoids, phenolic compounds, reducing sugars, and steroids. These compounds have been linked to several medicinal uses, such as treating intestine infections, anti-cancer properties, antimutagenic properties, antidiabetic properties, and anti-inflammatory activities. The study highlights the potential of *S. robusta* fruits as a rich source of phytochemicals with therapeutic applications.

Key words: Anticancer, antidiabetic, antimutagenic, therapeutic applications

Introduction

Shorea robusta, commonly known as Sal (Marandi *et al.*, 2016), is a tree species native to the Indian subcontinent and Southeast Asia (Rahman *et al.*, 2010). The tree is highly valued for its timber, fruits, leaves, and bark. It has been used in traditional medicine for centuries (Yadav and Antil, 2023). The traditional uses of *S. robusta* include treating various ailments such as fever, cough, and skin diseases (Bala *et al.*, 2020). Despite its widespread use in traditional medicine, there is a lack of scientific evidence to support the medicinal properties of *S. robusta* (Singh *et al.*, 2024). The phytochemical composition of the plant, particularly its fruits, remains largely unexplored. Phytochemical analysis is a critical tool in the discovery of novel medicinal compounds from plants (Egbuna *et al.*, 2020). Therefore, it is essential to investigate the phytochemical composition of *S. robusta* fruits to understand their potential medicinal applications. The increasing demand for natural products with medicinal properties has led to a surge in research on secondary metabolites from various plant species (David *et al.*, 2015). However, the phytochemical analysis of *S. robusta* fruits has received little attention. This study aims to bridge this knowledge gap by conducting a qualitative phytochemical analysis of *S. robusta* fruits. The need for this study arises from the potential of *S. robusta* fruits as a rich source of phytochemicals with therapeutic applications. The identification of bioactive compounds in *S. robusta* fruits could provide insight into their potential medicinal uses, such as treating various diseases and disorders. Furthermore, this study could contribute to the development of new drugs and therapies from natural sources, addressing the growing concern of antibiotic resistance and the need for alternative treatments.

Materials and methods

The fruits of *S. robusta* were collected from the Rourkela Forest Division of Sundargarh district of Odisha, India (Figure 2; Kumar *et al.*, 2021). The plant species was identified by the authors (Figure 1). The Soxhlet extraction method was adopted using different solvents for phytochemical analysis (Kumar *et al.*, 2013; Devi *et al.*, 2023; Marandi *et al.*, 2024).

Qualitative phytochemical analysis

Detection of nine secondary metabolites were conducted using standard methods (Thakur *et al.*, 2025).



Figure 1: Different plant parts of *S. robusta*

Test for Tannin: About 1 ml of the fruit extract was taken. Added 3-5 drops of 10% lead acetate solution to it. The formation of gelatinous precipitate confirmed the positive results for the presence of tannin (Kumar *et al.*, 2024).

Test for saponin: About 1 ml of the fruit extract was taken and 1 ml of distilled water was added and shaken well. The persistent froth formation confirmed the presence of saponin.

Test for flavonoids: About 1 ml of the fruit extract was taken. Added 2 ml of 2% NaOH solution and then dilute HCl to it. The colour initially turned to an intense yellow with NaOH solution and later became colourless. This colour changing transformation confirmed for the presence of flavonoids (Ankari *et al.*, 2024).

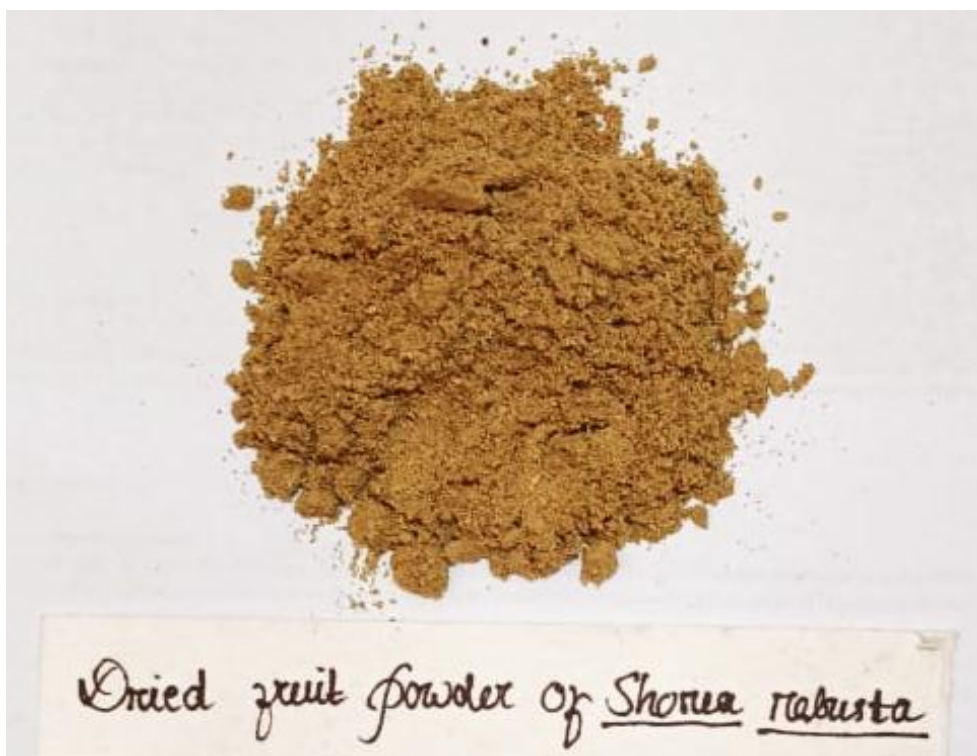


Figure 2: Dried fruit powder of *S. robusta* for experimental analysis

Test for terpenoids: About 1 ml of the filtrate was added with 6 drops of chloroform and placed in the water bath for a few minutes. Then 6 drops of concentrated sulphuric acid were added. The appearance of reddish-brown interface confirmed the presence of terpenoids.

Test for phenolic compounds: About 1 ml of the fruit extract was taken and added few drops of 5% ferric chloride solution to it. The dark bluish black appearance confirmed the presence of phenolic compounds (Singh *et al.*, 2024).

Test for reducing sugars: About 1 ml of the fruit extract was taken and 2-3 drops of Fehling's solution A and B were respectively added. Then kept in the water bath for some time. The presence of red-orange precipitate confirmed the presence of reducing sugar (Table 1).

Test for steroids: About 1 ml of the fruit extract was taken. 1 ml of chloroform and 1 ml of concentrated sulphuric acid was added into it. The

appearance of 2 phases with the upper red and lower yellow with green fluorescence confirmed the presence of steroids (Acharya *et al.*, 2024).

Test for alkaloids: About 1 ml of the extract was taken and added 3 to 4 drops of Dragendroff's reagent. The formation of reddish-brown precipitate confirmed the presence of alkaloids.

Test for carbonyl compounds: About 1 ml of the fruit extract was taken added 3 to 4 drops of 2,4-dinitrophenylhydrazine (DNPH) reagent. The yellow crystal formation confirmed the presence of carbonyl compounds (Jena *et al.*, 2024).

Results and discussion

The results of the phytochemical analysis, as presented in Table 1, revealed the presence of various bioactive compounds in *S. robusta* fruits. The aqueous, methanol, and ethanol extracts contain tannins, saponins, flavonoids, phenolic compounds, reducing sugars, and steroids, with varying degrees of presence across different extracts (Figure 3-5). These compounds have been linked to several medicinal uses, including the treatment of intestine infections, anti-cancer properties (Figure 6), antimutagenic properties, antidiabetic properties, and anti-inflammatory activities, as summarized in Table 2. Overall, the study highlights the potential of *S. robusta* fruits as a rich source of phytochemicals with therapeutic applications.

Table 1: Qualitative phytochemical analysis of *S. robusta* fruits using different extracts

Bioactive compounds	Extracts		
	Aqueous	Methanol	Ethanol
Tannin	+	+	-
Saponin	+	+	+
Flavonoids	-	+	+
Terpenoids	-	-	-
Phenolic compounds	+	+	+
Reducing sugars	+	+	+
Steroids	+	+	+
Alkaloids	-	+	-

Carbonyl compounds	-	-	-
--------------------	---	---	---

(+: Positive; -Negative)

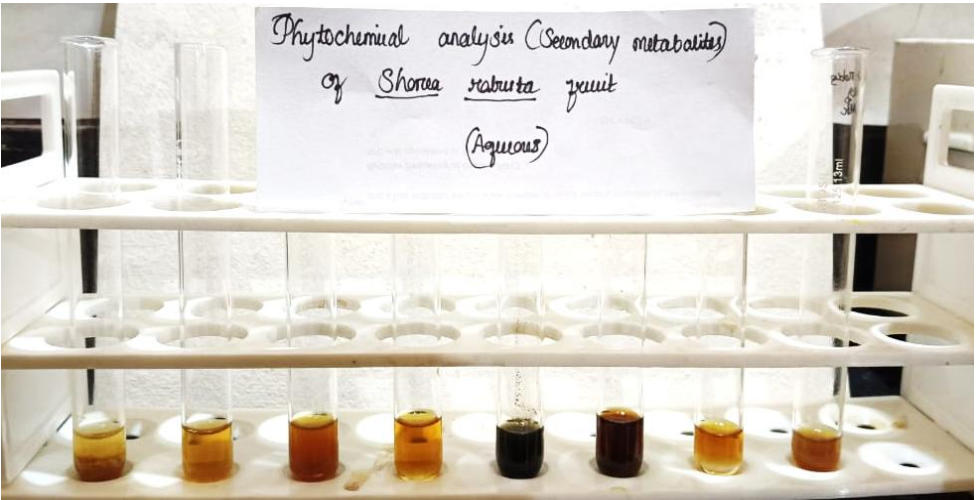


Figure 3: Detection of secondary metabolites of *S. robusta* using aqueous extract

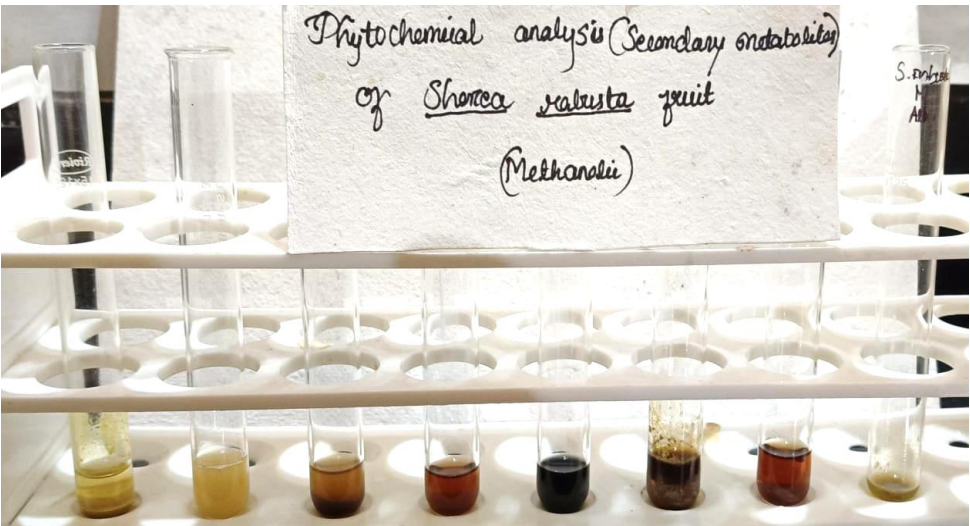


Figure 4: Detection of secondary metabolites of *S. robusta* using methanolic extract

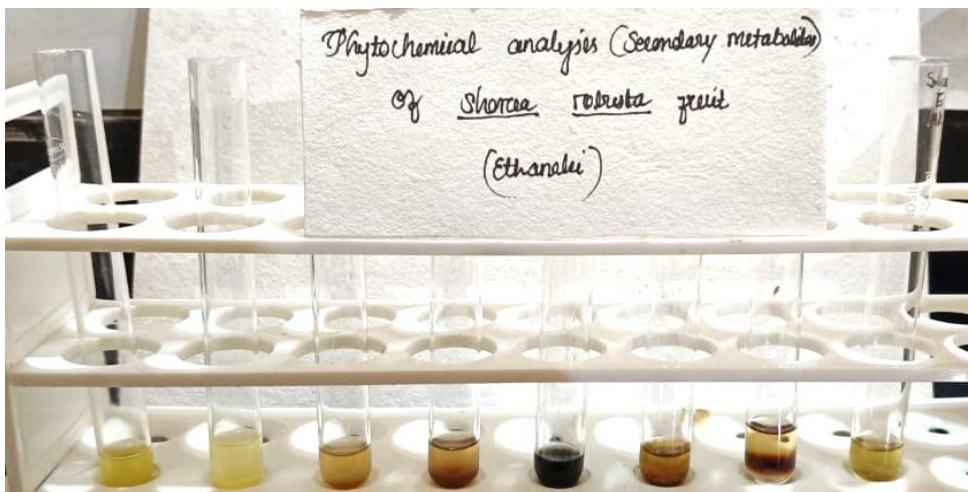


Figure 5: Detection of secondary metabolites of *S. robusta* using ethanolic extract

Table 2: Probable medicinal uses of *S. robusta* due to the presence of following bioactive compounds

Bioactive compounds	Medicinal uses	Source
Tannin	Tannin present in aqueous and methanol extracts have potentials to treat intestine infections	Pizzi, (2019)
Saponin	Presence of saponins in aqueous, methanol and ethanol have anti-cancer properties	Man <i>et al.</i> , (2010)
Phenolic compounds	Phenolic groups present in aqueous, methanol and ethanol extracts have antimutagenic properties.	Huang <i>et al.</i> , (2010)
Reducing sugars	Reducing sugars present in aqueous, methanol and ethanol extracts have antidiabetic properties	McKenzie and Lee, (2022)

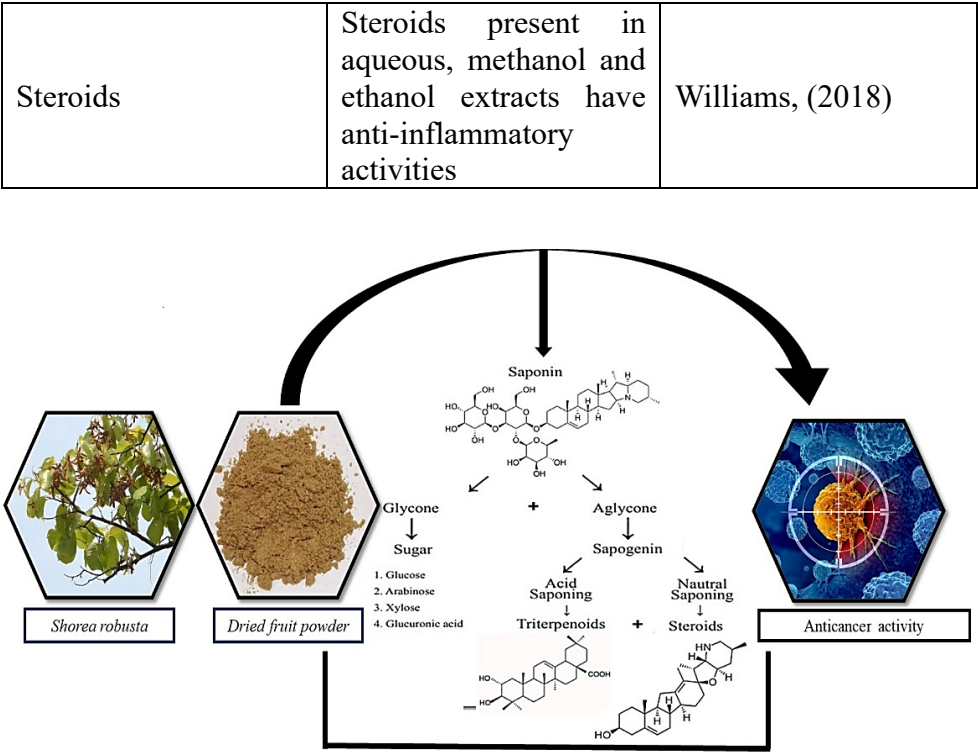


Figure 6: Pharmacological potential (anticancer activity) of *S. robusta* fruits

Conclusion

The present study has successfully demonstrated the presence of various bioactive compounds in *S. robusta* fruits. The study highlights the potential of *S. robusta* fruits as a rich source of phytochemicals with therapeutic applications. Future studies should focus on the isolation and characterization of the bioactive compounds present in *S. robusta* fruits. In vitro and in vivo studies should be conducted to evaluate the efficacy and safety of these compounds for various medicinal applications. Additionally, clinical trials should be conducted to confirm the therapeutic potential of *S. robusta* fruits. Furthermore, studies on the cultivation and conservation of *S. robusta* trees should be undertaken to ensure the sustainable use of this valuable plant species. Overall, the results of this study provide a foundation for further research on the medicinal properties of *S. robusta* fruits and their potential applications in the development of new drugs and therapies.

References

- Acharya S, Das K, Soni P, Kaur L, Ray P, Jena N and Kumar S. (2024). Primary and secondary metabolites of kusum seeds. Plants and Secondary Metabolites, Volume 2. Ambika Prasad Research Foundation, India.
- Ankari AB, Mahendru N, Paniyappanayara V, Tripathi G, Jena N and Kumar S. (2024). Evaluation of medicinal values of a fern species [*Thelypteris parasitica* (L.) Tardieu] of India. Plants & Secondary Metabolites, Volume 2, Ambika Prasad Research Foundation, India.
- Bala SK, Parida S and Mahalik G. (2020). Studies on the use of plants and plant parts by the tribals of Malkangiri district, Odisha for different rituals and medicinal uses. Plant Archives. 20(2): 3308-3312.
- David B, Wolfender JL and Dias DA. (2015). The pharmaceutical industry and natural products: historical status and new trends. Phytochemistry Reviews. 14: 299-315.
- Devi RS, Satapathy KB and Kumar S. (2023). Validation of tribal claims for formulation of future drugs through evaluation of ethno-pharmacological values of *Ludwigia adscendens*. Medicinal Plants. 15(4): 691-697.
- Egbuna C, Kumar S, Ifemeje JC, Ezzat SM and Kaliyaperumal S. (2020). Phytochemicals as lead compounds for new drug discovery. Elsevier Science Publishing Co Inc, Netherlands.
- Huang WY, Cai YZ and Zhang Y. (2010). Natural phenolic compounds from medicinal herbs and dietary plants: potential use for cancer prevention. Nutrition and Cancer. 62(1): 1-20.
- Jena N, Rout S, Devi RS and Kumar S. (2024). Phytochemical and cytotoxicity analysis of fruits of *Zanthoxylum asiaticum* (L.) Appelhans, Groppo & J. Wen: A minor fruit plant of Odisha, India. E-planet. 22(1): 62-70.
- Kumar A, Jadhav JY, Dehar PS, Gupta PSP, Mondal K, Vishwakarma K, Jena N and Kumar S. (2024). Qualitative phytochemical screening of a medicinally-ornamental wild fern species (*Pteris vittata* L.) of India. Plants & Secondary Metabolites, Volume 2. Ambika Prasad Research Foundation, India.
- Kumar S, Behera SP and Jena PK. (2013). Validation of tribal claims on *Dioscorea pentaphylla* through phytochemical screening and evaluation of antibacterial activity. Plant Science Research. 35: 55-61.
- Kumar SN, Mishra S and Kumar S. (2021). Documentation of Indigenous Traditional Knowledge (ITK) on commonly available plants in Koira Range, Bonai Forest Division, Sundargarh, Odisha, India. Asian Plant Research Journal. 8(4): 83-95.
- Man S, Gao W, Zhang Y, Huang L and Liu C. (2010). Chemical study and medical application of saponins as anti-cancer agents. Fitoterapia. 81(7): 703-714.

- Marandi RR, Britto SJ and Soreng PK. (2016). Phytochemical profiling, antibacterial screening and antioxidant properties of the sacred tree (*Shorea robusta* Gaertn.) of Jharkhand. International Journal of Pharmaceutical Sciences and Research. 7(7): 2874-2888.
- Marndi S, Barik M and Kumar S. (2024). Phytochemical and cytotoxicity analysis of *Eulophia explanata* Lindl. (Tuber extracts). African Journal of Biological Sciences. 6(4):2751-2756. DOI: 10.48047/AFJBS.6.Si4.2024.2751-2756.
- McKenzie E and Lee SY. (2022). Sugar reduction methods and their application in confections: a review. Food Science and Biotechnology. 31(4): 387-398.
- Pizzi A. (2019). Tannins: prospectives and actual industrial applications. Biomolecules. 9(8): 344-344.
- Rahman MM, Rahman M, Guogang Z and Islam KS. (2010). A review of the present threats to tropical moist deciduous sal (*Shorea robusta*) forest ecosystem of Central Bangladesh. Tropical Conservation Science. 3(1): 90-102.
- Singh B, Rao K, Aarti, Yadav N, Chauhan J, Jena N and Kumar S. (2024). Phytochemical screening and thin layer chromatography (TLC) of bark of *Alstonia scholaris* (Apocynaceae). Plants & Secondary Metabolites, Volume 1. Ambika Prasad Research Foundation, India.
- Singh SV, Johar V and Dhyani A. (2024). A review on importance of sal tree (*Shorea robusta*) as an interminable wood. Advanced Journal of Molecular Biology and Environmental Sciences. 26(1): 153-156.
- Thakur K, Jena N and Kumar S. (2025). Pharmacological evaluation of *Vitex altissima* L. Medico-Biowealth of India, Volume 19. Ambika Prasad Research Foundation, India.
- Williams DM. (2018). Clinical pharmacology of corticosteroids. Respiratory Care. 63(6): 655-670.
- Yadav P and Antil RS. (2023). Utilizing the multi-faceted potential of *Shorea robusta* in 2023: a comprehensive review. International Journal for Research in Applied Science & Engineering Technology. 11(10): 161-168.

Medicinal values and phytochemical screening of fruits of Indian franchincense (*Boswellia serrata*) Roxb.

