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

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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).

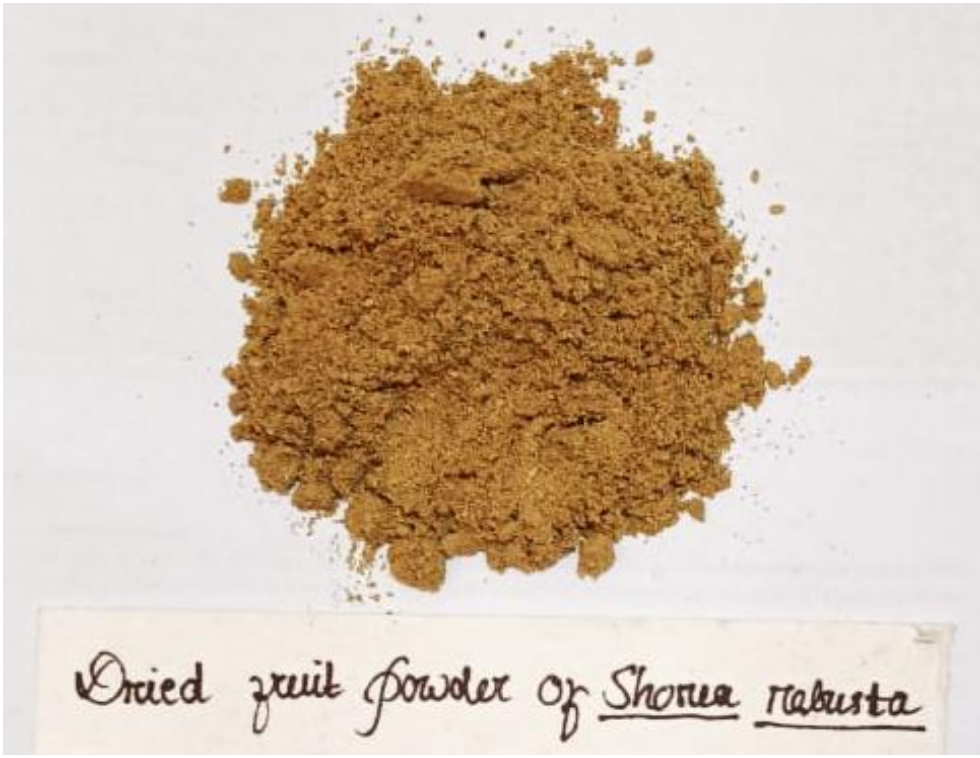

Figure 2: Dried fruit powder of *S. robusta* for experimental analysis

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 wad 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)

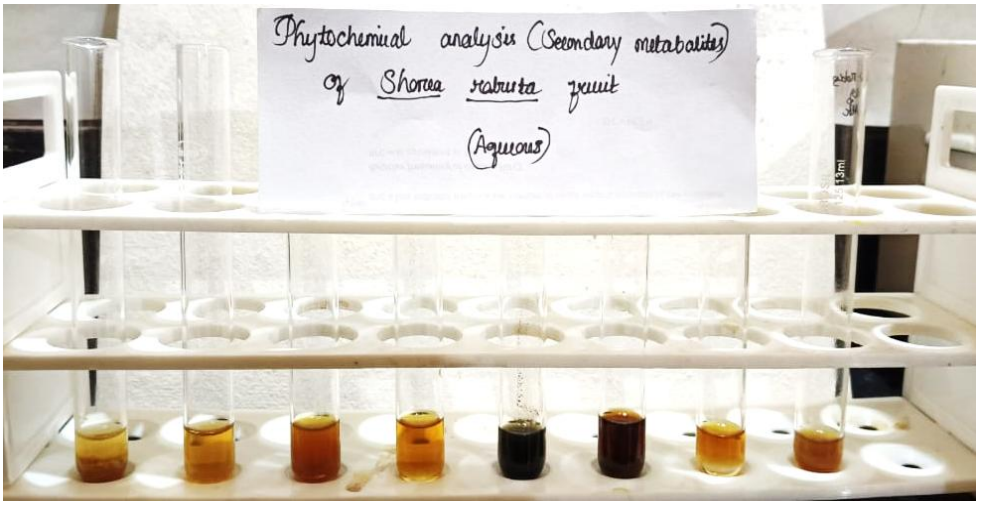

Figure 3: Detection of secondary metabolites of *S. robusta* using aqueous extract

