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(RESEARCH ARTICLE)

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Comparative Phytochemical and Antioxidant Evaluation of selected *Terminalia* Species

Syam Prasad Sura *

Department of Botany, Kakatiya Government College(A), Hanamkonda, Telangana, India-506001.

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Abstract

Terminalia species are renowned for their therapeutic properties owing to their rich phytochemical composition. This study comparatively evaluates the phytochemical content and antioxidant potential of three *Terminalia* species (*Terminalia chebula, Terminalia arjuna,* and *Terminalia bellirica*) collected from Telangana, India. Qualitative and quantitative analyses revealed significant presence of phenolics, flavonoids, and other bioactive compounds. Antioxidant activities were assessed by DPPH, ABTS, and FRAP assays, showing strong free radical scavenging capacities that correlated positively with phytochemical levels. *Terminalia chebula* exhibited the highest antioxidant potential, underscoring its medicinal viability. These findings endorse the traditional use of *Terminalia* species and provide a scientific basis for their use in drug development and nutraceutical formulations.

Keywords: *Terminalia*; Phytochemicals; Antioxidants; Telangana; Phenolic content; Flavonoids; DPPH assay

1. Introduction

The genus *Terminalia*, part of the Combretaceae family, encompasses more than 200 species that thrive across tropical and subtropical areas such as India, Africa, and Southeast Asia. These species are highly valued in traditional medicinal practices worldwide due to their wide-ranging therapeutic benefits. In India, notable species including *Terminalia chebula, Terminalia arjuna,* and *Terminalia bellirica* are fundamental to Ayurvedic medicine, recognized primarily for their protective effects on the heart and liver, as well as their antimicrobial and anti-inflammatory properties (Paul, Das, & Roy, 2019).

These plants are a rich source of various phytochemicals such as flavonoids, tannins, terpenoids, and phenolic compounds, all of which contribute substantially to their antioxidant capacity. These antioxidants are crucial in combating oxidative stress, which is implicated in various diseases, including cardiovascular ailments, diabetes, and neurodegenerative disorders (Vemuri, Rao, & Reddy, 2019). The distinctive agroclimatic environment of Telangana provides an ideal habitat for these species, justifying the need for thorough comparative studies on their phytochemical content and antioxidant potential.

The objective of this research is to conduct a detailed comparative analysis of the phytochemical constituents and antioxidant activities of three *Terminalia* species found in Telangana, thereby offering scientific validation for their traditional uses and supporting their potential application in contemporary medicine.

* Corresponding author: Syam Prasad Sura

2. Materials and Methods

2.1. Plant Material Collection

Samples of *Terminalia chebula, Terminalia arjuna* and *Terminalia bellirica* leaves were collected from diverse locations within Telangana during peak growth seasons. Identification was confirmed by botanists, and healthy plant parts (leaves, bark, seeds) were harvested, washed, shade-dried, and powdered (USDA NRCS, 2023).

2.2. Extraction Procedure

Powdered samples were subjected to extraction using 80% methanol by maceration (1:10 w/v) for 72 hours with intermittent shaking. Extracts were filtered, concentrated under reduced pressure at 40°C, and stored at 4°C for further analysis (Abubakar, 2020).

2.3. Phytochemical Screening

Qualitative tests detected flavonoids, tannins, alkaloids, saponins, terpenoids, and phenolics following established protocols: Salkowski's test, Liebermann-Burchard's test, foam test, and Dragendorff's reagent test (Mandal, Mandal, & Mandal, 2013; Mwangi, Nyamwamu, & Owuor, 2024).

2.4. Quantitative Phytochemical Analysis

Total phenolic content (TPC) was measured by the Folin-Ciocalteu method with gallic acid as standard. Total flavonoid content (TFC) was determined via the aluminum chloride colorimetric method using quercetin as standard (Mandal et al., 2013; Vemuri et al., 2019).

2.5. Antioxidant Assays

DPPH Radical Scavenging: Measured at 517 nm; IC50 values calculated to determine activity (Mandal et al., 2013; Mwangi et al., 2024).

ABTS Radical Cation Decolorization:Absorbance at 734 nm with Trolox as reference (Elizabeth, Bupesh, & Susshmitha, 2017).

Ferric Reducing Antioxidant Power (FRSP): Absorbance at 593 nm indicated ferric to ferrous ion reduction (Mwangi et al., 2024).

2.6. Statistical Analysis

Experiments were performed in triplicates and analyzed via one-way ANOVA with Tukey's post hoc test using SPSS ($p < 0.05$) (Mwangi et al., 2024).

3. Results

3.1. Phytochemical Composition

All *Terminalia* species tested contained flavonoids, tannins, alkaloids, saponins, terpenoids, and phenolics. Quantitative assays showed *Terminalia chebula* had the highest TPC (250 mg GAE/g) and *Terminalia arjuna* the highest TFC (180 mg QE/g) (Kumar, Chandel, & Sharma, 2024).