Ganesh Kumar¹, Rajesh Kumar Verma², Poonam Dilip Sable³, Sohan Lal⁴, Nibedita Jena⁵ and Sanjeet Kumar^{5*}

¹Department of Botany, MLS Government Girls' College, Jaisalmer, Rajasthan, India

²Department of Dravyaguna, Naiminath Ayurvedic Medical College and Research Centre, Agra, Uttar Pradesh, India

³Department of Dravyaguna Vigyana, Pharate Patil Ayurvedic Medical college, Mandavgan Pharata, Pune, India

⁴School of Studies in Botany, Shaheed Mahendra Karma Vishwavidhyalaya, Bastar, Jagdalpur, Chhattisgarh, India

⁵Ambika Prasad Research Foundation, Odisha, India

*Email-id: sanjeetaprf@gmail.com

DOI: <https://doi.org/10.5281/zenodo.14844846>



Licensed under a Creative Commons Attribution 4.0 International License

Abstract

The present study aimed to investigate the qualitative phytochemical analysis and probable medicinal uses of *Boswellia serrata* fruits. The results revealed the presence of bioactive compounds such as tannin, saponin, flavonoids, phenolic compounds, and reducing sugars in different extracts of *B. serrata*. The study suggests that *B. serrata* extracts may possess potential medicinal properties, including antitumor, anticholesterol, antibacterial, and antioxidant activities. Present study provides a scientific basis for its traditional use in folk medicine and highlighting its potential as a source of natural products with medicinal properties.

Key words: Fruits, secondary metabolites, medicinal uses

Introduction

Boswellia serrata, commonly known as Indian franchincense, is a significant plant species in traditional Indian medicine, particularly in Ayurveda (Hebbbar *et al.*, 2024). The plant is native to the Indian subcontinent and has been used

for centuries to treat various health problems Ayurveda (Hebbar *et al.*, 2024). The fruits of *B. serrata* have been traditionally used to prepare medicinal preparations, such as decoctions and powders, to treat various health conditions (Hebbar *et al.*, 2024). Despite its traditional use, the secondary metabolites and medicinal properties of *B. serrata* fruits have not been extensively studied. Previous studies have primarily focused on the resin extracts of the plant, which have been shown to possess anti-inflammatory and anti-arthritic properties (Hebbar *et al.*, 2024). However, the fruits of the plant are also rich in bioactive compounds and have been traditionally used for their medicinal properties. There is a growing interest in the development of natural products-based medicines (Kumar *et al.*, 2013; Singh *et al.*, 2022; Aradhana *et al.*, 2022; Devi *et al.*, 2023; Devi *et al.*, 2024; Marndi *et al.*, 2024; Kumar, 2025; Jena *et al.*, 2025), and *B. serrata* fruits offer a promising source of bioactive compounds. The phytochemical screening of the fruits can provide valuable insights into their chemical composition and potential medicinal properties. Furthermore, the identification of bioactive compounds in the fruits can lead to the development of novel therapeutic agents for various diseases. The present study aims to investigate the medicinal values and phytochemical composition of *B. serrata* fruits. The need for this study arises from the lack of comprehensive information on the phytochemical composition and medicinal properties of the fruits. This study will provide a detailed analysis of the phytochemical constituents of the fruits and evaluate their potential medicinal properties, which can lead to the development of novel natural products-based medicines.

Materials and methods

The fruits of *B. serrata* were collected from Rourkela Forest Division, Odisha. Authors have identified the plant specimen (Figure 1). Fruit extracts of aqueous, ethanol, and methanol were prepared, and nine different bioactive compounds were detected using standard methods (Mety *et al.*, 2024; Jena *et al.*, 2024).



Figure 1: Fruits of *B. serrata*

Qualitative phytochemical analysis

Detection of nine secondary metabolites were conducted using standard methods (Kumar *et al.*, 2024).

Test for Tannin: About 1 ml of the fruit extract was taken. Added 3-5 drops of 10% lead acetate solution to it. The formation of gelatinous precipitate confirmed the positive results for the presence of tannin (Behera *et al.*, 2024).

Test for saponin: About 1 ml of the fruit extract was taken and 1 ml of distilled water was added and shaken well. The persistent froth formation confirmed the presence of saponin.

Test for flavonoids: About 1 ml of the fruit extract was taken. Added 2 ml of 2% NaOH solution and then dilute HCl to it. The colour initially turned to an intense yellow with NaOH solution and later became colourless. This colour changing transformation confirmed for the presence of flavonoids.

Test for terpenoids: About 1 ml of the filtrate was added with 6 drops of chloroform and placed in the water bath for a few minutes. Then 6 drops of concentrated sulphuric acid were added. The appearance of reddish-brown interface confirmed the presence of terpenoids.

Test for phenolic compounds: About 1 ml of the fruit extract was taken and added few drops of 5% ferric chloride solution to it. The dark bluish black appearance confirmed the presence of phenolic compounds (Tailor *et al.*, 2024).

Test for reducing sugars: About 1 ml of the fruit extract was taken and 2-3 drops of Fehling's solution A and B were respectively added. Then kept in the water bath for some time. The presence of red-orange precipitate confirmed the presence of reducing sugar.

Test for steroids: About 1 ml of the fruit extract was taken. 1 ml of chloroform and 1 ml of concentrated sulphuric acid was added into it. The appearance of 2 phases with the upper red and lower yellow with green fluorescence confirmed the presence of steroids.

Test for alkaloids: About 1 ml of the extract was taken and added 3 to 4 drops of Dragendroff's reagent. The formation of reddish-brown precipitate confirmed the presence of alkaloids.

Test for carbonyl compounds: About 1 ml of the fruit extract was taken added 3 to 4 drops of 2,4-dinitrophenylhydrazine (DNPH) reagent. The yellow crystal formation confirmed the presence of carbonyl compounds (Jena *et al.*, 2024).

Results and discussion

The qualitative phytochemical analysis of *B. serrata* revealed the presence of various bioactive compounds, including tannin, saponin, flavonoids, phenolic compounds, and reducing sugars (Table 1; Figures 2-5). The results indicate that the aqueous extract is rich in phenolic compounds and reducing sugars, which are known for their antibacterial and antioxidant properties, respectively. On the other hand, the methanol and ethanol extracts contain flavonoids, which have been reported to possess lipid-lowering activities. The presence of tannin and saponin in all three extracts suggests that *B. serrata* may have antitumor and anticholesterol activities. The presence of these bioactive compounds in *B. serrata* extracts suggests that the plant may have potential health benefits (Table 2; Figure 5). The antibacterial and antioxidant properties of the aqueous extract make it a promising candidate for the development of natural remedies for infectious diseases and oxidative stress-related disorders. Similarly, the lipid-lowering activities of the flavonoids present in the methanol and ethanol extracts suggest that *B. serrata* may have potential in the prevention and management of cardiovascular diseases. Overall, the results of this study provide a scientific

basis for the traditional use of *B. serrata* in folk medicine and highlight its potential as a source of natural products with medicinal properties.

Table 1: Qualitative phytochemical analysis of *B. serrata* using different extracts

Bioactive compounds	Extracts		
	Aqueous	Methanol	Ethanol
Tannin	+	+	+
Saponin	+	+	+
Flavonoids	-	+	+
Terpenoids	-	-	-
Phenolic compounds	+	-	-
Reducing sugars	+	-	-
Steroids	-	-	-
Alkaloids	-	-	-
Carbonyl compounds	-	-	-

(+: Positive; -Negative)

Table 2: Probable medicinal uses of *B. serrata* as per presence of bioactive compounds

Bioactive compounds	Medicinal uses	Source
Tannin	Tannin present in aqueous, methanol and ethanol extracts have antitumor activities.	Jing <i>et al.</i> , (2022)
Saponin	Presence of saponin in aqueous, methanol and ethanol have anticholesterol activity.	Güçlü-Ustündağ and Mazza, (2007)

Flavonoids	Presence of flavonoids in methanol and ethanol extracts have the ability of lipid lowering activities.	Hasnat <i>et al.</i> , (2024)
Phenolic compounds	Phenolic groups are present in aqueous extract have antibacterial properties.	Tungmunnithum <i>et al.</i> , (2018)
Reducing sugars	Reducing sugars present in aqueous extract have antioxidant properties.	Warshaw and Edelman, (2021)



Figure 2: Detection of secondary metabolites of *B. serrata* fruits using aqueous extract

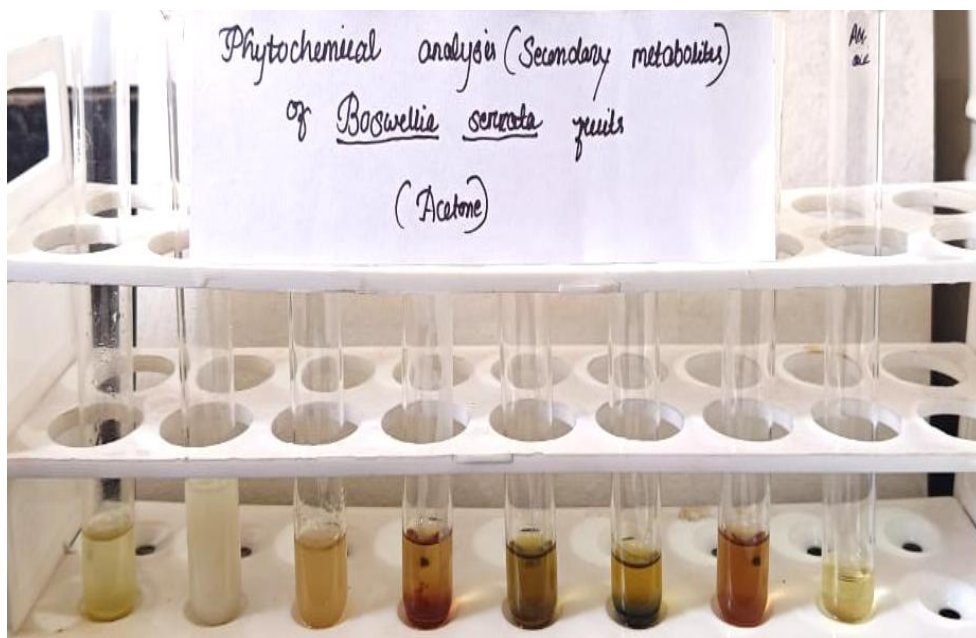


Figure 3: Detection of secondary metabolites of *B. serrata* fruits using acetone extract



Figure 4: Detection of secondary metabolites of *B. serrata* fruits using ethanolic extract

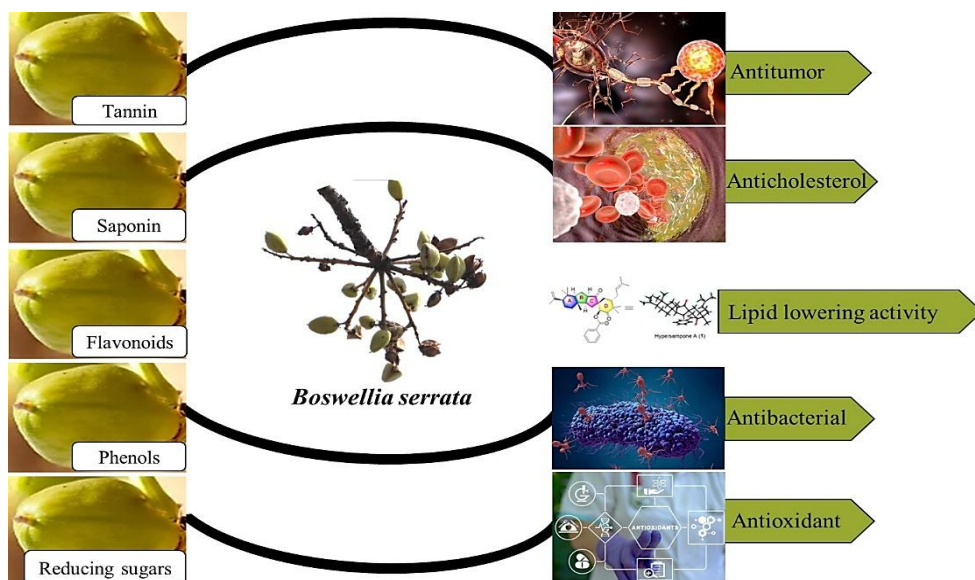


Figure 5: Pharmacological potential of *B. serrata* fruits due to the presence of several phytoconstituents

Conclusion

The present study demonstrates the presence of various bioactive compounds, including tannin, saponin, flavonoids, phenolic compounds, and reducing sugars, in different extracts of *B. serrata*. The results suggest that *B. serrata* extracts possess potential medicinal properties, including antitumor, anticholesterol, antibacterial, and antioxidant activities. These findings provide a scientific basis for the traditional use of *B. serrata* in folk medicine and highlight its potential as a source of natural products with medicinal properties, warranting further investigation for the development of novel therapeutic agents.

References

Aradhana S, Manjula BL and Kumar S. (2022). Scientific validation of tribal claims on the plants used in diabetes by Santhal community, Mayurbhanj, Odisha, India. Medicinal Plants. 14(4): 513-517.

- Behera B, Ray P, Lyngdoh A, Singh B, Kumar S, Jena N and Sharma BP. (2024). Phytochemical analysis and scientific validation of ethnomedicinal uses of *Mucuna monosperma* Roxb. ex Wight: a medicinal climber of India. Biological Archives, Volume 1. Ambika Prasad Research Foundation, India.
- Devi RS, Manjula BL, Mukherjee S, Watakhare DN, Satapathy KB and Kumar S. (2024). Cytotoxicity analysis of selected plants using *Artemia salina*. Annals of Agri-Bio Research. 29(1): 45-49.
- Devi RS, Satapathy KB and Kumar S. (2023). Validation of tribal claims for formulation of future drugs through evaluation of ethno-pharmacological values of *Ludwigia adscendens*. Medicinal Plants. 15(4): 691-697.
- Güçlü-Ustündağ O and Mazza G. (2007). Saponins: properties, applications and processing. Critical Reviews in Food Science and Nutrition. 47(3): 231-258.
- Hasnat H, Shompa SA, Islam MM, Alam S, Richi FT, Emon NU, Ashrafi S, Ahmed NU, Chowdhury MNR, Fatema N, Hossain MS, Ghosh A and Ahmed F. (2024). Flavonoids: a treasure house of prospective pharmacological potentials. Heliyon. 10(6): e27533. DOI: 10.1016/j.heliyon.2024.
- Hebbat DR, Behera B, Kumar N, Sharma A, Hossain E, Kumar S and Sharma BP. (2024). Validation of traditional therapeutic practices on *Boswellia serrata* for the treatment of asthma and other respiratory problems. African Journal of Biomedical Research. 27(3s): 6367-6372.
- Jena N, Pegu J, Chang T, Mahapatra BK, Walling T, Tripathi G and Kumar S. (2024). Qualitative phytochemical analysis of *Mallotus nudiflorus* (L.) Kuju & Welzen fruits. Plants & Secondary Metabolites, Volume 1. Ambika Prasad Research Foundation, Odisha, India.
- Jena N, Rout S, Mishra S and Kumar S. (2025). Evaluation of quantitative ethnobotanical uses in Mayurbhanj district, Odisha, India. Journal of Biodiversity and Conservation. 9(1): 1-29.
- Jing W, Xiaolan C, Yu C, Feng Q and Haifeng Y. (2022). Pharmacological effects and mechanisms of tannic acid. Biomedicine & Pharmacotherapy. 154: 113561. DOI: 10.1016/j.biopha.2022.113561.
- Kumar A, Jadhav JY, Dehar PS, Gupta PSP, Mondal K, Vishwakarma K, Jena N and Kumar S. (2024). Qualitative phytochemical screening of a medicinally-ornamental wild

- fern species (*Pteris vittata* L.) of India. Plants & Secondary Metabolites, Volume 2. Ambika Prasad Research Foundation, India.
- Kumar S, Behera SP and Jena PK. (2013). Validation of tribal claims on *Dioscorea pentaphylla* through phytochemical screening and evaluation of antibacterial activity. Plant Science Research. 35: 55-61.
- Kumar S. (2025). Leveraging the nutritional and medicinal potential of wild yam for a sustainable future. Journal of Biodiversity and Conservation. 9(1): E1-E2.
- Marndi S, Barik M and Kumar S. (2024). Phytochemical and cytotoxicity analysis of *Eulophia explanata* Lindl. (Tuber extracts). African Journal of Biological Sciences. 6(4):2751-2756; DOI: 10.48047/AFJBS.6.Si4.2024.2751-2756.
- Mety SS, Lal S, Topno SC, Rote K, Jena N, Kumar S and Behera B. (2024). Qualitative phytochemical analysis of *Solanum virginianum* L. flower: a medicinal plant of India. Plants & Secondary Metabolites, Volume 1. Ambika Prasad Research Foundation, India.
- Singh A, Lama R, Panda A, Marndi S, Devi RS and Kumar S. (2022). Phytochemical and anti-bacterial activity of *Toddalia asiatica*: a wild nutraceutical. Asian Pacific Journal of Health Sciences. 9(2):235-239.
- Tailor V, Prameela HC, Singh G, Dehar PS, Jeline RJ, Jena N, Kumar S and Singh B. (2024). Qualitative phytochemical analysis of leaves of *Croton bonplandianus* Baill. Plants and Secondary Metabolites, Volume 1. Ambika Prasad Research Foundation, India.
- Tungmunnithum D, Thongboonyou A, Pholboon A, and Yangsabai A. (2018). Flavonoids and other phenolic compounds from medicinal plants for pharmaceutical and medical aspects: an overview. Medicines (Basel). 5(3): 93-93.
- Warshaw H and Edelman SV. (2021). Practical strategies to help reduce added sugars consumption to support glycaemic and weight management goals. Clinical Diabetes. 39(1): 45-56.

Phytochemical investigation of fruits of *Soymida febrifuga* (Roxb.) A. Juss.: A medicinally important tree species in India

Bidhan Chandra Roy¹, Vikas Tailor², Nibedita Jena^{3*} and Sanjeet Kumar³

¹Department of Botany, Dinabandhu Mahavidyalaya, Bongaon, West Bengal, India

²Department of Biology, Swami Vivekanand Government Model School, Block Asind, Bhilwara, Rajasthan, India

³Ambika Prasad Research Foundation, Odisha, India

*Email-id: nibeditajena838@gmail.com

DOI: <https://doi.org/10.5281/zenodo.14844930>



Licensed under a Creative Commons Attribution 4.0 International License

Abstract

This study conducted a qualitative phytochemical analysis of *Soymida febrifuga* fruits, revealing their potential medicinal applications. The analysis detected various bioactive compounds, including tannins, saponins, flavonoids, terpenoids, phenolics, reducing sugars, steroids, alkaloids, and carbonyl compounds, across different plant extracts. The presence of these compounds suggests that *S. febrifuga* fruits possess significant pharmacological potential, supporting their traditional use in folk medicine and indicating potential therapeutic applications in managing chronic health problems.

Key words: Antimicrobial, anticancer, chronic illness, explore, folk medicine

Introduction

Soymida febrifuga, a tree species belonging to the family Meliaceae, has been used as traditional medicine in the Indian subcontinent (Singh *et al.*, 2022). The tree is known for its medicinal properties and has been used to treat various ailments (Kumar *et al.*, 2021; Nayak and Kumar, 2023; Jena and Devi, 2024). Despite its traditional use, the available secondary metabolites and medicinal properties of *S. febrifuga* fruits have not been extensively

studied. Phytochemical analysis of plants is essential to understand their medicinal properties and to identify potential secondary metabolites (Agidew., 2022). These compounds can be used to develop new medicines, functional foods, and other products that promote human health (Kumar *et al.*, 2013; Sorrenti *et al.*, 2023; Devi *et al.*, 2023; Devi *et al.*, 2024; Marndi *et al.*, 2024; Palei *et al.*, 2024). The phytochemical analysis of *S. febrifuga* can provide valuable insights into its bioactive compounds and potential medicinal uses. The aim of the present study is to investigate the qualitative phytochemical analysis of *S. febrifuga* fruits and to explore its probable medicinal uses. The study will analyse the presence of various bioactive compounds, including alkaloids, glycosides, flavonoids, and phenolic compounds, in different extracts of the plant. The findings of this study will provide a scientific basis for the traditional use of *S. febrifuga* fruits in folk medicine and highlight its potential as a source of natural products with medicinal properties (Nayak and Kumar, 2023). The present study is significant because it will contribute to the understanding of the bioactive compounds and medicinal properties of *S. febrifuga* fruits. The study will also provide valuable information for the development of new medicines and other products that promote human health. Furthermore, the study will highlight the importance of conserving traditional knowledge and promoting the sustainable use of medicinal trees like *S. febrifuga*.



Figure 1: Flowers of *S. febrifuga*



Figure 2: Fruits of *S. febrifuga*

Materials and methods

The fruits of *S. febrifuga* were collected from the Rourkela Forest Division of Sundargarh district of Odisha, India (Figure 2). The plant species was identified by the authors (Figure 1). The Soxhlet extraction method was adopted using different solvents for phytochemical analysis (Marndi *et al.*, 2024).

Qualitative phytochemical analysis

Detection of nine secondary metabolites were conducted using standard methods (Sharma *et al.*, 2024).

Test for Tannin: About 1 ml of the fruit extract was taken. Added 3-5 drops of 10% lead acetate solution to it. The formation of gelatinous precipitate confirmed the positive results for the presence of tannin (Tripathi *et al.*, 2024).

Test for saponin: About 1 ml of the fruit extract was taken and 1 ml of distilled water was added and shaken well. The persistent froth formation confirmed the presence of saponin.

Test for flavonoids: About 1 ml of the fruit extract was taken. Added 2 ml of 2% NaOH solution and then dilute HCl to it. The colour initially turned to an intense yellow with NaOH solution and later became colourless. This colour changing transformation confirmed for the presence of flavonoids.

Test for terpenoids: About 1 ml of the filtrate was added with 6 drops of chloroform and placed in the water bath for a few minutes. Then 6 drops of concentrated sulphuric acid were added. The appearance of reddish-brown interface confirmed the presence of terpenoids (Soni *et al.*, 2024).

Test for phenolic compounds: About 1 ml of the fruit extract was taken and added few drops of 5% ferric chloride solution to it. The dark bluish black appearance confirmed the presence of phenolic compounds (Jena *et al.*, 2024).

Test for reducing sugars: About 1 ml of the fruit extract was taken and 2-3 drops of Fehling's solution A and B were respectively added. Then kept in the water bath for some time. The presence of red-orange precipitate confirmed the presence of reducing sugar.

Test for steroids: About 1 ml of the fruit extract was taken. 1 ml of chloroform and 1 ml of concentrated sulphuric acid was added into it. The appearance of 2 phases with the upper red and lower yellow with green fluorescence confirmed the presence of steroids.

Test for alkaloids: About 1 ml of the extract was taken and added 3 to 4 drops of Dragendorff's reagent. The formation of reddish-brown precipitate confirmed the presence of alkaloids.

Test for carbonyl compounds: About 1 ml of the fruit extract was taken added 3 to 4 drops of 2,4-dinitrophenylhydrazine (DNPH) reagent. The yellow crystal formation confirmed the presence of carbonyl compounds (Vajha *et al.*, 2024).