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

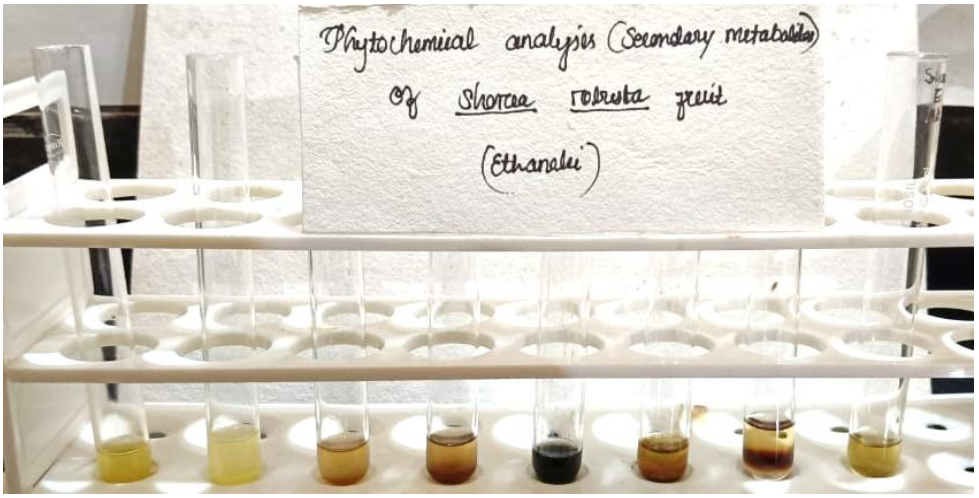

Figure 5: Detection of secondary metabolites of *S. robusta* using ethanolic extract

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 *et al.,* (2010)
Phenolic compounds	Phenolic groups present in aqueous, methanol and ethanol extracts have antimutagenic properties.	Huang *et al.,* (2010)
Reducing sugars	Reducing sugars present in aqueous, methanol and ethanol extracts have antidiabetic properties	McKenzie and Lee, (2022)

Steroids	Steroids present in aqueous, methanol and ethanol extracts have anti-inflammatory activities	Williams, (2018)

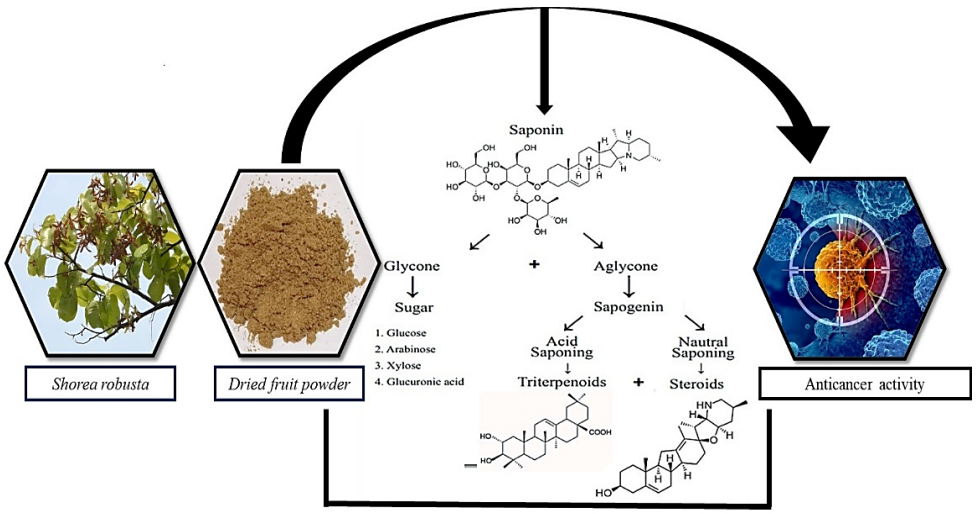

Figure 6: Pharmacological potential (anticancer activity) of *S. robusta* fruits

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.

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