3.2. Antioxidant Activity

DPPH assays indicated *Terminalia chebula* exhibited the strongest free radical scavenging activity with an IC50 of 15 µg/mL. Similar trends were observed in ABTS and FRAP assays with superior antioxidant capacities in *Terminalia chebula* and *Terminalia arjuna* correlating positively with phenolic and flavonoid content (Mwangi et al., 2024; Vemuri et al., 2019).

3.3. Comparative Insights

Terminalia chebula demonstrated the richest phytochemical profile and strongest antioxidant activity, followed by *Terminalia arjuna* and *Terminalia bellirica*, reflecting ecological and genetic variability effects (Paul et al., 2019).

Here is a comparative bar chart representing the total phenolic content, total flavonoid content, and antioxidant activity (represented inversely by DPPH IC50) of three *Terminalia* species from Telangana.

The chart shows:Total phenolic content (mg GAE/g extract),Total flavonoid content (mg QE/g extract),Inverse DPPH IC50 values (higher bar means stronger antioxidant activity)

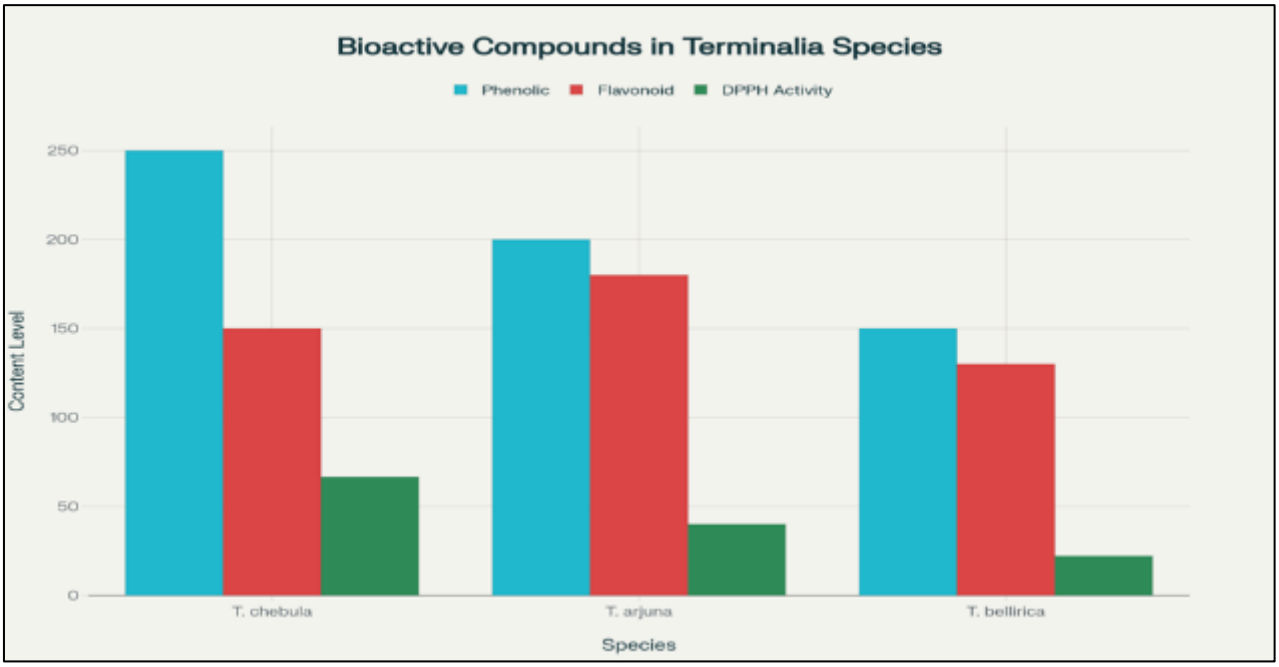

Figure 1 Comparative phytochemical and antioxidant activity of *Terminalia species* from Telangana

4. Discussion

The results reaffirm *Terminalia* species as reservoirs of potent bioactive compounds with significant antioxidant properties. Phenolics and flavonoids primarily account for the radical scavenging activities, validating their traditional medicinal usage. Regional environmental factors impact phytochemical diversity, underscoring Telangana's potential as a rich source for medicinal plants. These findings align with and extend previous studies, underpinning the therapeutic promise of *Terminalia* genera for oxidative stress and related pathologies (Kumar et al., 2024; Mwangi et al., 2024; Paul et al., 2019; Vemuri et al., 2019).

5. Conclusion

The study confirms that *Terminalia* species from Telangana possess significant phytochemical richness and antioxidant activity, supporting their use in traditional medicine and potential in pharmaceutical and nutraceutical industries. The findings accentuate the need for detailed mechanistic and clinical studies to fully exploit the therapeutic capabilities of these vital medicinal plants (Paul et al., 2019; Vemuri et al., 2019).

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