Results and discussion

The qualitative phytochemical analysis of *S. febrifuga* revealed the presence of various bioactive compounds, including tannin, saponin, flavonoids, terpenoids, phenolic compounds, reducing sugars, steroids, alkaloids, and carbonyl compounds (Table 1). The results showed that tannin, saponin, phenolic compounds, and reducing sugars were present in all three extracts

(aqueous, methanol, and ethanol), indicating their widespread distribution in the plant (Figure 3-5). Flavonoids, alkaloids, and terpenoids were detected in the methanol and ethanol extracts, while steroids were present in the aqueous and methanol extracts. The presence of these bioactive compounds suggests that *S. febrifuga* may possess a range of medicinal properties, including antimicrobial, anticancer, antioxidant, insecticidal, and antitubercular activities (Shi *et al.*, 2004). The plant may also have potential in the treatment of chronic illnesses and in reducing blood lipids. The findings of this study provide a scientific basis for the traditional use of *S. febrifuga* in folk medicine and highlight its potential as a source of natural products with medicinal properties (Masyita *et al.*, 2022). Further studies are needed to isolate and characterize the bioactive compounds present in the plant and to evaluate their therapeutic potential (Table 2).

Table 1: Qualitative phytochemical analysis of *S. febrifuga* using different extracts

Bioactive compounds	Extracts		
	Aqueous	Methanol	Ethanol
Tannin	+	+	+
Saponin	+	+	+
Flavonoids	-	+	+
Terpenoids	-	-	+
Phenolic compounds	+	+	+
Reducing sugars	+	+	+
Steroids	+	+	-
Alkaloids	-	+	+
Carbonyl compounds	-	-	+

(+: Positive; -: Negative)

Table 2: Probable medicinal uses as per bioactive compounds present in *S. febrifuga* fruits

Bioactive compounds	Medicinal uses	Source
---------------------	----------------	--------

Tannin	Presence of tannin in aqueous, methanol and ethanol extracts have antimicrobial properties	Smeriglio <i>et al.</i> , (2017)
Saponin	Saponin present in aqueous, methanol and ethanol extracts have the ability to decrease blood lipids	Shi <i>et al.</i> , (2004)
Flavonoids	Flavonoids present in methanol and ethanol extracts have anticancer potentials	Safe <i>et al.</i> , (2021)
Terpenoids	Terpenoids present in ethanol extract could be useful in antimicrobial treatment.	Masyita <i>et al.</i> , (2022)
Phenolic compounds	Phenols present in aqueous, methanol and ethanol extracts have antioxidant effects	Zeb, (2020)
Reducing sugars	Reducing sugars present in aqueous, methanol and ethanol extracts have insecticidal activity	Hu <i>et al.</i> , (2010)
Steroids	Presence of steroids have the potentials to cure chronic illness	Yasir <i>et al.</i> , (2023)
Alkaloids	Presence of alkaloids have potentials of antitubercular properties	Dey <i>et al.</i> , (2020)
Carbonyl compounds	Carbonyl compounds present in ethanol extract have antimicrobial activities	Wareham <i>et al.</i> , (2015)



Figure 3: Detection of secondary metabolites of *S. febrifuga* fruits using aqueous extract

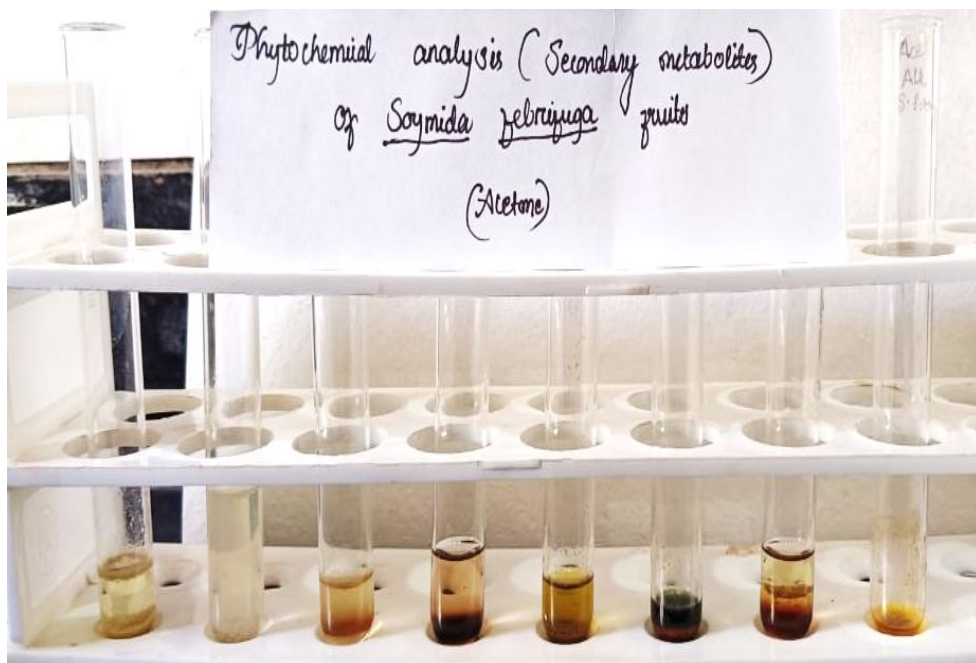


Figure 4: Detection of secondary metabolites of *S. febrifuga* fruits using acetone extract

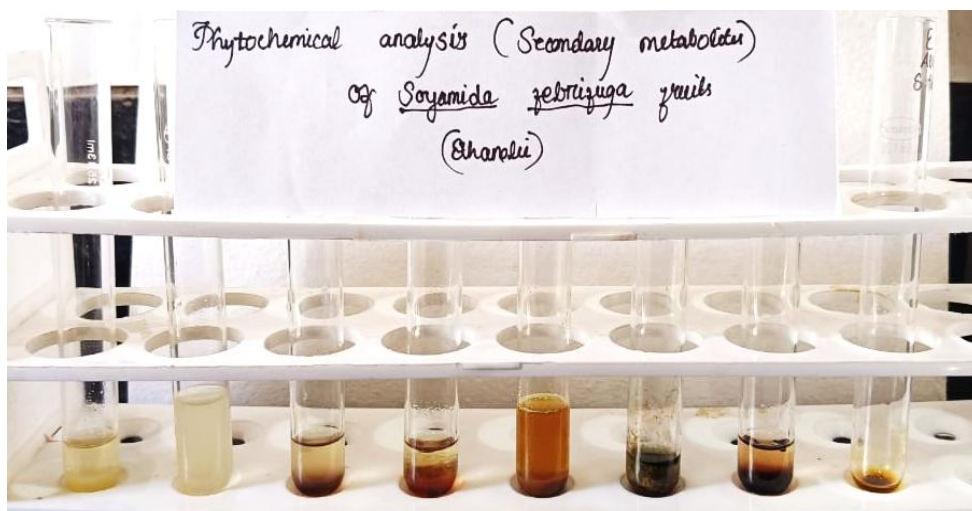


Figure 5: Detection of secondary metabolites of *S. febrifuga* fruits using ethanolic extract

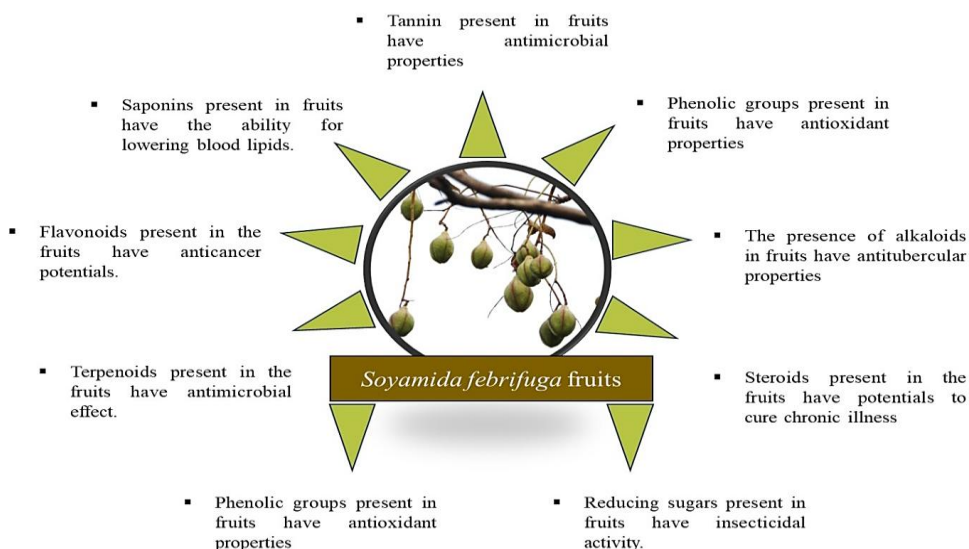


Figure 6: Pharmacological potentials of *S. febrifuga* fruits due to the presence of different bioactive compounds

Conclusion

Present study demonstrated the presence of various bioactive compounds in *S. febrifuga*, indicating its potential medicinal uses (Figure 6). The plant's extracts showed promising antimicrobial, anticancer, antioxidant,

insecticidal, and antitubercular activities, which provide a scientific basis for its traditional use in folk medicine. The study highlights the importance of *S. febrifuga* fruits as a source of natural products with medicinal properties, and further research is warranted to isolate and characterize the bioactive compounds present in the plant and to evaluate their therapeutic potential.

References

- Agidew MG. (2022). Phytochemical analysis of some selected traditional medicinal plants in Ethiopia. Bulletin of the National Research Centre. 46(87). DOI: 10.1186/s42269-022-00770-8.
- Devi RS, Satapathy KB and Kumar S. (2023). Validation of tribal claims for formulation of future drugs through evaluation of ethno-pharmacological values of *Ludwigia adscendens*. Medicinal Plants. 15(4): 691-697.
- Devi RS, Satapathy KB, Manjula BL, Sharma BP and Kumar S. (2024). Evaluation of ethnopharmacological potential of *Oenanthe javanica* DC. Annals of Biology. 40(1): 135-139.
- Dey P, Kundu A, Kumar A, Gupta M, Lee BM, Bhakta T, Dash S and Kim HS. (2020). Analysis of alkaloids (indole alkaloids, isoquinoline alkaloids, tropane alkaloids). Recent Advances in Natural Products Analysis. DOI: 10.1016/B978-0-12-816455-6.00015-9
- Hu JS, Gelman DB, Salvucci ME, Chen YP and Blackburn MB. (2010). Insecticidal activity of some reducing sugars against the sweet potato whitefly, *Bemisia tabaci*, biotype B. Journal of Insect Science. 10: 203. DOI: 10.1673/031.010.20301.
- Jena N and Devi RS. (2024). Some common native medicinal plants used by tribals in Odisha, India. Journal of Biodiversity and Conservation. 8(1): 75-82.
- Jena N, Kumar S and Sharma BP. (2024). Qualitative phytochemical analysis of *Phyllanthus virgatus* G. Forst.: a riparian herb. Biological Archives, Volume 1. Ambika Prasad Research Foundation, India.
- Kumar S, Behera SP and Jena PK. (2013). Validation of tribal claims on *Dioscorea pentaphylla* through phytochemical screening and evaluation of antibacterial activity. Plant Science Research. 35: 55-61.
- Kumar SN, Mishra S and Kumar S. (2021). Documentation of Indigenous Traditional Knowledge (ITK) on commonly available plants in Koira Range, Bonai Forest Division, Sundargarh, Odisha, India. Asian Plant Research Journal. 8(4): 83-95.
- Marndi S, Barik M and Kumar S. (2024). Phytochemical and cytotoxicity analysis of *Eulophia explanata* Lindl. (Tuber extracts). African Journal of Biological Sciences. 6(4): 2751-2756. DOI: 10.48047/AFJBS.6. Si4.2024.2751-2756.

- Masyita A, Mustika Sari R, Dwi Astuti A, Yasir B, Rahma RN, Emran TB, Nainu F and Simal-Gandara J. (2022). Terpenes and terpenoids as main bioactive compounds of essential oils, their roles in human health and potential application as natural food preservatives. *Food Chemistry X*. 13: 100217. DOI: 10.1016/j.fochx.2022.100217.
- Nayak S and Kumar S. (2023). Medicinal plants used by tribals of Odisha. State Medicinal Plants Board, Bhubaneswar, Odisha & Ambika Prasad Research Foundation, Odisha, India.
- Palei S, Dagwal MJ, Choudhari SS, Raut ST, Parmeela HC, Sharma BP and Kumar S. (2024). Ethno-pharmacological values of *Drosera Indica* L.: a carnivorous plant of India. *African Journal of Biological Sciences*. 6(Si4): 4908-4913; DOI: 0.48047/AFJBS.6.Si4.2024.4908-4913.
- Safe S, Jayaraman A, Chapkin RS, Howard M, Mohankumar K and Shrestha R. (2021). Flavonoids: structure-function and mechanisms of action and opportunities for drug development. *Toxicology Research*. 37(2): 147-162.
- Sharma BP, Tripathi G, Sharma S, Dehar PS, Kumar S, Jena N and Sureshrao GA. (2024). Qualitative phytochemical analysis of *Ficus religiosa* fruits. *Medico Biowealth of India*, Volume 17. Ambika Prasad Research Foundation, India.
- Shi J, Arunasalam K, Yeung D, Kakuda Y, Mittal G and Jiang Y. (2004). Saponins from edible legumes: chemistry, processing, and health benefits. *Journal of Medicinal Food*. 7(1): 67-78.
- Singh AK, Chandra KK, Kumar R and Bhardwaj AK. (2022). Phytochemical analysis and medicinal properties of *Soymida febrifuga* (Roxb.) A. Juss: a review. *Advances in BioResearch*. 13(6): 37-43.
- Smeriglio A, Barreca D, Bellocchio E and Trombetta D. (2017). Proanthocyanidins and hydrolysable tannins: occurrence, dietary intake and pharmacological effects. *British Journal of Pharmacology*. 174(11): 1244-1262.
- Soni P, Mahendru N, Dimri R, Hamdy R, Jena N and Kumar S. (2024). Qualitative phytochemical analysis of *Cascabela thevetia* fruits. *Biological Archives*, Volume 1. Ambika Prasad Research Foundation, India.
- Sorrenti V, Buro I, Consoli V and Vanella L. (2023). Recent advances in health benefits of bioactive compounds from food wastes and by-products: biochemical aspects. *International Journal of Molecular Sciences*. 24(3). DOI:10.3390/ijms24032019.
- Tripathi G, Jadhao AB, Kumar S, Jena N and Das K. (2024). Qualitative phytochemical analysis of *Datura stramonium* L. fruits. *Biological Archives*, Volume 1. Ambika Prasad Research Foundation, India.
- Vajha M, Das K, Hebbar DR, Singh B, Jena N, Kumar S and Kumar N. (2024). Qualitative phytochemical analysis of *Sapindus emarginatus* Vahl: a natural soapnut of India.

Medico Biowealth of India, Volume 16. Ambika Prasad Research Foundation, India.

- Wareham LK, Poole RK and Tinajero-Trejo M. (2015). CO-releasing metal carbonyl compounds as antimicrobial agents in the post-antibiotic era. *Journal of Biological Chemistry*. 290(31):18999-9007. DOI: 10.1074/jbc.R115.642926.
- Yasir M, Goyal A and Sonthalia S. (2023). Corticosteroid adverse effects. StatPearls [Internet]. Treasure Island (FL): Stat Pearls Publishing. DOI: <https://www.ncbi.nlm.nih.gov/books/NBK531462/>.
- Zeb A. (2020). Concept, mechanism, and applications of phenolic antioxidants in foods. *Journal of Food Biochemistry*. 44(9): e13394. DOI: 10.1111/jfbc.13394.

Phytochemical profiling of flowers of *Eranthemum nervosum* (Acanthaceae)

Kadambini Das¹, Balkar Singh², Jyoti Chauhan³, Binod Kumar Mahapatra⁴, Subhalakshmi Rout^{5*} and Sanjeet Kumar⁵

¹University Department of Botany, Babasaheb Bhimrao Ambedkar Bihar University, Muzaffarpur, Bihar, India

²Department of Botany, Arya P.G. College, Panipat, Haryana, India

³Department of Botany, Institute of Integrated and Honors Studies, Kurukshetra University, Kurukshetra, Haryana, India

⁴Post Graduate Department of Botany, P.N. College Autonomous, Khordha, Odisha, India

⁵Ambika Prasad Research Foundation, Odisha, India

*Email-id: subhalakshmirout98@gmail.com

DOI: <https://doi.org/10.5281/zenodo.14845010>



Licensed under a Creative Commons Attribution 4.0 International License

Abstract

The present study investigated the qualitative phytochemical analysis of *Eranthemum nervosum* flowers using aqueous, ethanol, and methanol extracts. The results revealed the presence of bioactive compounds such as tannins, saponins, flavonoids, phenolic compounds, and reducing sugars, which are associated with various medicinal properties. The study suggests that *E. nervosum* may possesses potential therapeutic applications supporting its traditional use in folk medicine.

Key words: Secondary metabolites, flowers, medicinal plants

Introduction

Plants have played a vital role in human existence for centuries, providing essential resources beyond just sustenance and habitat, including a rich source of medicinal properties (Das *et al.*, 2020; Das *et al.*, 2022; Saha *et al.*, 2022; Mishra *et al.*, 2022; Devi *et al.*, 2022; Agarwal *et al.*, 2023; Devi *et al.*, 2024; Sahu *et al.*, 2024). The practice of using plants for medicinal purposes

has its roots in ancient cultures, where diverse civilizations developed unique traditional medicine systems that relied heavily on plant-based remedies. (Kumar *et al.*, 2012; Kumar, 2015; Kumar and Jena, 2017; Kumar, 2017; Swain *et al.*, 2020; Kumar and Kumar, 2020; Kumar *et al.*, 2021). The importance of plants in healthcare has endured even with the advancement of modern medicine, as a significant number of contemporary medicines owe their origins to compounds extracted from plants (Laware *et al.*, 2024; Mukherjee *et al.*, 2024; Singh *et al.*, 2024; Jaiswal *et al.*, 2024; Sharma *et al.*, 2024; Dimri *et al.*, 2024). There has been a surge of interest in phytochemical analysis in recent years, fueled by the desire to scientifically confirm the traditional uses of plants and uncover novel bioactive compounds with potential therapeutic applications (Dimri *et al.*, 2024; Sethi *et al.*, 2024; Sharma *et al.*, 2024; Hebbar *et al.*, 2024; Bhat *et al.*, 2024; Palei *et al.*, 2024; Jena *et al.*, 2024; Kumar, 2025; Jena *et al.*, 2025). Phytochemical studies encompass a comprehensive process of extracting, identifying, and analyzing the bioactive compounds found in plants, thereby shedding light on their potential medicinal benefits and therapeutic applications (Behera *et al.*, 2022). Such studies are essential for the development of new drugs and therapies, as well as for the conservation and sustainable use of plant resources. The importance of phytochemical studies is amplified by the reality that a vast number of plants remain untapped for their medicinal potential, and the alarming loss of traditional wisdom and biodiversity poses a significant threat to the discovery of novel plant-derived medicines (Karle *et al.*, 2022; Nayak and Kumar, 2023). In this context, the present study aims to investigate the phytochemical profile of *Eranthemum nervosum*, a plant species used in traditional medicine, with a view to validating its traditional uses and identifying potential new bioactive compounds.

Methodology

The flowers of *E. nervosum* were collected from Mahanadi River areas, Cuttack, Odisha, India. Authors have identified the plant specimen (Figure 1-2). Flower extracts of aqueous, ethanol, and methanol were prepared, and nine different bioactive compounds were detected using standard methods (Marndi *et al.*, 2024).

Qualitative phytochemical analysis

Detection of nine secondary metabolites were conducted using standard methods (Kumar *et al.*, 2013).



Figure 1: Habitat of *E. nervosum*

Test for Tannin: About 1 ml of the flower extract was taken. Added 3-5 drops of 10% lead acetate solution to it. The formation of gelatinous precipitate confirmed the positive results for the presence of tannin.

Test for saponin: About 1 ml of the flower extract was taken and 1 ml of distilled water was added and shaken well. The persistent froth formation confirmed the presence of saponin.

Test for flavonoids: About 1 ml of the flower extract was taken. Added 2 ml of 2 % NaOH solution and then dilute HCl to it. The colour initially turned to an intense yellow with NaOH solution and later became colourless. This colour changing transformation confirmed for the presence of flavonoids.



Figure 2: Flowers of *E. nervosum*

Test for terpenoids: About 1 ml of the filtrate was added with 6 drops of chloroform and placed in the water bath for a few minutes. Then 6 drops of

concentrated sulphuric acid were added. The appearance of reddish-brown interface confirmed the presence of terpenoids.

Test for phenolic compounds: About 1 ml of the flower extract was taken and added few drops of 5% ferric chloride solution to it. The dark bluish black appearance confirmed the presence of phenolic compounds.

Test for reducing sugars: About 1 ml of the flower extract was taken and 2-3 drops of Fehling's solution A and B were respectively added. Then kept in the water bath for some time. The presence of red-orange precipitate confirmed the presence of reducing sugar.

Test for steroids: About 1 ml of the flower extract was taken. 1 ml of chloroform and 1 ml of concentrated sulphuric acid was added into it. The appearance of 2 phases with the upper red and lower yellow with green fluorescence confirmed the presence of steroids.

Test for alkaloids: About 1 ml of flower extract was taken and added 3 to 4 drops of Dragendorff's reagent. The formation of reddish-brown precipitate confirmed the presence of alkaloids.

Test for carbonyl compounds: About 1 ml of the flower extract was taken added 3 to 4 drops of 2,4-dinitrophenylhydrazine (DNPH) reagent. The yellow crystal formation confirmed the presence of carbonyl compounds.

Results and discussion

The qualitative phytochemical analysis of *E. nervosum*, as presented in Table 1, reveals the presence of various bioactive compounds in different extracts of the plant. The results show that tannins are present in all three extracts (aqueous, ethanol, and methanol), while saponins are only present in the

aqueous extract. Flavonoids, phenolic compounds, and reducing sugars are present in both ethanol and methanol extracts, but absent in the aqueous extract. These findings suggest that the choice of solvent can significantly impact the extraction of bioactive compounds from *E. nervosum*. The presence of these bioactive compounds in *E. nervosum* is associated with various medicinal properties, as listed in Table 2. For example, the presence of tannins is linked to wound-healing properties, while saponins are associated with hypocholesterolaemia activity. Flavonoids, phenolic compounds, and reducing sugars are reported to have anti-cholinesterase, anti-inflammatory, and antioxidant activities, respectively. These findings provide a scientific basis for the traditional use of *E. nervosum* in folk medicine and highlight its potential as a source of new medicinal agents (Figure 3).

Table 1: Qualitative phytochemical analysis of *E. nervosum* using different extracts

Bioactive compounds	Extracts		
	Aqueous	Ethanol	Methanol
Tannin	+ve	+ve	+ve
Saponin	+ve	-ve	-ve
Flavonoids	-ve	+ve	+ve
Terpenoids	-ve	-ve	-ve
Phenolic compounds	-ve	+ve	+ve
Reducing sugars	-ve	+ve	+ve
Steroids	-ve	-ve	-ve
Alkaloids	-ve	-ve	-ve
Carbonyl compounds	-ve	-ve	-ve

(+ve: Positive; -ve: negative)

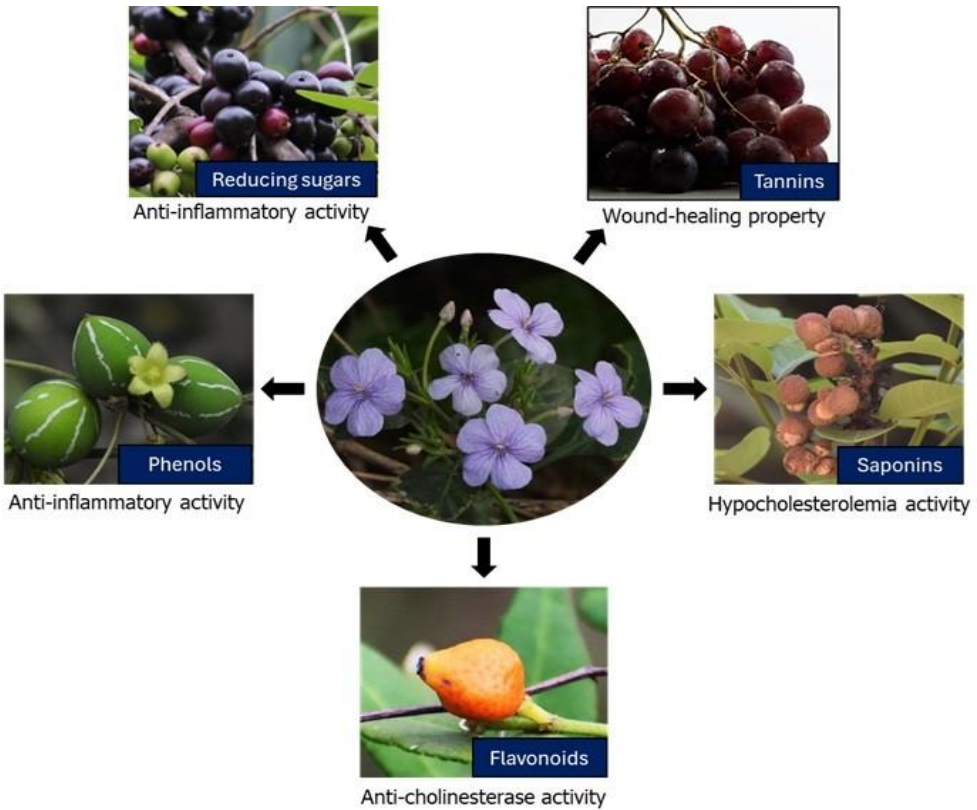


Figure 3: Probable medicinal potentials of *E. nervosum*

Table 2: Probable medicinal uses of *E. nervosum* as per presence of bioactive compounds

Bioactive compounds	Medicinal uses	Source
Tannin	Tannins present in aqueous, ethanol, and methanol extracts have wound-healing properties.	Sharma <i>et al.</i> , (2019)
Saponin	Saponins present in aqueous, ethanol, and methanol extracts have hypocholesterolemia activity.	Timilsena <i>et al.</i> , (2023)
Flavonoids	Flavonoids present in aqueous, ethanol, and	Panche <i>et al.</i> , (2016)

	methanol extracts have anti-cholinesterase activity.	
Phenolic compounds	Phenolic compounds in aqueous, ethanol, and methanol extracts have anti-inflammatory activity.	Rahman <i>et al.</i> , (2021)
Reducing sugars	Reducing sugars in the aqueous, ethanol, and methanol extracts have antioxidant activity.	Khatri and Chhetri, (2020)

Conclusion

The phytochemical analysis of *E. nervosum* revealed the presence of various bioactive compounds, including tannins, saponins, flavonoids, phenolic compounds, and reducing sugars, which are associated with several medicinal properties. The study validates the traditional use of *E. nervosum* in folk medicine and highlights its potential as a source of new medicinal agents for the treatment of various diseases, including wounds, cardiovascular disorders, and oxidative stress-related disorders.

References

- Agarwal B, Rathore S, Krishnan R, Jaiswal A, Panda A, Hegde L and Kumar S. (2023). A check list on wild nutraceutical tuberous plants of India. *Indian Forester*. 149(5): 587-590.
- Behera P, Kumar SN and Kumar S. (2022). Primary detection of natural phenols from the stems used in teeth problems by the tribal communities of Bonai Forest Division, Odisha. *Journal of Biodiversity and Conservation*. 6(4): 516-518.
- Bhat SS, Tallur PN, Prameela HC, Thakur S, Singh B, Chauhan J, Kumar S and Singh R. (2024). Medicinal, phytochemical screening and cytotoxicity of *Pergularia daemia* (Forssk.) Chiov. *African Journal of Biological Sciences*. 6(Si4): 5867-5874.

- Das L, Mishra S, Das A, Dimri R and Kumar S. (2022). Some common flora of temple city of Odisha, India: source for ethno-medico-cultural values. *Indian Forester*. 148(2): 207-212.
- Das MK, Das PK, Kumar S and Singh NR. (2020). Flora of Khandagiri & Udayagiri, an urban heritage of Odisha. *Indian Forester*. 146(6): 509-518.
- Devi RS, Satapathy KB and Kumar S. (2022). Ethnomedicinal plants of Phumdi, Loktak lake, Manipur, India. *Asian Pacific Journal of Health Sciences*. 9(4): 77-80.
- Devi RS, Satapathy KB and Kumar S. (2024). Loktak Lake of the state Manipur: A review to educate the intellectuals and awareness on its biowealth. *Educational Administration: Theory and Practice*. 30(5): 6936–6947. DOI: 10.53555/kuey.v30i5.4064.
- Dimri R, Das K, Devi RS, Kumar S, Kumar N and Das A. (2024). Ecological, socioeconomic and nutraceutical values of *Zizania latifolia* (Kambong): a wetland grass for Sangai deer & human population. *Indian Forester*. 150 (10): 956-961.
- Dimri R, Sinha MK, Moharana A, Ofoeze MA and Kumar S. (2024). Wild Nutraceutical Plants. Ambika Prasad Research Foundation, India. DOI: 10.5281/zenodo.10574104.
- Hebbbar DR, Behera B, Kumar N, Sharma A, Hossain E, Kumar S and Sharma BP. (2024). Validation of traditional therapeutic practices on *Boswellia serrata* for the treatment of asthma and other respiratory problems. *African Journal of Biomedical Research*. 27(3s): 6367-6372.
- Jaiswal A, Hossain E, Kumar N and Kumar S. (2024). Plants & Secondary Metabolites, Volume II. Ambika Prasad Research Foundation, Odisha, India. DOI: 10.5281/zenodo.13995335
- Jena N, Rout S, Devi RS and Kumar S. (2024). Phytochemical and cytotoxicity analysis of fruits of *Zanthoxylum asiaticum* (L.) Appelhans, Groppo & J. Wen: a minor fruit plant of Odisha, India. *E-planet*. 22(1): 62-70.
- Jena N, Rout S, Mishra S and Kumar S. (2025). Evaluation of quantitative ethnobotanical uses in Mayurbhanj district, Odisha, India. *Journal of Biodiversity and Conservation*. 9(1): 1-29.

- Karle B, Rote K, Kumari P, Gagotia R, Choudhari S, Manjula BL and Kumar S. (2022). Common wild ethnomedicinal tuberous plants of Asia. Ecology Environment & Conservation. 28: S353-S361.
- Khatri D and Chhetri SBB. (2020). Reducing sugar, total phenolic content, and antioxidant potential of Nepalese plants. BioMed Research International. 2020: 7296859. DOI: 10.1155/2020/7296859.
- Kumar A and Kumar S. (2020). Some medicinal orchid species of Jharkhand, India. Journal of Biodiversity and Conservation. 4(4): 398-404.
- Kumar S and Jena PK. (2017). Tools from biodiversity: wild nutraceutical plants. Ed: James N Furze et al.: identifying frontier research integrating mathematic approaches to diverse systems / sustainability. Springer, Switzerland. DOI: 10.1007/978-3-319-43901-3-9.
- Kumar S, Behera SP and Jena PK. (2013). Validation of tribal claims on *Dioscorea pentaphylla* through phytochemical screening and evaluation of antibacterial activity. Plant Science Research. 35: 55-61.
- Kumar S, Tripathy PK and Jena PK. (2012). Study of wild edible plants among tribal groups of Similipal Biosphere Reserve Forest, Odisha, India; with special reference to *Dioscorea* species. International Journal of Biological Technology. 3(1): 11-19.
- Kumar S. (2015). Life support plant species among aboriginals of Similipal Biosphere Reserve Forest, Odisha: diversity and conservation. International Journal of Biological Sciences and Engineering. 6(2): 80-86.
- Kumar S. (2017). Yam (*Dioscorea* species): Future functional wild food of tribal Odisha, India. In Frontiers in bioactive compounds. Bentham Science Publishers Limited.
- Kumar S. (2025). Leveraging the nutritional and medicinal potential of wild yam for a sustainable future. Journal of Biodiversity and Conservation. 9(1): E1-E2.
- Kumar SN, Mishra S and Kumar S. (2021). Documentation of Indigenous Traditional Knowledge (ITK) on commonly available plants in Koira Range, Bonai Forest Division, Sundargarh, Odisha, India. Asian Plant Research Journal. 8(4): 83-95.
- Laware S, Jaiswal A, Behera M and Kumar S. (2024). Plants & Secondary Metabolites, Volume I. Ambika Prasad Research Foundation, Odisha, India. DOI: 10.5281/zenodo.13742393.

- Marndi S, Barik M and Kumar S. (2024). Phytochemical and cytotoxicity analysis of *Eulophia explanata* Lindl. (Tuber extracts). African Journal of Biological Sciences. 6(4):2751-2756; DOI: 10.48047/AFJBS.6.Si4.2024.2751-2756.
- Mishra S, Agrawal B, Rathore S, Mishra AK and Kumar S. (2022). Medicinal grasses of Eastern Ghats of Odisha, India. Indian Forester. 148(11): 1172-1174.
- Mukherjee S, Mudalkar S, Singh G and Kumar S. (2024). Medico-Biowealth of India, Volume 17. Ambika Prasad Research Foundation, Odisha, India. DOI: 10.5281/zenodo.13924509.
- Nayak S and Kumar S. (2023). Medicinal plants used by tribals of Odisha. State Medicinal Plants Board, Bhubaneswar, Odisha & Ambika Prasad Research Foundation, Odisha, India.
- Palei S, Dagwal MJ, Choudhari SS, Raut ST, Parmeela HC, Sharma BP and Kumar S. (2024). Ethno-pharmacological values of *Drosera indica* L.: a carnivorous Plant of India. African Journal of Biological Sciences. 6(Si4): 4908-4913. DOI: 10.48047/AFJBS.6.Si4.2024.4908-4913.
- Panche AN, Diwan AD and Chandra SR. (2016). Flavonoids: an overview. Journal of Nutritional Science. 5: e47. DOI: 10.1017/jns.2016.41.
- Rahman MM, Rahaman MS, Islam MR, Rahman F, Mithi FM, Alqahtani T, Almikhlaifi MA, Alghamdi SQ, Alruwaili AS, Hossain MS, Ahmed M, Das R, Emran TB and Uddin MS. (2021). Role of phenolic compounds in human disease: current knowledge and future prospects. Molecules. 27(1): 233. DOI: 10.3390/molecules27010233.
- Saha M, Roy AB, Kumar S and Datta BK. (2022). Ethnobotanical diversity of some wetland plants of North-East India: implications for conservation. Indian Forester. 148(11): 1149-1154.
- Sahu LM, Das K, Sahu JK, Das A, Behera B and Kumar S. (2024). Eco-social services of native tree species: a conservation approach. Indian Forester. 150(7): 630-634.
- Sethi J, Jena N and Kumar S. (2024). Medicinal Plants of Rourkela Forest Division, Odisha, India. Asian Journal of Environment & Ecology. 23 (12):69-84. DOI: 10.9734/ajee/2024/v23i12635.
- Sharma BP, Marndi S and S Kumar. (2024). Orchids of India, food, medicinal and ecological aspects. Ambika Prasad Research Foundation, India. DOI: 10.5281/zenodo.11209084.

- Sharma BP, Saradar B, Choudhari SS, Sampatrao TS, Marndi S and Kumar S. (2024). Orchid diversity in mining impacted forest areas of Odisha: documentation, restoration and conservation aspect. *Indian Forester*. 150 (9): 876-881.
- Sharma K, Kumar V, Kaur J, Tanwar B, Goyal A, Sharma R, Gat Y and Kumar A. (2019). Health effects, sources, utilization and safety of tannins: a critical review. *Toxin Reviews*. DOI: 10.1080/15569543.2019.1662813.
- Singh RK and Kumar S. (2024). *Medico-Biowealth of India*, Volume 18. Ambika Prasad Research Foundation, Odisha, India. DOI: 10.5281/zenodo.14581320.
- Swain J, Kumar S, Parida S and Jena PK. (2020). *In-vitro* screening of antibacterial activities of selected wild tuberous plants of Odisha, India. *Asian Journal of Biological and Life Sciences*. 9(1): 79-87.
- Timilsena YP, Phosanam A and Stockmann R. (2023). Perspectives on saponins: food functionality and applications. *International Journal of Molecular Sciences*. 24(17): 13538. DOI: 10.3390/ijms241713538.

Phytochemical and cytotoxic analysis of bulbs of *Drimia indica* (Jungli piyaz): a medicinal plant of Asparagaceae

J Jeline Rani¹, Gireesh Tripathi², Shreya Pattanayak³, Suchitra Boxi⁴, Subhalakshmi Rout⁵, Sanjeet Kumar⁵ and Alok Ranjan Sahu^{6*}

¹Department of Botany, Bishop Heber College, Tiruchirappalli, Tamil Nadu, India

²Department of Pharmacy, Shri Krishna University, NH Sagar Road, Chhatarpur, Madhya Pradesh, India

³Department of Biotechnology, Odisha University of Technology and Research, Bhubaneswar, Odisha, India

⁴Department of Botany, Davangere University, Karnataka, India

⁵Ambika Prasad Research Foundation, Odisha, India

⁶Department of Botany, Vikash Degree College, Bargarh, Odisha, India

*Email-Id: alok.btgene@gmail.com

DOI: <https://doi.org/10.5281/zenodo.14845056>



Licensed under a Creative Commons Attribution 4.0 International License

Abstract

Drimia indica, an herb used in traditional medicine, was investigated for its bioactive compounds and cytotoxic potential. Qualitative phytochemical analysis of the hydroethanolic extract of *D. indica* bulbs revealed the presence of tannins, saponins, flavonoids, phenolic compounds, reducing sugars, and steroids. Cytotoxic analysis using the brine shrimp lethality assay showed that the extract exhibited significant cytotoxic activity, with a 100% death rate at concentrations of 25-200 mg/ml. The results suggested that *D. indica* bulbs possess bioactive compounds with potential therapeutic applications.

Key words: *Artemia salina*, bioactive compounds, bulb, traditional

Introduction

For centuries, bulbous plants have played a vital role in traditional medicine, serving as a rich source of bioactive compounds with potential healing properties (Karle *et al.*, 2022; Nayak and Kumar, 2023; Dimri *et al.*, 2024;

Kumar, 2025). These plants, including *Drimia indica* (Figure 1) have been utilized across cultures to treat various health issues, ranging from infections to chronic conditions (Kumar *et al.*, 2012; Kumar, 2015; Kumar and Jena, 2017; Kumar *et al.*, 2017; Jena and Devi, 2024).



Figure 1: Bulb of *D. indica*

The distinct characteristics of bulbs, such as their ability to store nutrients and water, make them an appealing target for phytochemical research. Phytochemical screening is a critical step in identifying new plant-based drugs (Jena *et al.*, 2024; Jena *et al.*, 2025). Phytochemical screening provides

valuable insights into the potential toxicity and interactions of plant-based medicines (Devi *et al.*, 2024a). Despite its importance, many bulbous plants remain understudied. *D. indica*, for instance, is a bulbous plant with purported health benefits, but it requires systematic phytochemical screening to fully comprehend its bioactive compounds and potential therapeutic applications. The significance of phytochemical screening extends beyond drug discovery, contributing to the conservation of plant biodiversity and promoting sustainable healthcare practices. By exploring the medicinal properties of bulbous plants, researchers can help preserve traditional knowledge and promote the use of plant-based medicines that are accessible, affordable, and effective.

Methodology

The bulbs of *D. indica* were collected from Sundargarh district, Odisha, in September 2024 (Figure 2). The Soxhlet extraction method was used using three solvents (aqueous, ethanol, and methanol) for phytochemical analysis (Devi *et al.*, 2023). Nine different bioactive compounds were detected using standard methods (Kumar *et al.*, 2013).

Qualitative phytochemical analysis for secondary metabolites

Test for tannin: 2-5 drops of 0.1 % lead acetate solution were added to 1 ml of the filtrate of the bulb extract. The white gelatinous precipitate provided a positive result for the presence of tannins.

Test for saponin: 1 ml of distilled water was added to 1 ml of the filtrate of the bulb extract and shaken vigorously. The persistent froth formation after shaking indicated the presence of saponin.



Figure 2: Collection of bulbs for experimental works

Test for flavonoids: 2 ml of 2 % NaOH solution and 3 drops of dilute HCl were added to 1 ml of the filtrate of the bulb extract. The colour of the filtrate initially turned to an intense yellow colour with NaOH solution and later turned colourless. This colour change confirmed the presence of flavonoids.

Test for terpenoids: 1 ml of the filtrate of bulb extract was added with 6 drops of chloroform and placed in the water bath for a few minutes. Then 6 drops of concentrated H_2SO_4 were added. The reddish-brown interface confirmed the positive result for the presence of terpenoids.

Test for phenolic compounds: 1 ml of the filtrate of bulb extract was taken and a few drops of 5 % Ferric chloride solution were added. The bluish-black colour provided the positive result of the phenolic compounds.

Test for reducing sugars: 1 ml of the filtrate of bulb extract was taken and 2 drops of Fehling's solution A followed by Fehling's solution B were added and kept in the water bath for a few minutes. The presence of red-orange precipitate confirmed the presence of reducing sugars.

Test for steroids: 1 ml of the filtrate of the bulb extract was added with 1 ml of chloroform and 1 ml of concentrated H_2SO_4 were added to it. The appearance of upper red and lower yellow with green fluorescence provided the positive result of the test for steroids.

Test for alkaloids: 1 ml of the filtrate of the bulb extract was taken and 3-4 drops of Dragendroff's reagent was added to it. The formation of a reddish-brown precipitate confirmed the presence of alkaloids.

Test for carbonyl compounds: 1 ml of the filtrate of the bulb extract was taken and 3-4 drops of 2,4-Di-nitrophenylhydrazine reagent was added to it. The formation of yellow crystals confirmed the presence of carbonyl compounds.

Cytotoxicity analysis: For the cytotoxicity test, the hatching of Brine shrimp cysts (MAF Peqon Artemia) was the initial process. Standardisation of the optimum salinity was done at 2.0, 3.5 and 5.0 % saline concentrations to

check the optimum salinity for proper hatching of Brine shrimp (*Artemia salina*) cysts (Devi *et al.*, 2024b). The brine shrimp cysts were then incubated in 3.5 % saline water with proper aeration, room temperature or between (28-35°C) and light for 72 hours. Proper hatching could be observed within 24-72 hours depending upon the quality of cysts, proper aeration and light provided. Different concentrations (25 mg ml⁻¹, 50 mg ml⁻¹, 100 mg ml⁻¹ and 200 mg ml⁻¹) of the bulb extracts were taken and 3.5% saline water was used to make the volume of 2 ml in each test tube. 1 % DMSO was used to dissolve the crude extracts. 10 live nauplii were selected and introduced to five test tubes of the extracts. Positive and negative controls were prepared using 3.5% saline water and vincristine sulphate (5 mg ml⁻¹) respectively with a volume of 2 ml. The live larvae are highly mobile and thus differentiated from the unhatched cysts. The survivor nauplii were counted and the death % was analysed (Marndi *et al.*, 2024).

Results and discussion

The qualitative phytochemical analysis of the hydroethanolic extract of *D. indica* bulbs revealed the presence of tannins, saponins, flavonoids, phenolic compounds, reducing sugars, and steroids (Table 2). The results indicate that the plant contains a diverse range of bioactive compounds that could contribute to its medicinal properties. The cytotoxic analysis of the extract showed significant activity against brine shrimp nauplii, with a 100% death rate at concentrations of 25-200 mg/mL (Table 2). The IC₅₀ value of the extract was found to be 25 mg/mL, indicating its potential as a cytotoxic agent. The positive control, vincristine sulphate, also showed 100% cytotoxicity at a concentration of 10 mg/mL. The results suggest that the hydroethanolic extract of *D. indica* bulbs possesses significant cytotoxic activity, warranting further investigation into its potential as an anticancer

agent. The presence of a diverse range of bioactive compounds in the hydroethanolic extract of *D. indica* bulbs is consistent with the plant's traditional use in medicine. The cytotoxic activity of the extract against brine shrimp nauplii suggests that it may possess anticancer properties, although further studies are needed to confirm this. The results of this study highlight the potential of *D. indica* as a source of novel anticancer agents and it may possess other pharmacological potentials (Figure 3). Further studies are needed to isolate and characterize the bioactive compounds responsible for the cytotoxic activity of the extract, and to evaluate its safety and efficacy in animal models. Additionally, the study suggests that phytochemical screening and cytotoxic analysis can be useful tools for identifying plants with potential anticancer properties.

Table 1: Qualitative phytochemical analysis of *D. indica* bulbs using different extracts

Bioactive compounds	Hydroethanolic extract
Tannins	+ve
Saponins	+ve
Flavonoids	+ve
Terpenoids	-ve
Phenolic compounds	+ve
Reducing sugars	+ve
Steroids	+ve
Alkaloids	-ve
Carbonyl compounds	-ve

(+ve: Presence; -ve: Absence)

Table 2: Cytotoxic analysis of *D. indica* bulbs

Extract	Concentration (in mg/ml)	Initial number of Nauplii	Number of deaths of Nauplii (after in hours)		Death rates (%)
			1	2	
Hydroethanolic extract	25	10	4	10	100
	50	10	10	10	100
	100	10	10	10	100
	200	10	10	10	100
	3.5% Saline	10	0	0	0
	Vincristine sulphate	10	10	10	100

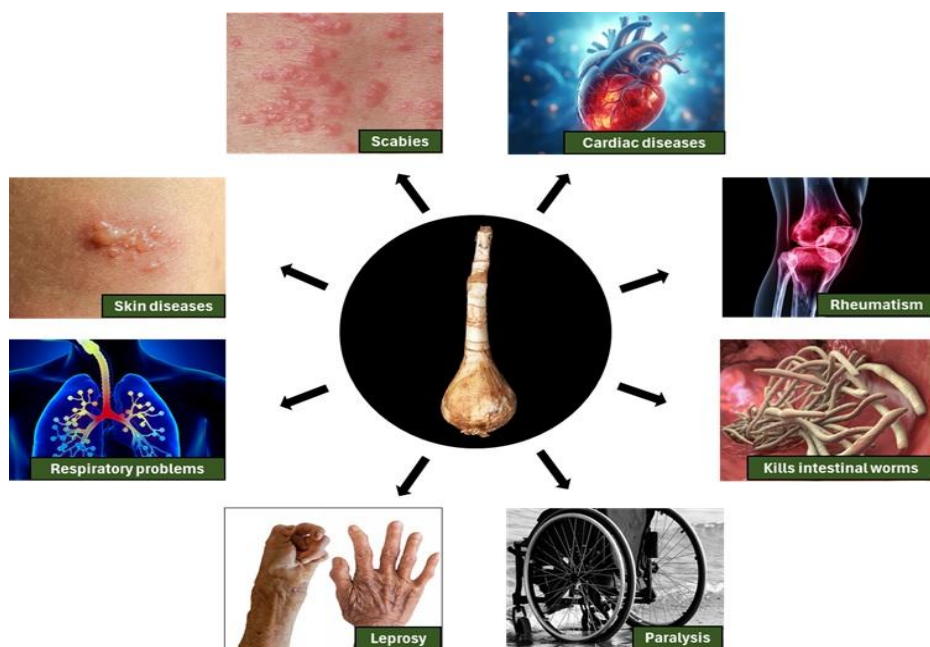


Figure 3: Probable pharmacological potential of *D. indica*

Conclusion

The present study demonstrates the phytochemical and cytotoxic potential of *Drimia indica* bulbs. The qualitative phytochemical analysis revealed the presence of various bioactive compounds, while the cytotoxic analysis showed significant activity against brine shrimp nauplii. These findings suggest that *D. indica* may be a valuable source of novel anticancer agents, and warrant further investigation into its pharmacological properties and potential therapeutic applications.

References

- Devi RS, Kumar A, Jadhav JY, Satapathy KB and Kumar S. (2024a). Economically important plants of Loktak Lake, Manipur, India. *Indian Forester*. 150(12): 1253-1256.
- Devi RS, Satapathy KB and Kumar S. (2023). Validation of tribal claims for formulation of future drugs through evaluation of ethno-pharmacological values of *Ludwigia adscendens*. *Medicinal Plants*. 15(4): 691-697.
- Devi RS, Satapathy KB, Manjula BL, Sharma BP and Kumar S. (2024b). Evaluation of ethnopharmacological potential of *Oenanthe javanica* DC. *Annals of Biology*. 40(1): 135-139.
- Dimri R, Das K, Devi RS, Kumar S, Kumar N and Das A. (2024). Ecological, socioeconomic and nutraceutical values of *Zizania latifolia* (Kambong): a wetland grass for Sangai deer & human population. *Indian Forester*. 150(10): 956-961.
- Jena N and Devi RS. (2024). Some common native medicinal plants used by tribals in Odisha, India. *Journal of Biodiversity and Conservation*. 8(1): 75-82.
- Jena N, Rout S, Devi RS and Kumar S. (2024). Phytochemical and cytotoxicity analysis of fruits of *Zanthoxylum asiaticum* (L.) Appelhans, Groppo & J.Wen: a minor fruit plant of Odisha, India. *E-planet*. 22(1): 62-70.
- Jena N, Rout S, Mishra S and Kumar S. (2025). Evaluation of quantitative ethnobotanical uses in Mayurbhanj district, Odisha, India. *Journal of Biodiversity and Conservation*. 9(1): 1-29.
- Karle B, Rote K, Kumari P, Gagotia R, Choudhari S, Manjula BL and Kumar S. (2022). Common wild ethnomedicinal tuberous plants of Asia. *Ecology Environment & Conservation*. 28: S353-S361.

- Kumar S and Jena PK. (2017). Tools from biodiversity: wild nutraceutical plants. Ed: James N Furze et al.: identifying frontier research integrating mathematic approaches to diverse systems / sustainability. Springer, Switzerland. DOI: 10.1007/978-3-319-43901-3-9.
- Kumar S, Behera SP and Jena PK. (2013). Validation of tribal claims on *Dioscorea pentaphylla* through phytochemical screening and evaluation of antibacterial activity. Plant Science Research. 35: 55-61.
- Kumar S, Das G, Shin HS and Patra JK. (2017). *Dioscorea* spp. (a wild edible tuber): a study on its ethnopharmacological potential and traditional use by the tribal people of Similipal Biosphere Reserve, India. Frontiers in Pharmacology. 8:52. DOI:10.3389/fphar.2017.0052.
- Kumar S, Tripathy PK and Jena PK. (2012). Study of wild edible plants among tribal groups of Similipal Biosphere Reserve Forest, Odisha, India; with special reference to *Dioscorea* species. International Journal of Biological Technology. 3(1): 11-19.
- Kumar S. (2015). Life support plant species among aboriginals of Similipal Biosphere Reserve Forest, Odisha: diversity and conservation. International Journal of Biological Sciences and Engineering. 6(2): 80-86.
- Kumar S. (2017). Yam (*Dioscorea* species): Future functional wild food of tribal Odisha, India. In Frontiers in bioactive compounds. Bentham Science Publishers Limited.
- Kumar S. (2025). Leveraging the nutritional and medicinal potential of wild yam for a sustainable future. Journal of Biodiversity and Conservation. 9(1): E1-E2.
- Marndi S, Barik M and Kumar S. (2024). Phytochemical and cytotoxicity analysis of *Eulophia explanata* Lindl. (Tuber extracts). African Journal of Biological Sciences. 6(4): 2751-2756. DOI:10.48047/AFJBS.6.Si4.2024.2751-2756.
- Nayak S and Kumar S. (2023). Medicinal plants used by tribals of Odisha. State Medicinal Plants Board, Bhubaneswar, Odisha & Ambika Prasad Research Foundation, Odisha, India.

Phytochemical and cytotoxicity analysis of flowers of *Symphorema involucratum* (Lamiaceae)

Kadambini Das¹, Nibedita Jena^{2*}, Arjun Patra³, Sanjeet Kumar² and Shruti Rathore⁴

¹University Department of Botany, Babasaheb Bhimrao Ambedkar Bihar University, Muzaffarpur, Bihar, India

²Ambika Prasad Research Foundation, Odisha, India

³Department of Botany, Prabhat Kumar College, Contai, Purba Medinipur, West Bengal, India

⁴Chouksey College of Pharmacy, Lalkhadan, Bilaspur, Chhattisgarh, India

*Email-Id: nibeditajena838@gmail.com

DOI: <https://doi.org/10.5281/zenodo.14845127>



Licensed under a Creative Commons Attribution 4.0 International License

Abstract

The present study investigates the secondary metabolites and toxicity of different extracts of *Symphorema involucratum* flowers. Qualitative phytochemical analysis revealed the presence of tannin, phenolic compounds, and reducing sugars in the aqueous, methanol, and ethanol extracts. Toxicity analysis using brine shrimp nauplii showed significant toxicity of the extracts, indicating their potential as therapeutic agents. The study suggests that *S. involucratum* flowers may be a valuable source of bioactive compounds with potential applications in formulation of drugs.

Key words: Bioactive compounds, medicinal values, plants

Introduction

Medicinal plants have been an integral part of traditional medicine in India (Kumar and Jena, 2017; Kumar *et al.*, 2018; Kumar *et al.*, 2021; Mishra and Kumar, 2021; Das *et al.*, 2022; Kumar *et al.*, 2022; Kumar, 2022). The country is home to a rich diversity of medicinal plants (Kumar and Tripathy, 2017; Nayak and Kumar, 2023). These plants have been used to treat a wide

range of health problems (Das *et al.*, 2024; Sinha *et al.*, 2024; Laware *et al.*, 2024; Dimri *et al.*, 2024; Kumar, 2025). The importance of medicinal plants in India cannot be overstated, as they provide a vital source of healthcare for millions of people (Hebbbar *et al.*, 2024; Sethi *et al.*, 2024; Sharma *et al.*, 2024a; Mukherjee *et al.*, 2024; Bhat *et al.*, 2024; Palei *et al.*, 2024; Jena *et al.*, 2024; Sahu *et al.*, 2024; Kumar, 2024; Jena *et al.*, 2025).



Figure 1: Inflorescence of *S. involucreatum*

However, the increasing prevalence of antimicrobial resistance has become a major public health concern worldwide (Kumar *et al.*, 2013; Tripathy *et al.*, 2014; Kumar and Jena, 2014; Nayak *et al.*, 2015; Tripathy *et al.*, 2015; Murmu *et al.*, 2016; Kumar, 2017). The overuse and misuse of antibiotics have accelerated the emergence of resistant microorganisms, making it challenging to treat infections (Mancuso *et al.*, 2021). As a result, there is an urgent need to discover new antimicrobial agents that can effectively combat resistant microorganisms (Yao *et al.*, 2023). Medicinal plants offer a promising solution, as they have been shown to possess antimicrobial properties that can help combat infections (Abdallah *et al.*, 2023). Despite the rich diversity of medicinal plants in India, many species remain unexplored for their phytochemical and pharmacological properties. Phytochemical screening of unexplored plants is essential to identify new bioactive compounds that can be developed into novel medicines. This approach has led to the discovery of many life-saving medicines. In this context, the present study aims to investigate the availability of secondary metabolites of *Symphorema involucratum* flowers (Figure 1) and toxicity to *Artemia salina*.

Materials and methods

The flowers of *S. involucratum* were collected from the different regions of Khordha district of Odisha, India (Figure 2). The plant species was identified by the authors. The Soxhlet extraction method was adopted using different solvents for phytochemical analysis (Figure 3-8; Devi *et al.*, 2024; Marndi *et al.*, 2024). An herbarium specimen is deposited to the Herbarium unit of Biodiversity and Conservation Lab of APRF, Cuttack, Odisha, India (Figure 9; Basole *et al.*, 2024; Jena *et al.*, 2025).

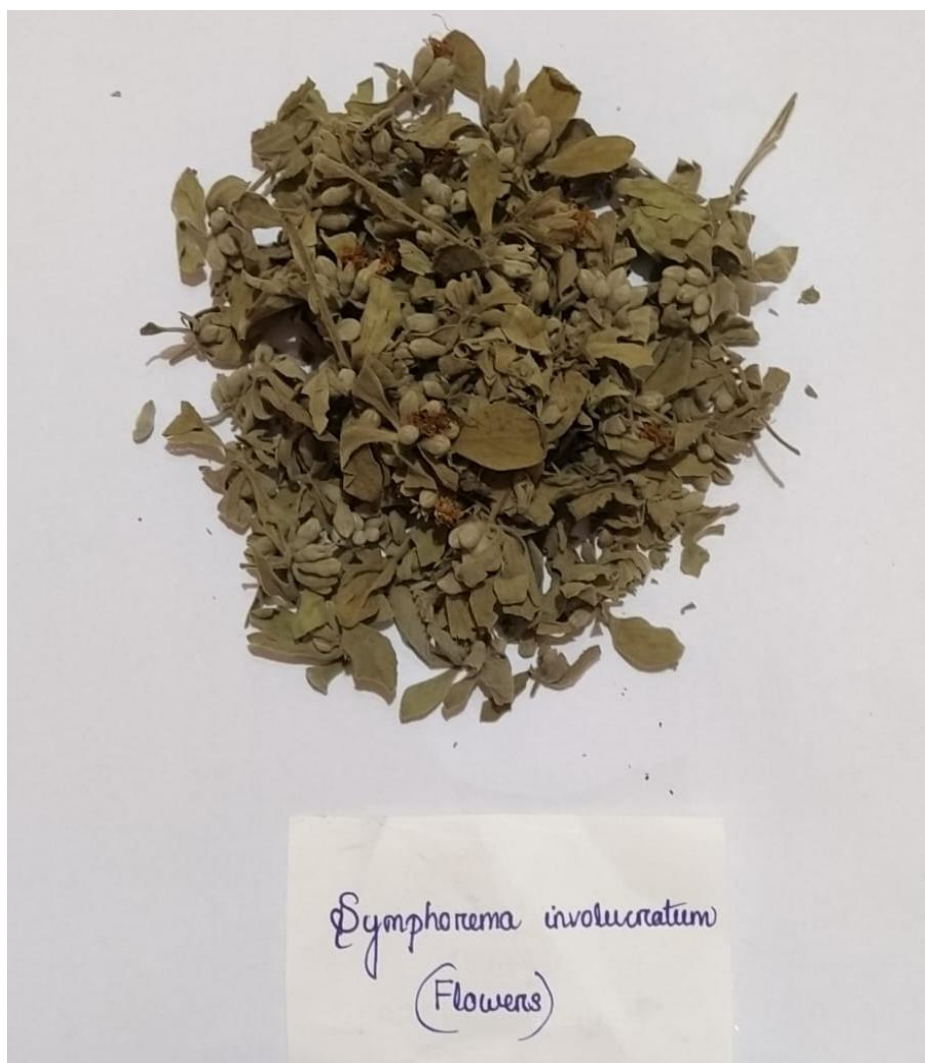


Figure 2: Collected flowers of *S. involucreatum* for experimental analysis

Qualitative phytochemical analysis

Detection of nine secondary metabolites were conducted using standard methods (Sethi *et al.*, 2024; Sharma *et al.*, 2024b; Topno *et al.*, 2024).

Test for tannin: About 1 ml of the flowers extract was taken. 3-5 drops of 10% lead acetate solution were added to it. The formation of gelatinous precipitate confirmed the positive results for the presence of tannin.

Test for saponin: About 1 ml of the flowers extract was taken and 1 ml of distilled water was added and shaken well. The persistent froth formation confirmed the presence of saponin.

Test for flavonoids: About 1 ml of the flowers extract was taken. 2 ml of 2% NaOH solution and then dilute HCl were added to it. The colour initially turned to an intense yellow with NaOH solution and later became colourless. This colour-changing transformation confirmed the presence of flavonoids.

Test for terpenoids: About 1 ml of the filtrate was added with 6 drops of chloroform and placed in the water bath for a few minutes. Then 6 drops of concentrated sulphuric acid were added. The appearance of a reddish-brown interface confirmed the presence of terpenoids.

Test for phenolic compounds: About 1 ml of the flowers extract was taken and a few drops of 5% ferric chloride solution was added to it. The dark bluish-black appearance confirmed the presence of phenolic compounds.

Test for reducing sugars: About 1 ml of the flowers extract was taken and 2-3 drops of Fehling's solution A and B were added. Then kept in the water bath for some time. The presence of red-orange precipitate confirmed the presence of reducing sugar.

Test for steroids: About 1 ml of the flowers extract was taken. 1 ml of chloroform and 1 ml of concentrated sulphuric acid was added to it. The appearance of 2 phases with the upper red and lower yellow with green fluorescence confirmed the presence of steroids.

Test for alkaloids: About 1 ml of flowers extract was taken and 3 to 4 drops of Dragendroff's reagent was added. The formation of a reddish-brown precipitate confirmed the presence of alkaloids.

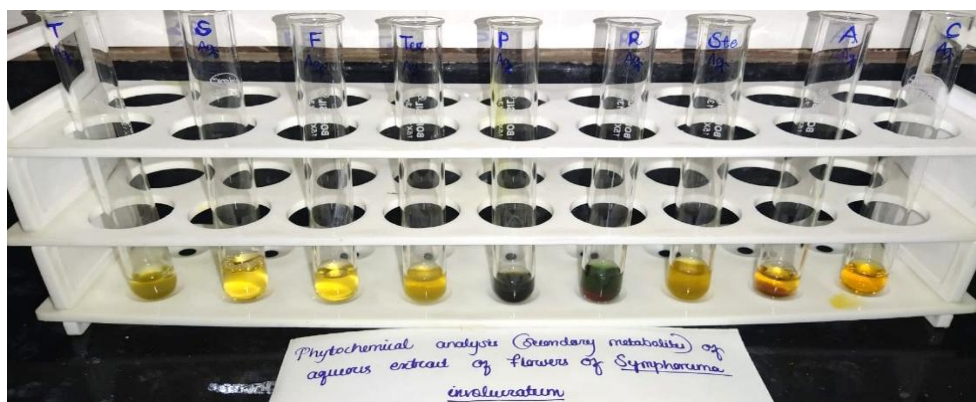


Figure 3: Detection of secondary metabolites of *S. involucratum* flowers using aqueous solvent

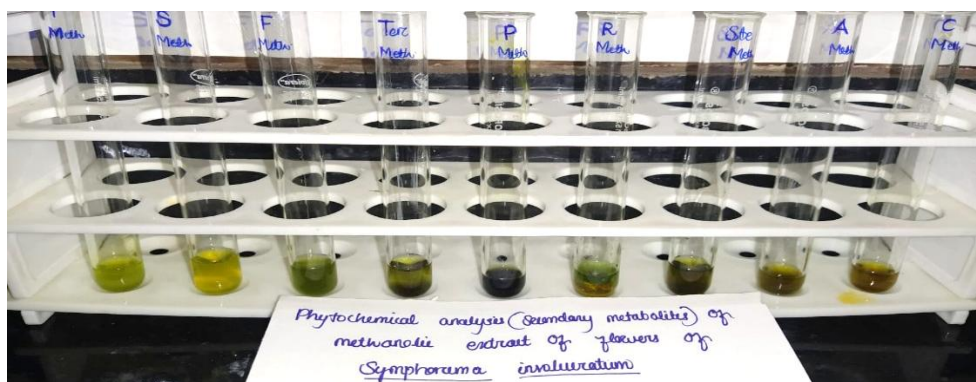


Figure 4: Detection of secondary metabolites of *S. involucratum* flowers using methanol solvent

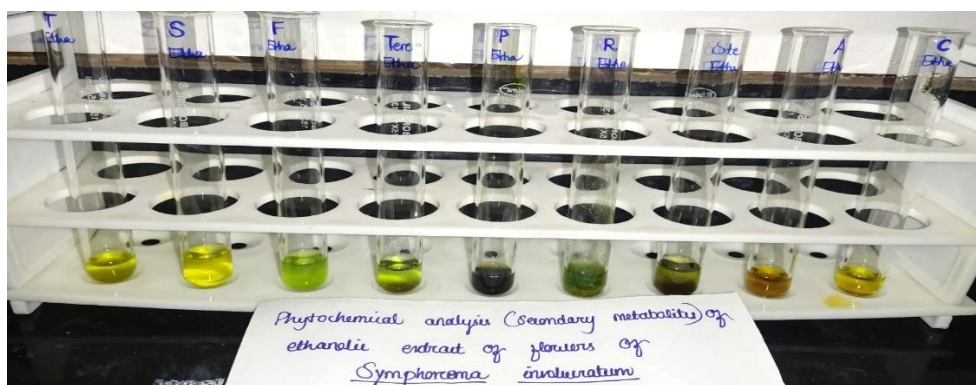


Figure 5: Detection of secondary metabolites of *S. involucratum* flowers using ethanol solvent

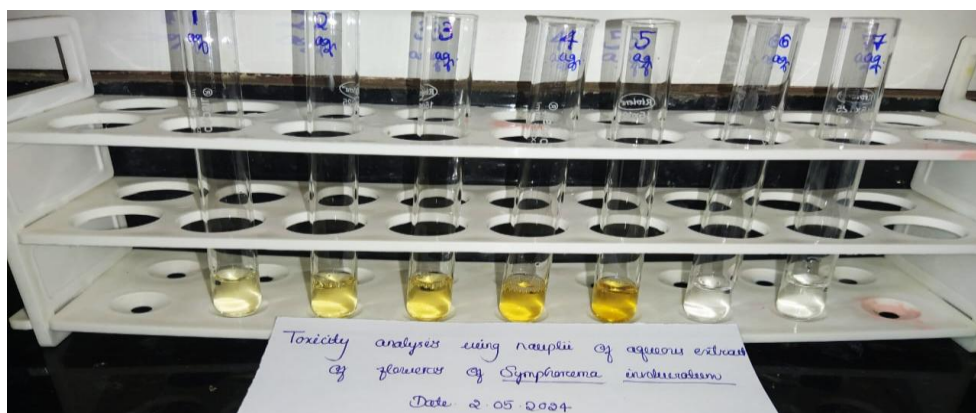


Figure 6: Toxicity analysis using Brine shrimp nauplii of aqueous extract of *S. involucratum* flowers

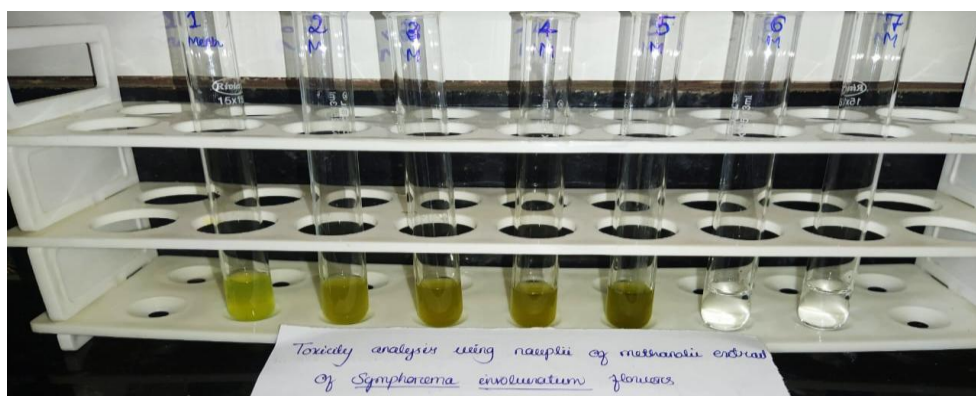


Figure 7: Toxicity analysis using Brine shrimp nauplii of methanolic extract of *S. involucratum* flowers

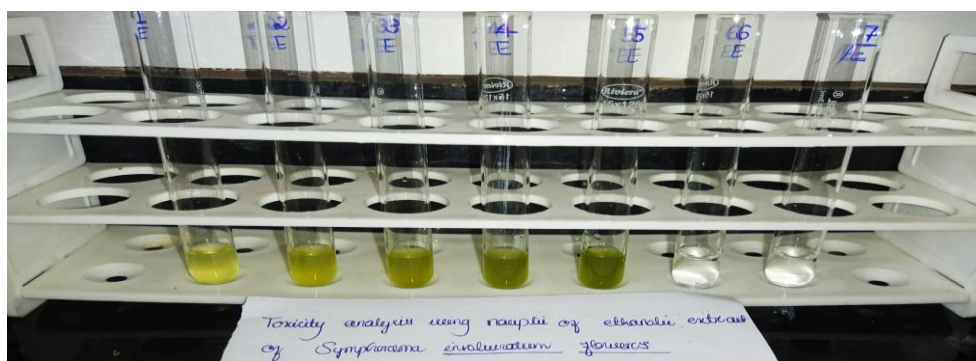


Figure 8: Toxicity analysis using Brine shrimp nauplii of ethanolic extract of *S. involucratum* flowers

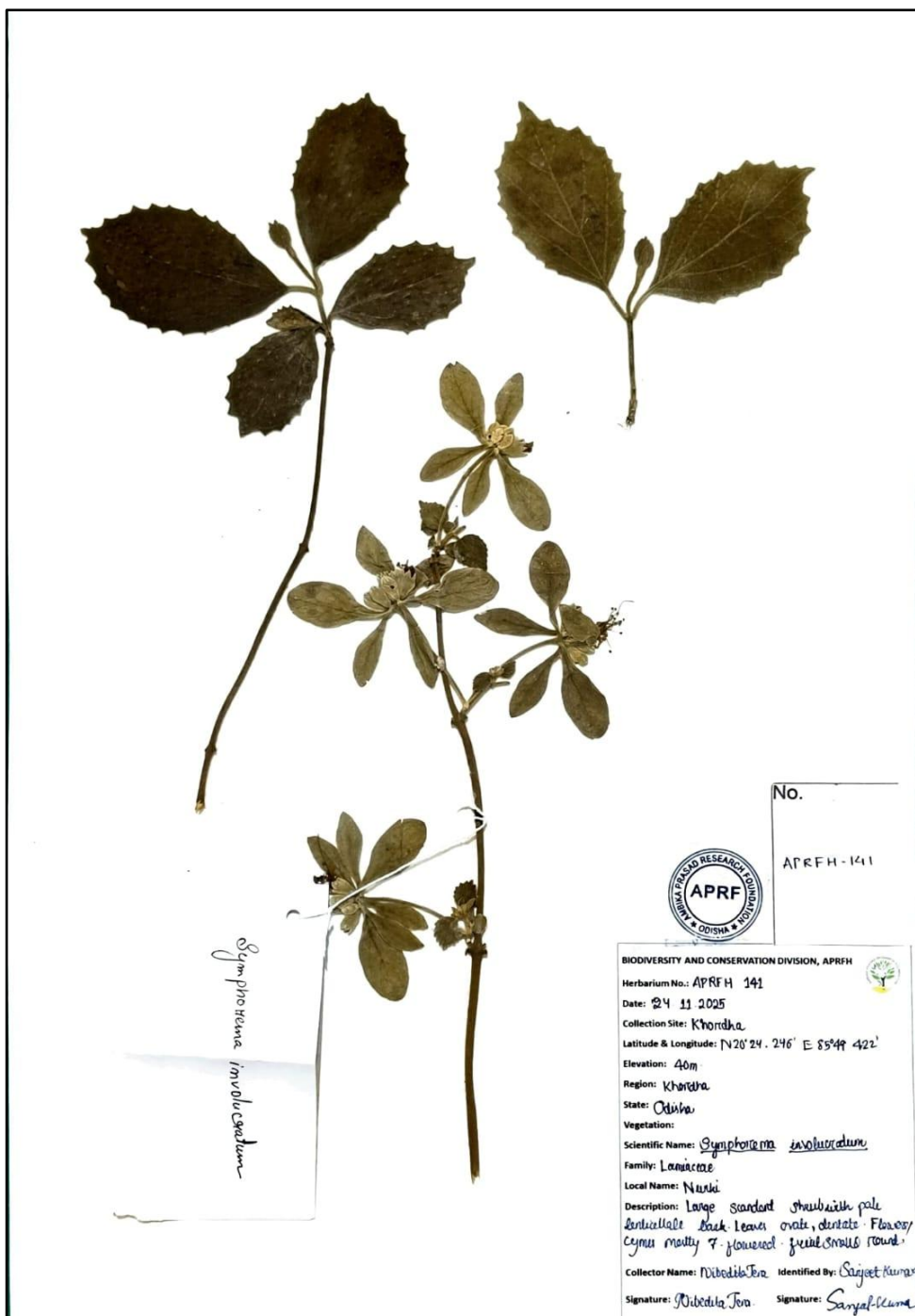


Figure 9: Herbarium specimen of *S. involucratum*

Test for carbonyl compounds: About 1 ml of the flowers extract was taken and 3 to 4 drops of 2,4-dinitrophenylhydrazine (DNPH) reagent was added to it. The yellow crystal formation confirmed the presence of carbonyl compounds.

Toxicity to *Artemia salina*

For toxicity analysis, hatching of Brine cysts was the initial process. Standardization of the optimum was done at 2.0, 3.5, and 5.0 % saline concentrations to check the optimum salinity for proper hatching of Brine shrimp (*Artemia salina*) cysts (Kumar *et al.*, 2012). The brine shrimp cysts are then incubated in 3.5% saline water with proper aeration, room temperature or between (28-35) ° C and light for 48 hours. Proper hatching could be observed within 24-48 hours depending upon the quality of cysts, proper aeration and light provided. Different concentrations (15 mg/ml, 31 mg/ml, 47 mg/ml, 63 mg/ml and 79 mg/ml) of the *S. involucreatum* flowers extracts were taken and 3.5% saline water was used to make the volume 2 ml in each test tube. 1% DMSO (Dimethyl sulfoxide) was used to dissolve the crude extracts. Ten nauplii were selected and introduced to five test tubes of the extracts. Positive and negative controls were prepared using 3.5% saline water and vincristine sulphate (5 mg/ml) respectively with a volume of 2 ml. The live larvae are highly motile and thus differentiate from the unhatched cysts. The survivor nauplii were counted and analysed the death% (Kumar *et al.*, 2012).

Results and discussion

The qualitative phytochemical analysis of the different extracts of *S. involucreatum* flowers revealed the presence of several bioactive compounds. Tannin, phenolic compounds, and reducing sugars were detected in all three

extracts (aqueous, methanol, and ethanol), indicating that these compounds are widely distributed in the plant (Table 1). The presence of these compounds suggests that *S. involucratum* flowers may possess antimicrobial, antioxidant, and anti-inflammatory properties, which could be useful in the development of new medicinal products (Table 3). The toxicity analysis using brine shrimp nauplii showed that all three extracts (aqueous, methanol, and ethanol) exhibited significant toxicity against the nauplii. The results indicate that the extracts are toxic at concentrations of 15-79 mg/ml, with the methanol extract showing the highest toxicity (Table 2). These results suggest that the extracts of *S. involucratum* flowers may have potential as therapeutic agents. The detection of these compounds suggests that *S. involucratum* flowers may possess antimicrobial, antioxidant, and anti-inflammatory properties, which could be useful in the development of new medicinal products (Figure 10).

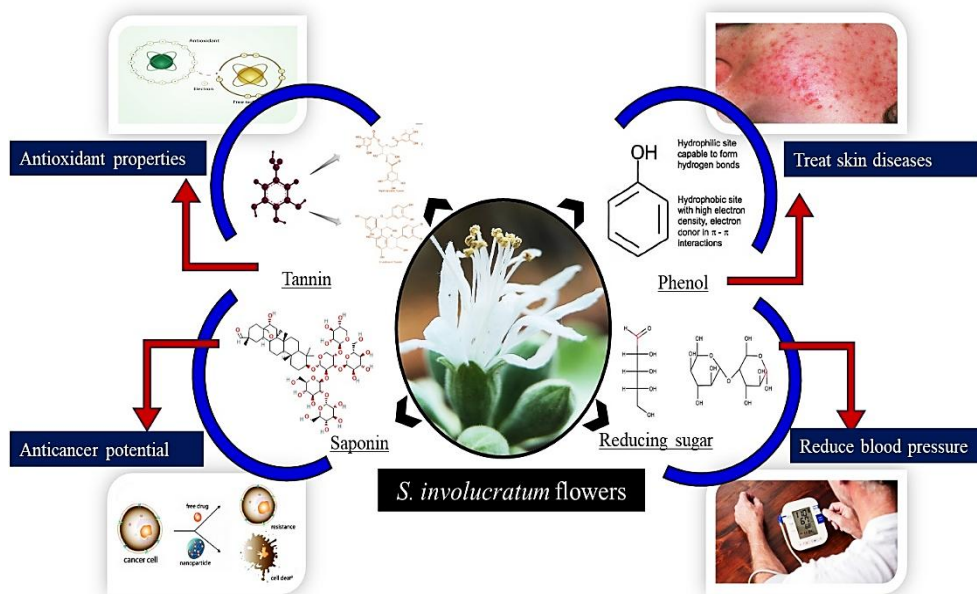


Figure 10: Pharmacological potentials of *S. involucratum* flowers

Table 1: Qualitative phytochemical analysis of different extracts of flowers of *S. involucratum*

Bioactive compounds	Extracts		
	Aqueous	Methanol	Ethanol
Tannin	+	+	+
Saponin	+	-	-
Flavonoid	-	-	-
Terpenoid	-	-	-
Phenolic compounds	+	+	+
Reducing sugars	+	+	+
Steroids	-	-	-
Alkaloids	-	-	-
Carbonyl compounds	-	-	-

(+: Positive, -: Negative)

Table 2: Toxicity analysis using Brine shrimp nauplii of different extracts of *S. involucratum* flowers

Extracts	Concentration (mg/ml)	Initial number of Nauplii	Number of deaths of nauplii (after hours)			
			1	2	3	4
Aqueous	15	10	5	6	7	9
	31	10	5	7	8	10
	47	10	6	7	8	10
	63	10	8	8	9	10
	79	10	9	10	10	10
	3.5% Saline	10	0	0	0	0
	Vincristine sulphate	10	9	10	10	10
Methanol	15	10	6	7	8	10

	31	10	8	8	9	10
	47	10	8	9	10	10
	63	10	9	10	10	10
	79	10	9	10	10	10
	3.5% Saline	10	0	0	0	0
	Vincristine sulphate	10	10	10	10	10
Ethanol	15	10	7	7	9	10
	31	10	8	8	10	10
	47	10	8	8	10	10
	63	10	9	9	10	10
	79	10	9	10	10	10
	3.5% Saline	10	0	0	0	0
	Vincristine sulphate	10	10	10	10	10

Table 3: Probable medicinal uses as per bioactive compounds

Bioactive compounds	Medicinal uses	Source
Tannin	The presence of tannin in aqueous, methanol, and ethanol extracts indicates of having antioxidant properties.	Fraga-Corral <i>et al.</i> , (2021)
Saponin	The presence of saponin in aqueous extract tends to anticancer activities.	Timilsena <i>et al.</i> , (2023)
Phenolic compounds	Phenolic compounds present in the aqueous, methanol and ethanol extracts have significant anti-inflammatory properties to treat skin diseases.	Rahman <i>et al.</i> , (2021)

Reducing sugars	Reducing sugars present in aqueous, methanol and ethanol extracts indicate to reduce blood pressure.	Chen <i>et al.</i> , (2010)
-----------------	--	-----------------------------

Conclusion

In conclusion, the present study demonstrates the presence of bioactive compounds including tannin, phenolic compounds, and reducing sugars, in the extracts of *S. involucratum* flowers. Furthermore, the toxicity analysis against brine shrimp nauplii suggests that these extracts possess potential therapeutic applications, making them promising sources for the development of novel medicinal agents.

References

- Abdallah EM, Alhatlani BY, De Paula Menezes R and Martins CHG. (2023). Back to nature: medicinal plants as promising sources for antibacterial drugs in the post-antibiotic era. *Plants (Basel)*. 12(17): 3077. DOI: 10.3390/plants12173077.
- Basole S, Jena N and Kumar S. (2024). *Indian Medicinal Plants, Volume 1*. Ambika Prasad Research Foundation, India.
- Bhat SS, Tallur PN, Prameela HC, Thakur S, Singh B, Chauhan J, Kumar S and Singh R. (2024). Medicinal, phytochemical screening and cytotoxicity of *Pergularia daemia* (Forssk.) Chiov. *African Journal of Biological Sciences*. 6(Si4): 5867-5874.
- Chen L, Caballero B, Mitchell DC, Loria C, Lin PH, Champagne CM, Elmer PJ, Ard JD, Batch BC, Anderson CA and Appel LJ. (2010). Reducing consumption of sugar-sweetened beverages is associated with reduced blood pressure: a prospective study among United States adults. *Circulation*. 121(22): 2398-406.
- Das A, Das K, Mishra S and Kumar S. (2024). *Medicinal Poaceae of India, Volume 1*. Ambika Prasad Research Foundation, Odisha, India.

- Das L, Mishra S, Das A, Dimri R and Kumar S. (2022). Some common flora of temple city of Odisha, India: source for ethno-medico-cultural values. *Indian Forester*. 148(2): 207-212.
- Devi RS, Satapathy KB, Manjula BL, Sharma BP and Kumar S. (2024). Evaluation of ethnopharmacological potential of *Oenanthe javanica* DC. *Annals of Biology*. 40(1): 135-139.
- Dimri R, Sinha MK, Moharana A, Ofoeze MA and Kumar S. (2024). Wild Nutraceutical Plants. Ambika Prasad Research Foundation, Odisha, India.
- Fraga-Corral M, Otero P, Cassani L, Echave J, Garcia-Oliveira P, Carpena M, Chamorro F, Lourenço-Lopes C, Prieto MA and Simal-Gandara J. (2021). Traditional applications of tannin rich extracts supported by scientific data: chemical composition, bioavailability and bioaccessibility. *Foods*. 10(2): 251-251.
- Hebbbar DR, Behera B, Kumar N, Sharma A, Hossain E, Kumar S and Sharma BP. (2024). Validation of traditional therapeutic practices on *Boswellia serrata* for the treatment of asthma and other respiratory problems. *African Journal of Biomedical Research*. 27(3S): 6367-6372.
- Jena N, Rout S, Devi RS and Kumar S. (2024). Phytochemical and cytotoxicity analysis of fruits of *Zanthoxylum asiaticum* (L.) Appelhans, Groppo & J. Wen: A minor fruit plant of Odisha, India. *E-planet*. 22(1): 62-70.
- Jena N, Rout S, Mishra S and Kumar S. (2025). Evaluation of quantitative ethnobotanical uses in Mayurbhanj district, Odisha, India. *Journal of Biodiversity and Conservation*. 9(1): 01-29.
- Kumar S and Jena PK. (2014). Chromatographic, antibacterial and FT-IR analysis of *Dioscorea pentaphylla* L. tuber extracts. *Plant Science Research*. 36(1&2): 83-90.
- Kumar S and Jena PK. (2017). Tools from biodiversity: wild nutraceutical plants. Ed: James N Furze et al.: Identifying frontier research integrating mathematic approaches to diverse systems / sustainability. Springer, Switzerland. DOI: 10.1007/978-3-319-43901-3-9.
- Kumar S and Tripathy PK. (2017). Wild cucurbits: source of traditional therapeutic systems & medicine. LAMBART Academic Publishing, London, United Kingdom.

- Kumar S, Behera SP and Jena PK. (2013). Validation of tribal claims on *Dioscorea pentaphylla* through phytochemical screening and evaluation of antibacterial activity. *Plant Science Research*. 35: 55-61.
- Kumar S, Das G, Shin HS, Kumar P and Patra JK. (2018). Diversity of plant species in the Steel City of Odisha, India: ethnobotany and implications for conservation of urban bio resources. *Brazilian Archives of Biology and Technology*. DOI: 10.190/1678-4324-2018160650.
- Kumar S, Devi RS, Choudhury R, Mahapatra M, Biswal SK, Kaur N, Tudu J and Rath SK. (2022). Orchid diversity, conservation and sustainability in Northeastern India. In: James et al., *Earth System Protection and Sustainability*. 111-139.
- Kumar S, Tripathy PK and Jena PK. (2012). Ethnobotany and bioactive compounds in leaf of *Bixa orellana* L. and its toxicity to *Artemia salina*. *Plant Science Research*. 34(1&2): 93-96.
- Kumar S. (2017). Yam (*Dioscorea* species): Future functional wild food of tribal Odisha, India. In *Frontiers in bioactive compounds*. Bentham Science Publishers Limited. (Check)
- Kumar S. (2022). Ground orchids of Odisha: medicinally and ecologically important flowering plants. *Journal of Biodiversity and Conservation*. 6(4): 503-503.
- Kumar S. (2024). A note on *Eulophia explanata* Lindl.: a terrestrial orchid of Jamtara Forest Division, Jharkhand & Rourkela Forest Division, Odisha. *Journal of Biodiversity and Conservation*. 8(3): E1-E2.
- Kumar S. (2025). Leveraging the nutritional and medicinal potential of wild yam for a sustainable future. *Journal of Biodiversity and Conservation*. 9(1): E1-E2.
- Kumar SN, Mishra S and Kumar S. (2021). Documentation of Indigenous Traditional Knowledge (ITK) on commonly available plants in Koira Range, Bonai Forest Division, Sundargarh, Odisha, India. *Asian Plant Research Journal*. 8(4): 83-95.
- Laware S, Jaiswal A, Behera M and Kumar S. (2024). *Plants & Secondary Metabolites*, Volume I. Ambika Prasad Research Foundation, Odisha, India.
- Mancuso G, Midiri A, Gerace E and Biondo C. (2021). Bacterial antibiotic resistance: the most critical pathogens. *Pathogens*. 10(10): 1310. DOI: 10.3390/pathogens10101310.

- Marndi S, Barik M and Kumar S. (2024). Phytochemical and cytotoxicity analysis of *Eulophia explanata* Lindl. (Tuber extracts). African Journal of Biological Sciences. 6(4): 2751-2756.
- Mishra S and Kumar S. (2021). Medicinal carnivorous plants of Odisha: a source of future drugs. Medico-Biowealth of India, Volume-II. Ambika Prasad Research Foundation, Odisha, India.
- Mukherjee S, Hebbar DR, Alam SKS, Krishnan R, Sharma BP, Mishra S and Kumar S. (2024). Medicinally important plants of Bignoniaceae family and their pharmacological potential. African Journal of Biological Sciences. 6(Si4): 4856-4866.
- Murmu P, Kumar S, Patra JK, Singh NR and Rath SK. (2016). Ethnobotanical, nutritional, phytochemical and antimicrobial studies of *Garcinia xanthochymus* fruit extracts. British Biotechnology Journal. 13(2): 1-11.
- Nayak S and Kumar S. (2023). Medicinal plants used by tribals of Odisha. State Medicinal Plants Board, Bhubaneswar, Odisha & Ambika Prasad Research Foundation, Odisha, India.
- Nayak S, Chakroborty S, Bhakta S, Panda P, Mohapatra S, Kumar S, Jena PK and Purohit C. (2015). Design and synthesis of (E)-4-(2-Phenyl-2H-Chromine-3-yl)-but-3-en-2-ones and evaluation of their in vitro antimicrobial activity. Letters in Organic Chemistry. 12: 1-7.
- Palei S, Dagwal MJ, Choudhari SS, Raut ST, Parmeela HC, Sharma BP and Kumar S. (2024). Ethno-pharmacological values of *Drosera indica* L.: a carnivorous plant of India. African Journal of Biological Sciences. 6(Si4): 4908-4913.
- Rahman MM, Rahaman MS, Islam MR, Rahman F, Mithi FM, Alqahtani T, Almikhlaifi MA, Alghamdi SQ, Alruwaili AS, Hossain MS, Ahmed M, Das R, Emran TB and Uddin MS. (2021). Role of phenolic compounds in human disease: current knowledge and future prospects. Molecules. 27(1): 233-233.
- Sahu LM, Das K, Sahu JK, Das A, Behera B and Kumar S. (2024). Eco-social services of native tree species: a conservation approach. Indian Forester. 150(7): 630-634.
- Sethi J, Jena N and Kumar S. (2024). Medicinal plants of Rourkela Forest Division, Odisha, India. Asian Journal of Environment & Ecology. 23(12): 69-84.

- Sharma BP, Saradar B, Choudhari SS, Sampatrao TS, Marndi S and Kumar S. (2024a). Orchid Diversity in mining impacted forest areas of Odisha: documentation, restoration and conservation aspect. *Indian Forester*. 150(9): 876-881.
- Sharma BP, Tripathi G, Sharma S, Dehar PS, Kumar S, Jena N and Sureshrao GA. (2024b). Qualitative phytochemical analysis of *Ficus religiosa* fruits. *Medico Biowealth of India*, Volume 17. Ambika Prasad Research Foundation, India.
- Sinha MK, Hegde L, Marndi S and Kumar S. (2024). Medicinal plants of India, a pictorial guide, Volume I. Ambika Prasad Research Foundation, Odisha, India.
- Timilsena YP, Phosanam A and Stockmann R. (2023). Perspectives on saponins: food functionality and applications. *International Journal of Molecular Sciences*. 24(17): 13538. DOI: 10.3390/ijms241713538.
- Topno SC, Lyngdoh D, Thakur S, Kumar S and Jena N. (2024). Qualitative phytochemical analysis of fruits of *Ficus benghalensis* L. *Biological Archives*, Volume 1. Ambika Prasad Research Foundation, India.
- Tripathy PK, Kumar S and Jena PK. (2014). Nutritional and medicinal values of selected wild cucurbits available in Similipal Biosphere Reserve Forest, Odisha. *International Journal of Pharmaceutical Sciences and Research*. 5(10): 5430-5437.
- Tripathy PK, Kumar S and Jena PK. (2015). Comparison of antibacterial activities of some selected wild cucurbits collected from Similipal Biosphere Reserve. *Plant Science Research*. 37(1&2): 18-23.
- Yao J, Zou P, Cui Y, Quan L, Gao C, Li Z, Gong W and Yang M. (2023). Recent advances in strategies to combat bacterial drug resistance: antimicrobial materials and drug delivery systems. *Pharmaceutics*. 15(4): 1188. DOI: 10.3390/pharmaceutics15041188.

Phytochemical analysis of *Vitex negundo* L. (Lamiaceae): A biopesticide of India

Sonalaxmi Thapa¹, Divya Jain², Nibedita Jena^{3*} and Sanjeet Kumar³

¹Sravanti Serenity 2, Botanical Garden Road, Kondapur Hyderabad, Telangana, India

²Department of Botany, Sanatan Dharma College, Ambala Cantt, Haryana, India

³Ambika Prasad Research Foundation, Odisha, India

*Email-id: nibeditajena838@gmail.com

DOI: <https://doi.org/10.5281/zenodo.14845173>



Licensed under a Creative Commons Attribution 4.0 International License

Abstract

This research examines the phytochemical profile of *Vitex negundo* (Lamiaceae) leaves and stem through various extraction methods. The qualitative analysis identified a range of bioactive compounds, including tannins, saponins, flavonoids, phenols, reducing sugars, and alkaloids. The study sheds light on the phytochemical composition of *V. negundo*, suggesting its potential as a natural source of biopesticides. The results contribute to the development of environmentally friendly pest management strategies and underscore the significance of phytochemical screening in identifying plant-based biopesticides.

Key words: Biopesticides, eco-friendly pest control, phytochemical analysis

Introduction

The increasing use of synthetic pesticides has led to environmental pollution, human health hazards, and the development of pesticide-resistant pest populations (Pathak *et al.*, 2022; Ahmad *et al.*, 2024). As a result, there is a growing need to identify alternative, eco-friendly pest control methods. Biopesticides, derived from natural sources such as plants, offer a promising solution (Bhat *et al.*, 2021; Mishra *et al.*, 2023; Tadesse *et al.*, 2024). Plants have evolved complex defence mechanisms against pests and pathogens, and

many of these defence compounds have potential as biopesticides (Sengul and Canpolat, 2022). Phytochemical screening is a crucial step in the search for biopesticides from plants.



Figure 1: Different plant parts of *V. negundo*

Phytochemical screening can help identify plants with potential pest control properties, and provide valuable insights into the structure and function of bioactive compounds (Khameneh *et al.*, 2021). By screening plants for phytochemicals, researchers can discover new leads for the development of biopesticides (Divekar *et al.*, 2022). *Vitex negundo* L. (Lamiaceae; Figure 1) is a plant species that has been traditionally used in Indian medicine for its various therapeutic properties (Gill *et al.*, 2018; Nayak and Kumar, 2023). Previous studies have reported the insecticidal and repellent properties of *V. negundo*, making it a potential source of biopesticides (Kumar *et al.*, 2022). However, a comprehensive phytochemical analysis of this plant is lacking. The present study aims to investigate the phytochemical composition of *V. negundo* leaves and stem using different extracts. The study will provide valuable insights into the bioactive compounds present in this plant, and their potential as biopesticides. The findings of this study will contribute to the search for eco-friendly pest control methods and highlight the importance of phytochemical screening in the discovery of biopesticides from plants.

Materials and methods

The leaves and stems of *V. negundo* were collected from the village of Badampahar of Mayurbhanj district, Odisha in June 2024 (Figure 2-3; Kumar *et al.*, 2021). Authors have identified the plant specimen (Jena *et al.*, 2025). Leaves and stem extracts of aqueous, ethanol and methanol were prepared followed by nine different bioactive compounds were detected using standard methods (Devi *et al.*, 2023; Marndi *et al.*, 2024; Devi *et al.*, 2024). An herbarium specimen (APRFH 123; Figure 4) is deposited to the Herbarium unit of Biodiversity and Conservation Lab of Ambika Prasad research Foundation, Cuttack, Odisha (Basole *et al.*, 2024).



Figure 2: Dried leaves powder of *V. negundo* for experimental analysis



Figure 3: Dried stem powder of *V. negundo* for experimental analysis

Detection of nine secondary metabolites were conducted using standard methods (Tripathi *et al.*, 2024; Jena *et al.*, 2024; Tallur *et al.*, 2024).

Test for tannin: About 1 ml of the filtrate extract was taken. 3-5 drops of 10% lead acetate solution were added to it. The gelatinous precipitate formation confirmed the presence of tannin.

Test for saponin: About 1 ml of the filtrate extract was taken and 1 ml of distilled water was added and shaken well. The formation of persistent froth was observed confirming the presence of saponin.

Test for flavonoids: About 1 ml of the filtrate extract was taken. 2 ml of 2% NaOH solution and 3 to 4 drops of dilute hydrochloric acid were added to it. The colour initially turned to an intense yellow colour with NaOH solution and later became colourless. This colour change appearance confirmed the presence of flavonoids.

Test for terpenoids: About 1 ml of the filtrate was added with 6 drops of chloroform and placed in the water bath for a few minutes. Then 6 drops of concentrated H_2SO_4 were added. The reddish- brown interface confirmed the presence of terpenoids.

Test for phenolic groups: About 1 ml of the filtrate extract was taken. A few drops of 5% Ferric chloride solution were added. The dark bluish-black appearance confirmed the presence of phenolic compounds.

Test for reducing sugars: About 1 ml of the filtrate extract was taken and 2 drops of Fehling's solution A followed by Fehling's solution B were added and kept in the water bath for some time. The presence of red-orange precipitate confirmed the presence of reducing sugar.

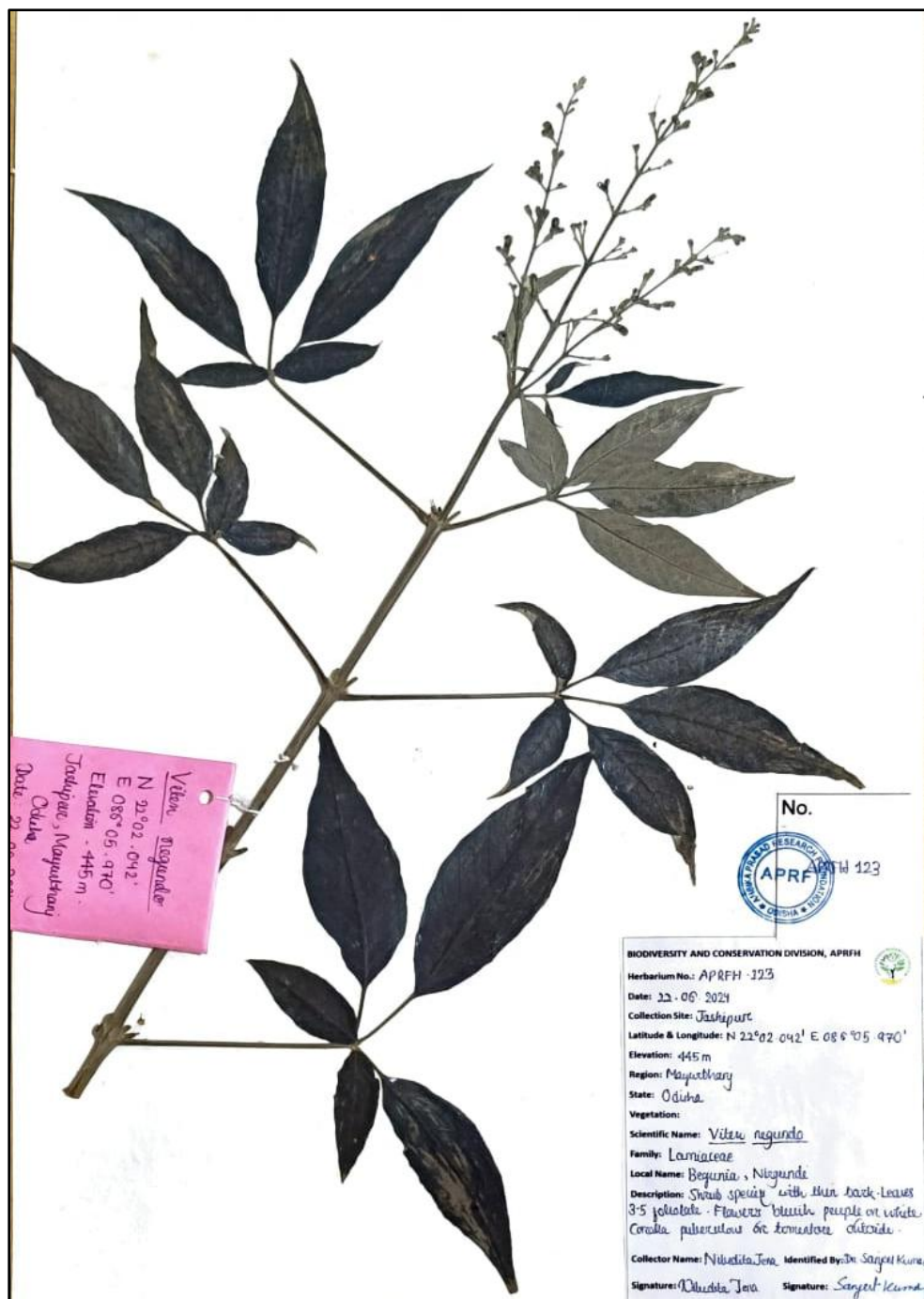


Figure 4: Herbarium specimen of *V. negundo*

Test for steroids: About 1 ml of the filtrate extract was taken. 1 ml of chloroform and 1 ml of concentrated sulphuric acid was added gently into it touching test tube mouth. The appearance of upper red and lower yellow with green fluorescence provides the presence of steroids (Hebbar *et al.*, 2024).

Test for alkaloids: About 1 ml of the filtrate extract was taken and added 3 to 4 drops of Dragendroff's reagent. The formation of a reddish-brown precipitate confirmed the presence of alkaloids.

Test for carbonyl compounds: About 1 ml of the filtrate extract was taken and added 3 to 4 drops of 2,4- Dinitrophenylhydrazine (DNPH) reagent. The formation of yellow crystal confirmed the presence of carbonyl compounds (Nayak *et al.*, 2025).

Results and discussion

The qualitative phytochemical analysis of *V. negundo* leaves and stem revealed the presence of various bioactive compounds (Table 1-2). The results showed that tannin, saponin, flavonoids, phenols, reducing sugar, and alkaloids were present in different extracts of the plant.

Table 1: Qualitative phytochemical analysis of *Vitex negundo* leaves using different extracts

Bioactive compounds	Leaves		
	Aqueous	Methanol	Ethanol
Tannin	+	+	-
Saponin	+	+	+
Flavonoids	-	-	+
Terpenoids	-	-	-
Phenols	+	+	+
Reducing sugar	+	-	-

Steroid	-	-	-
Alkaloid	+	-	-
Carbonyl compounds	-	-	-

(+: Positive; -: negative)

Table 2: Qualitative phytochemical analysis of *Vitex negundo* stem using different extracts

Bioactive compounds	Stem		
	Aqueous	Methanol	Ethanol
Tannin	+	+	-
Saponin	+	+	+
Flavonoids	-	-	-
Terpenoids	-	-	-
Phenols	-	-	-
Reducing sugar	+	-	-
Steroid	-	-	-
Alkaloid	+	-	-
Carbonyl compounds	-	-	-

(+: Positive; -: negative)

The aqueous and methanol extracts of leaves and stem showed the presence of tannin, saponin, and phenols, while the ethanol extract of leaves showed the presence of flavonoids. The phytochemical analysis also revealed that the bioactive compounds were present in varying concentrations in different parts of the plant. The leaves were found to contain a higher concentration of bioactive compounds compared to the stem. The results suggest that *V. negundo* has the potential to be used as a source of biopesticides. The presence of bioactive compounds such as tannin, saponin, flavonoids, phenols, reducing sugar, and alkaloids in *V. negundo* indicates its potential as a biopesticide.

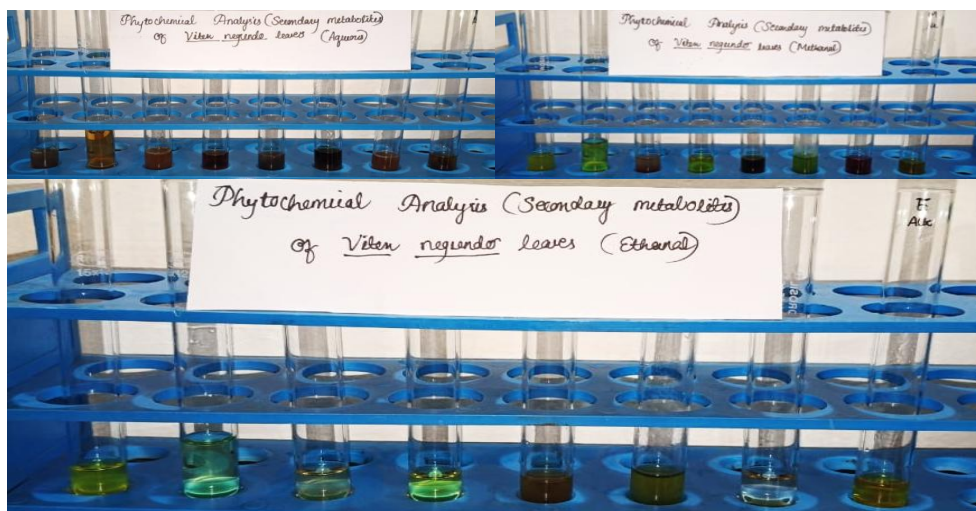


Plate 5: Detection of secondary metabolites of *V. negundo* leaves using different extracts

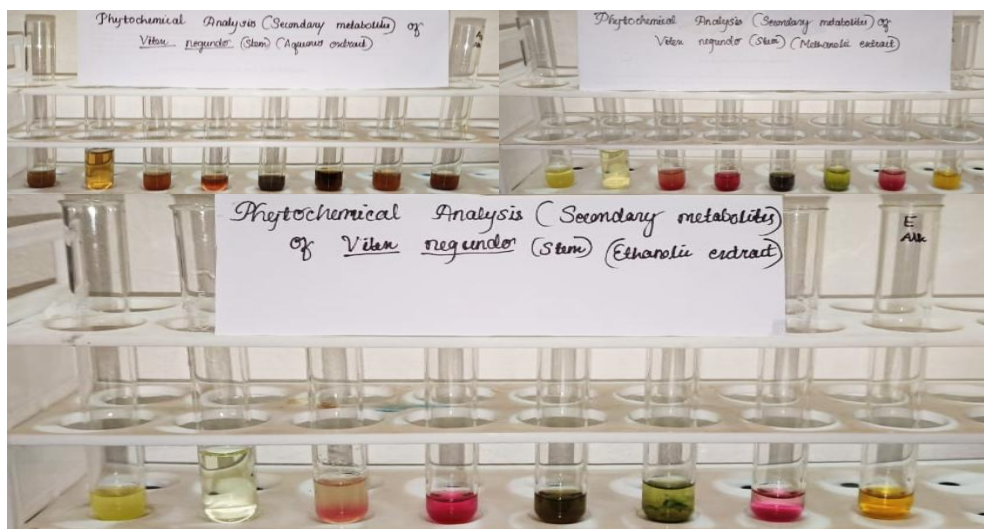


Plate 6: Detection of secondary metabolites of *V. negundo* stem using different extracts

These compounds have been reported to possess insecticidal, repellent, and antimicrobial properties, making them useful for pest control. The presence of these compounds in varying concentrations in different parts of the plant suggests that *V. negundo* could be a valuable source of bioactive compounds

for the development of eco-friendly pest control methods. The phytochemical analysis of *V. negundo* also highlights the importance of secondary metabolites in plant defense. The presence of tannin, saponin, and phenols in the plant suggests that these compounds play a crucial role in protecting the plant against pests and pathogens. The results of this study provide valuable insights into the phytochemical composition of *V. negundo* and its potential as a source of biopesticides, and emphasize the need for further research into the development of eco-friendly pest control methods using plant-based bioactive compounds. The authors have also noted that neem leaves and cow dung cake ashes are traditionally used to preserve seeds. Additionally, the first author has personal experience with using biopesticides on her farm. Specifically, she prepares a biopesticide solution by finely chopping leaves of Sitahal, Aam, and Neem, and soaking them in cow urine for a week. The mixture is then filtered and diluted with water in a 1:10 ratio before being sprayed as a biopesticide (Present study).

Conclusion

The present study demonstrates the presence of various bioactive compounds in *V. negundo* leaves and stem, highlighting its potential as a source of biopesticides. The phytochemical analysis reveals that the plant contains a range of secondary metabolites, including tannin, saponin, flavonoids, phenols, reducing sugar, and alkaloids. These compounds have been reported to possess insecticidal, repellent, and antimicrobial properties, making *V. negundo* a valuable resource for the development of eco-friendly pest control methods. Further research is needed to isolate and characterize the bioactive compounds present in *V. negundo* and to evaluate their potential as biopesticides.

References

- Ahmad MF, Ahmad FA, Alsayegh AA, Zeyauallah M, AlShahrani AM, Muzammil K, Saati AA, Wahab S, Elbendary EY, Kambal N, Abdelrahman MH and Hussain S. (2024). Pesticides impacts on human health and the environment with their mechanisms of action and possible countermeasures. *Heliyon*. 10(7): e29128. DOI: 10.1016/j.heliyon. 2024.e29128.
- Basole S, Jena N and Kumar S. (2024). *Indian Medicinal Plants, Volume 1*. Ambika Prasad Research Foundation, India.
- Bhat SS, Soni PK, Menasinakayi VS, Biswal SK and Kumar S. (2021). Plants used as a traditional biopesticide. *Medico Biowealth of India, Volume III*, Ambika Prasad Research Foundation, Odisha, India.
- Devi RS, Satapathy KB and Kumar S. (2023). Validation of tribal claims for formulation of future drugs through evaluation of ethno-pharmacological values of *Ludwigia adscendens*. *Medicinal Plants*. 15(4): 691-697.
- Devi RS, Satapathy KB, Manjula BL, Sharma BP and Kumar S. (2024). Evaluation of ethnopharmacological potential of *Oenanthe javanica* DC. *Annals of Biology*. 40(1): 135-139.
- Divekar PA, Narayana S, Divekar BA, Kumar R, Gadratagi BG, Ray A, Singh AK, Rani V, Singh V, Singh AK, Kumar A, Singh RP, Meena RS and Behera TK. (2022). Plant Secondary Metabolites as Defense Tools against Herbivores for Sustainable Crop Protection. *International Journal of Molecular Science*. 23(5):2690. DOI: 10.3390/ijms23052690.
- Gill BS, Mehra R, Navgeet and Kumar S. (2018). *Vitex negundo* and its medicinal value. *Molecular Biology Reports*. 45(6): 2925–2934.
- Hebbbar DR, Jena N and Kumar S. (2024). Qualitative phytochemical analysis of *Lantana camara* L. fruits. *Medico Biowealth of India, Volume 16*. Ambika Prasad Research Foundation, India.
- Jena N, Kumar S and Sharma BP. (2024). Qualitative phytochemical analysis of *Phyllanthus virgatus* G. Forst.: a riparian herb. *Biological Archives, Volume 1*. Ambika Prasad Research Foundation, India.
- Jena N, Rout S, Mishra S and Kumar S. (2025). Evaluation of quantitative ethnobotanical uses in Mayurbhanj district, Odisha, India. *Journal of Biodiversity and Conservation*. 9(1): 1-29.
- Khameneh B, Eskin NAM, Iranshahy M and Fazly Bazzaz BS. (2021). Phytochemicals: A Promising Weapon in the Arsenal against Antibiotic-Resistant Bacteria. *Antibiotics (Basel)*. 10(9):1044. DOI: 10.3390/antibiotics10091044.

- Kumar S, Mishra S, Mishra AK and Kumar SN. (2022). Floral diversity of Koira & Barsuan Ranges of Bonai Forest Division, Odisha. Bonai Forest Division, Odisha & Ambika Prasad Research Foundation, Odisha, India.
- Kumar SN, Mishra S and Kumar S. (2021). Documentation of Indigenous Traditional Knowledge (ITK) on commonly available plants in Koira Range, Bonai Forest Division, Sundargarh, Odisha, India. Asian Plant Research Journal. 8(4): 83-95.
- Marndi S, Barik M and Kumar S. (2024). Phytochemical and cytotoxicity analysis of *Eulophia explanata* Lindl. (Tuber extracts). African Journal of Biological Sciences. 6(4):2751-2756.
- Mishra S, Sethi J and Kumar S. (2023). *Cleistanthus collinus* (Karada): a traditional biopesticide used by rural and tribal farmers of Odisha, India. Journal of Biodiversity and Conservation. 7(3): 45-49.
- Nayak G, Roy BC, Jena N and Kumar S. (2025) Phytochemical screening of fruits and bark of *Cleistanthus collinus*: a wild biopesticide of India. Medico-Biowealth of India, Volume 19. Ambika Prasad Research Foundation, India.
- Nayak S and Kumar S. (2023). Medicinal Plants used by Tribals of Odisha. State Medicinal Plants Board, Odisha & Ambika Prasad Research Foundation, Odisha, India.
- Pathak VM, Verma VK, Rawat BS, Kaur B, Babu N, Sharma A, Dewali S, Yadav M, Kumari R, Singh S, Mohapatra A, Pandey V, Rana N and Cunill JM. (2022). Current status of pesticide effects on environment, human health and it's eco-friendly management as bioremediation: A comprehensive review. Frontiers in Microbiology. 13:962619. DOI: 10.3389/fmicb.2022.962619.
- Şengül Demirak MŞ and Canpolat E. Plant-Based Bioinsecticides for Mosquito Control: Impact on Insecticide Resistance and Disease Transmission. Insects. 13(2):162. DOI: 10.3390/insects13020162.
- Tadesse Mawcha K, Malinga L, Muir D, Ge J and Ndolo D. (2024). Recent Advances in Biopesticide Research and Development with a Focus on Microbials. F1000Res. 13:1071. DOI: 10.12688/f1000research.154392.2.
- Tallur PN, Verma RK, Limaye P, Jena N and Kumar S. (2024). Qualitative phytochemical analysis of fruits of *Suregada multiflora* (A. Juss.) Baill.: a medicinal tree of India. Medico Biowealth of India, Volume 16. Ambika Prasad Research Foundation, India.
- Tripathi G, Jadhao AB, Kumar S, Jena N and Das K. (2024). Qualitative phytochemical analysis of *Datura stramonium* L. fruits. Biological Archives, Volume 1. Ambika Prasad Research Foundation, India.

Analysis of secondary metabolites of seeds of *Oroxylum indicum* (L.) Kurz (Bignoniaceae)

Jyoti J Kshirsagar¹, Manvi Malwal², Nihar Ranjan Nayak³, Bhagwati Prashad Sharma⁴, Nibedita Jena^{5*}, and Sanjeet Kumar⁵

¹Department of Botany, Saw K.S.K College Beed, Maharashtra, India

²Department of Botany, Post Graduate Govt College for Girls, Sector-11, Chandigarh, India

³Department of Botany, Maa Manikeshwari University, Bhawanipatna, Kalahandi, Odisha, India

⁴Department of Botany, Sidharth Government College Nadaun, Himachal Pradesh, India

⁵Ambika Prasad Research Foundation, Odisha, India

*Email-id: nibeditajena838@gmail.com

DOI: <https://doi.org/10.5281/zenodo.14845236>



Licensed under a Creative Commons Attribution 4.0 International License

Abstract

The present study investigates the phytochemical composition of *Oroxylum indicum* seeds using aqueous, methanol, and ethanol extracts. Qualitative phytochemical analysis revealed the presence of various bioactive compounds, including saponin, flavonoids, phenolic compounds, reducing sugars, tannin, and alkaloids. The study provides valuable insights into the phytochemical composition of *O. indicum* seeds, highlighting their potential as a source of natural bioactive compounds with potential applications in medicine and agriculture.

Key words: Bignoniaceae, bioactive compounds, pharmacological applications

Introduction

Oroxylum indicum, commonly known as Sonapatha or Tree of Damocles, is a plant species belonging to the family Bignoniaceae (Nayak and Kumar, 2023). It is known as Arlu and Tal Palanga in Himachal Pradesh and its long sword shaped fruits form important feature of vegetation, particularly in Himalayan foothills. It is distributed in Indian subcontinent, South-east Asia

and South China. In India, it is distributed in Himalayas, north-east, Western Ghats, Central India, Odisha, Bihar, Jharkhand, Chhattisgarh, Rajasthan and Gujrat. The plant is known for its diverse range of bioactive compounds, which have been reported to possess various pharmacological properties (Patra *et al.*, 2019). In recent years, there has been a growing interest in the phytochemical analysis of *O. indicum*, with several studies reporting the presence of flavonoids, phenolic acids, and other bioactive compounds in different parts of the plant (Lama *et al.*, 2022). However, the bioactive compounds of *O. indicum* seeds remains largely unexplored. Seeds are an important part of plant-based traditional medicine, and are often used as a source of bioactive compounds (Slawinska and Olas, 2022).

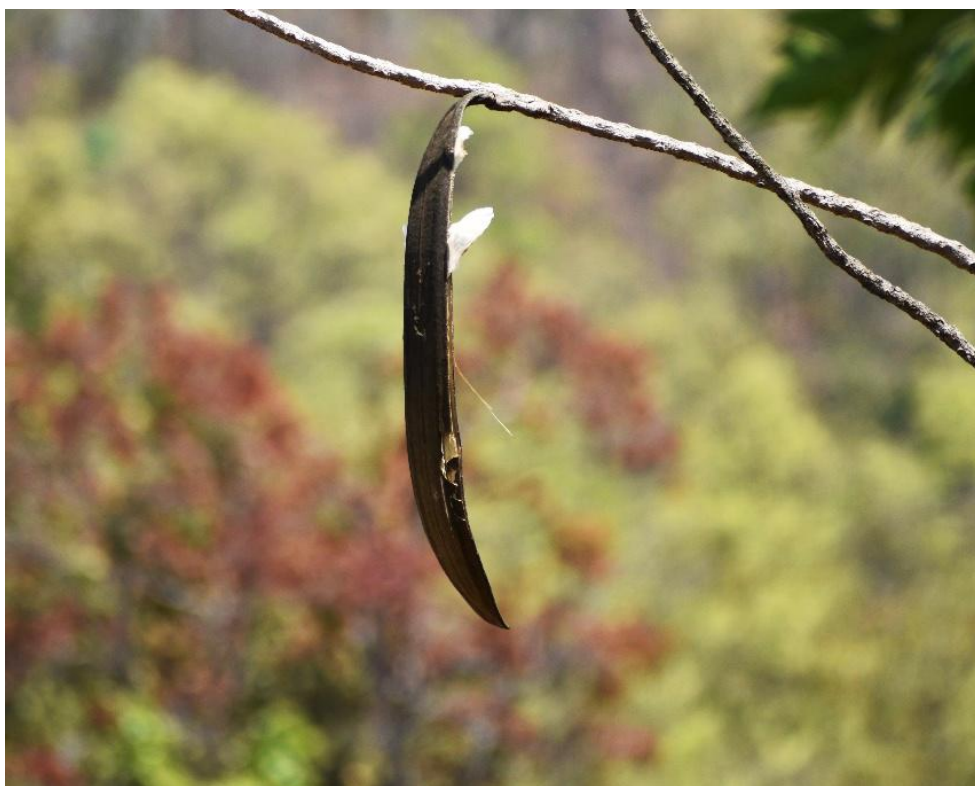


Figure 1: Fruit of *Oroxyllum indicum*

The phytochemical analysis of seeds can provide valuable insights into their potential medicinal properties and applications. Therefore, the present study aims to investigate the phytochemical composition of *O. indicum* seeds using different solvent extracts. The study is expected to provide valuable information on the bioactive compounds present in *O. indicum* seeds, which can be useful for the development of new medicinal products and therapies. Furthermore, the study can contribute to the conservation and sustainable use of *O. indicum*, a plant species with significant cultural and medicinal importance.

Materials and methods

The fruits of *O. indicum* were collected from the bank of Mahanadi River areas, Cuttack, in December 2024 (Kumar *et al.*, 2021; Jena *et al.*, 2025). Authors have identified the plant specimen (Figure 1-2).



Figure 2: Seeds of *Oroxyllum indicum* for experimental analysis

The seeds were collected from the fruits and extracts using different solvents were prepared for phytochemical screening (Figure 3-5; Devi *et al.*, 2024; Marndi *et al.*, 2024; Jena *et al.*, 2024).

Qualitative phytochemical analysis

Detection of nine secondary metabolites were conducted using standard methods (Sreedevi *et al.*, 2024; Tailor *et al.*, 2024).

Test for tannin: About 1 ml of the seed extract was taken. Added 3-5 drops of 10% lead acetate solution into it. The gelatinous precipitate formation confirmed the presence of tannin.

Test for saponin: About 1 ml of the seed extract was taken and added with 1 ml of distilled water. After addition shaken it well and observed the persistent froth formation, which confirmed the presence of saponin (Mety *et al.*, 2024).

Test for flavonoids: About 1 ml of the seed extract was taken. Added 2 ml of 2% NaOH solution and 3 to 4 drops of dilute HCl. The colour initially turned to an intense yellow colour with NaOH solution and later became colourless. This change in colours confirmed the presence of flavonoids.

Test for terpenoids: About 1 ml of the filtrate was added with 6 drops of chloroform and placed it in the water bath for few minutes. Then 6 drops of concentrated H₂SO₄ were added. The reddish-brown interface confirmed the positive result for the presence of terpenoids (Acharya *et al.*, 2024).

Test for phenolic groups: About 1 ml of the filtrate was taken. Few drops of 5% Ferric chloride solution were added. The dark bluish black color provided the positive result of the test for phenolic groups.

Test for reducing sugars: About 1 ml of the seed extract was taken and 2 drops of Fehling's solution A followed by Fehling's solution B were added and kept it in water bath for some time. The presence of red orange precipitate confirmed the presence of reducing sugar (Thakur *et al.*, 2025).

Test for steroids: About 1 ml of the seed extract was taken. 1 ml of chloroform and 1 ml of concentrated sulphuric acid was added into it. The appearance of upper red and lower yellow with green fluorescence confirmed the presence of steroids.

Test for alkaloids: About 1 ml of the seed extract was taken and added 3 to 4 drops of Dragendroff's reagent. The formation of reddish-brown precipitate confirmed the presence of alkaloids (Sharma *et al.*, 2024).

Test for carbonyl compounds: About 1 ml of the seed extract was taken and added 3 to 4 drops of 2,4- Dinitrophenylhydrazine (DNPH) reagent. The formation of yellow crystal confirmed the presence of carbonyl compounds.

Results and discussion

The phytochemical analysis of *Oroxylum indicum* seeds revealed the presence of various bioactive compounds, including saponin, flavonoids, phenolic compounds, reducing sugars, tannin, and alkaloids (Table 1). The results showed that saponin, flavonoids, phenolic compounds, and reducing sugars were present in all three extracts (aqueous, methanol, and ethanol), indicating their stability and solubility in different solvents. The presence of these bioactive compounds in *O. indicum* seeds suggests that they may possess various pharmacological properties, such as antioxidant, anti-inflammatory, and antimicrobial activities. The seeds may also have potential

applications in traditional medicine, particularly in the treatment of diseases related to oxidative stress and inflammation.

Table 1: Qualitative phytochemical screening of *O. indicum* seeds using different extracts

Bioactive compounds	Extracts		
	Aqueous	Methanol	Ethanol
Tannin	Presence	Presence	Absence
Saponin	Presence	Presence	Presence
Flavonoids	Presence	Presence	Presence
Terpenoids	Absence	Absence	Absence
Phenolic compounds	Presence	Presence	Presence
Reducing sugars	Presence	Presence	Presence
Steroids	Absence	Absence	Absence
Alkaloids	Presence	Absence	Absence
Carbonyl compounds	Absence	Absence	Absence



Figure 3: Detection of secondary metabolites of *O. indicum* seeds using aqueous extract

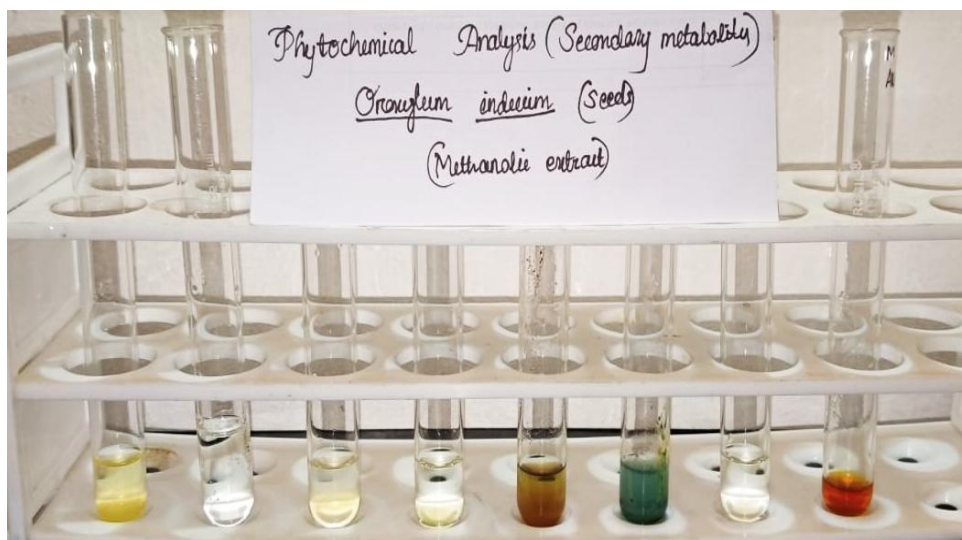


Figure 4: Detection of secondary metabolites of *O. indicum* seeds using methanolic extract



Figure 5: Detection of secondary metabolites of *O. indicum* seeds using ethanolic extract

The study's findings are consistent with previous reports on the phytochemical composition of *O. indicum*, which have highlighted the plant's potential as a source of natural bioactive compounds. However, further studies are needed to isolate and characterize the specific bioactive

compounds present in *O. indicum* seeds and to evaluate their pharmacological properties and potential applications.

Conclusion

The present study demonstrates the presence of various bioactive compounds in *Oroxylum indicum* seeds, highlighting their potential as a source of natural bioactive compounds. The study's findings are consistent with previous reports on the phytochemical composition of *O. indicum* and provide valuable insights into the seed's phytochemical profile. Future studies should focus on isolating and characterizing the specific bioactive compounds present in *O. indicum* seeds and evaluating their pharmacological properties and potential applications. Additionally, investigations into the seed's potential as a source of natural pesticides, antimicrobials, and anti-inflammatory agents could provide valuable insights into its potential uses. Overall, the study's findings highlight the importance of further research into the phytochemical composition and potential applications of *O. indicum* seeds.

References

- Acharya S, Das K, Soni P, Kaur L, Jena N, Kumar S and Ray P. (2024). Primary and secondary metabolites of kusum seeds. *Plants & Secondary Metabolites*, Volume 2. Ambika Prasad Research Foundation, India.
- Behera B, Ray P, Lyngdoh A, Singh B, Kumar S, Jena N and Sharma BP. (2024). Phytochemical analysis and scientific validation of ethnomedicinal uses of *Mucuna monosperma* Roxb. ex Wight: a medicinal climber of India. *Biological Archives*, Volume 1. Ambika Prasad Research Foundation, India.
- Devi RS, Satapathy KB, Manjula BL, Sharma BP and Kumar S. (2024). Evaluation of ethnopharmacological potential of *Oenanthe javanica* DC. *Annals of Biology*. 40(1): 135-139.
- Jena N, Kumar S and Sharma BP. (2024). Qualitative phytochemical analysis of *Phyllanthus virgatus* G. Forst.: a riparian herb. *Biological Archives*, Volume 1. Ambika Prasad Research Foundation, India.

- Jena N, Rout S, Mishra S and Kumar S. (2025). Evaluation of quantitative ethnobotanical uses in Mayurbhanj district, Odisha, India. *Journal of Biodiversity and Conservation*. 9(1): 1-29.
- Lama R, Manjula BL, Kumbar V, Panda A, Singh A, Kumar S and Marndi S. (2022). Phytochemical Screening and Antibacterial Activities of *Oroxylum indicum* (Linn.): A Threatened Tree of India. *Asian Pacific Journal of Health Sciences*. 9(4): 140–144. DOI: 10.21276/apjhs.2022.9.4S.27
- Marndi S, Barik M and Kumar S. (2024). Phytochemical and cytotoxicity analysis of *Eulophia explanata* Lindl. (Tuber extracts). *African Journal of Biological Sciences*. 6(4): 2751-2756.
- Mety SS, Lal S, Rote K, Topno SC, Jena N, Kumar S and Behera B. (2024). Qualitative phytochemical analysis of *Solanum virginianum* L. flower: a medicinal plant of India. *Plants & Secondary Metabolites*, Volume 1. Ambika Prasad Research Foundation, Odisha, India.
- Nayak S and Kumar S. (2023). Medicinal Plants used by Tribals of Odisha. State Medicinal Plants Board, Odisha & Ambika Prasad Research Foundation, Odisha, India.
- Patra JK, Das G, Kumar S and Thatoi H. (Eds.). (2019). *Ethnopharmacology and Biodiversity of Medicinal Plants* (1st ed.). Apple Academic Press. DOI: 10.1201/9780429398193
- Sharma BP, Tripathi G, Sharma S, Dehar PS, Kumar S, Jena N and Sureshrao GA. (2024). Qualitative phytochemical analysis of *Ficus religiosa* fruits. *Medico Biowealth of India*, Volume 17. Ambika Prasad Research Foundation, India.
- Singh B, Rao K, Aarti, Yadav N, Chauhan J, Jena N and Kumar S. (2024). Phytochemical screening and thin layer chromatography (TLC) of bark of *Alstonia scholaris* (Apocynaceae). *Plants & Secondary Metabolites*, Volume 1. Ambika Prasad Research Foundation, India.
- Sławińska N and Olas B. (2022). Selected Seeds as Sources of Bioactive Compounds with Diverse Biological Activities. *Nutrients*. 15(1): 187. DOI: 10.3390/nu15010187
- Soni P, Mahendru N, Dimri R, Hamdy R, Jena N and Kumar S. (2024). Qualitative phytochemical analysis of *Cascabela thevetia* fruits. *Biological Archives*, Volume 1. Ambika Prasad Research Foundation, India.
- Sreedevi A, Gurjar ES, Abidi A, Sharma BP, Jena N and Kumar S. (2024). Qualitative phytochemical analysis of *Artabotrys hexapetalus* (L. f.) Bhandari fruits: a medicinal tree of India. *Medico Biowealth of India*, Volume 16. Ambika Prasad Research Foundation, India.
- Tailor V, Prameela HC, Singh G, Dehar PS, Rani JJ, Jena N, Kumar S and Singh B. (2024). Qualitative phytochemical analysis of leaves of *Croton bonplandianus* Baill. *Plants and Secondary Metabolites*, Volume 1. Ambika Prasad Research Foundation, India.

Thakur K, Jena N and Kumar S. (2025). Pharmacological evaluation of *Vitex altissima* L.f. Medico-Biowealth of India, Volume 19. Ambika Prasad Research Foundation, India.

Tripathi G, Jadhao AB, Kumar S, Jena N and Das K. (2024). Qualitative phytochemical analysis of *Datura stramonium* L. fruits. Biological Archives, Volume 1. Ambika Prasad Research Foundation, India.

INDEX

A

Anti-inflammatory 1, 6, 8, 12, 15, 19, 47, 95

Antioxidant 1, 6, 18, 22, 24, 26, 33, 34, 36, 71, 95

Anti-mutagenic 8, 12, 14

Antibiotic resistance 9, 76

Antitumor 18, 22, 23, 26

B

Bioactive compounds 3, 4, 6, 8, 12, 15, 18, 19, 20, 23, 26, 30, 32, 37, 40, 41, 42, 44, 45, 46, 52, 54, 58, 60, 62, 70, 74, 79, 81, 85, 86, 87, 91, 92, 93, 95

Biopesticide 79, 80, 81, 86, 88

C

Contemporary medicines 41

Cytotoxicity 7, 16, 17, 52, 56, 57, 62, 74, 75, 77, 90, 99

I

Immunomodulatory 6

Insecticidal 33, 34, 37, 81, 87, 88

M

Multipurpose 1, 2

N

Neuroprotective 6

P

Pharmacological 1, 2, 4, 6, 15, 26, 29, 36, 60, 64, 92, 95, 98

S

Secondary metabolites 1, 2, 3, 5, 9, 18, 19, 22, 30, 31, 36, 42, 64, 65

Sustainable 2, 15, 30, 41, 54, 93

T

Therapeutics 1, 40

Traditional knowledge 7, 16, 30, 37, 49, 54, 76, 90

U

Unexplored 9, 64, 92



Editor's Profile



Dr. Emdad Hossain, is currently working as Associate Professor, Department of Pharmaceutical Technology, Jadavpur University, Kolkata. Before joining Jadavpur University he has worked as Principal & Professor at Pharmacy College, Azamgarh, Uttar Pradesh, India. He has completed his M. Pharm and Ph. D. from Jadavpur University, Kolkata, India. He is engaged in teaching as well in research associated with natural products studies for last twenty-three years. He has published more than 17 research and review papers in several reputed, referred and impact international journals, one conference proceedings, one editorial as well seven book chapters and one edited book. He has presented more than 80 research papers in different international and national conferences. He is life member of several renowned associations. He is Editor-in Chief of International Journal of Advanced Research in Pharmacy & Education, Global Academic Journal of Pharmacy and Drug Research and associate editor of Bioequivalence & Bioavailability International Journal, Indian Journal of Research in Pharmacy & Biotechnology as well as editorial board member of other twelve Indian and overseas journals. He is an active reviewer of different Elsevier, Springer-Nature, Taylor & Francis journals. He also delivered numbers of lectures in different refresher's course, national and international conferences in India and other country. He was awarded with the Best Teacher Award 2002, Jewel of India Award 2014, Young Performer Award 2015, Best Faculty Award 2018, Shikshak Shri Award 2018, Bharat Ratna Dr. Abdul Kalam Gold Medal Award 2018, Nirali's Pharma Recognition Award 2019, Best Researcher Award 2019, Best Educationist Award 2019, Rastriya Vidya Gaurav Gold Medal Award 2019, SAS Best Principal Award 2020 along with many other awards.



Mr. Bidhan Chandra Roy, is currently working as a Faculty Member at Department of Botany, Dinabandhu Mahavidyalaya, Bongaon, West Bengal, India. He is an enthusiastic botanist and researcher from India. He has completed M.Sc. in Botany (G.G.U.), B.Ed. (K.U.), M.A. in Education (K.U.), P.G. Diploma in Biodiversity from Bharathiar University, Coimbatore, India, and pursuing Ph.D. from Department of Life Science & Biotechnology, Jadavpur University, Kolkata, India. He has 11 years of academic experience in teaching. He is also the author of many book chapters and research articles. He has made significance contributions to the field through his research in Bioinformatics. He was awarded with the Best Oral Presentations, 2022 at the Department of Genetics & Biotechnology, Osmania University, Hyderabad, India.



Ms. Nibedita Jena, is currently employed by Ambika Prasad Research Foundation, Cuttack, Odisha as a Junior Research Fellow. She has completed her M.Sc. in Biotechnology from Sambalpur University, Odisha, India. Her research works focus on the study of medicinal plants, primary and secondary metabolites with their biological activities, pharmacological potentials, phytochemistry, antimicrobial properties, ethnomedicinal uses, indigenous traditional knowledge and healing practices of tribal communities. She has published 8 research articles, 64 book chapters, and 1 book.



Dr. Sanjeet Kumar, He is the founder and CEO of Ambika Prasad Research Foundation (APRF), Odisha & Institute of Biological Sciences (IBS), Odisha. He has worked with several reputed organizations & institutes such as RPRC (Regional Plant Resources Centre), Odisha, RJE (Regional Institute of Education), Odisha, IBSD (Institute of Bioresources and Sustainable Development), Imphal, Manipur, NIT (National Institute of Technology), Odisha and Forest & Environment Department, Odisha. His research interests are plant taxonomy, medicinal plants, biodiversity and conservation, restoration of floral wealth, phytochemistry, and microbiology. He has published about 336 research papers in journals of national and international repute, 80 books (Intech Open, Apple Academics Press, APRF, LAP Lambert Academic Publishing), with 323 book chapters and many popular articles. Six Ph.D. scholars are working under his guidance and 45 M.Sc. students have submitted their project work under his able supervision.

Emdad Hossain • Bidhan Chandra Roy • Nibedita Jena • Sanjeet Kumar

Plants & Secondary Metabolites, Volume 4 is a comprehensive guide that explores the phytochemical composition and medicinal properties of various plant species, shedding light on their potential applications in the development of new drugs and therapies.



ISBN: 978-81-973870-0-5