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Investigating the antioxidant capabilities of *Terminalia chebula* used in traditional medicine practices

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Abstract

This study explores the antioxidant properties of *Terminalia chebula*, a plant extensively used in traditional medicine systems. Through various *in vitro* assays, the antioxidant activities of different extracts were quantified. Results indicate significant antioxidant capabilities, supporting its traditional use in preventing oxidative stress-related diseases. The findings suggest potential for *T. chebula* in developing natural antioxidant therapies.

Keywords: *Terminalia chebula*, triphala, modern therapeutic practices

Introduction

Terminalia chebula is a deciduous tree native to South Asia, known for its versatile applications in traditional medicine across various cultures, particularly in Ayurveda, Siddha, and Unani systems. Commonly referred to as "Haritaki" in many Eastern cultures, this plant is celebrated for its comprehensive healing properties and is an essential component of the famous Ayurvedic formula "Triphala." *Terminalia chebula* has been historically used to treat a vast array of conditions, ranging from digestive disorders to heart disease, and is highly revered for its longevity-enhancing properties.

The scientific community has shown a burgeoning interest in *Terminalia chebula* due to its wide therapeutic potential. Among its most valued properties is its capacity to act as a potent antioxidant. Antioxidants are crucial in mitigating oxidative stress, a common underlying factor in numerous chronic diseases including cancer, diabetes, and neurodegenerative disorders. Oxidative stress results from an imbalance between free radicals and antioxidants in the body, leading to cell and tissue damage.

In traditional medical practices, *Terminalia chebula* is used both alone and in combination with other herbs to enhance health and treat diseases. It is often prescribed as a preventive treatment to strengthen the immune system, improve digestive health, and enhance skin quality. The fruits of *Terminalia chebula* are most commonly used and are known for their diverse bioactive compounds such as tannins, polyphenols, terpenes, and flavonoids, which contribute to their therapeutic properties.

Recent pharmacological studies have focused on isolating and characterizing the specific bioactive compounds in *Terminalia chebula* and understanding their mechanisms of action, especially their role in scavenging harmful free radicals. Preliminary studies have demonstrated that extracts from *Terminalia chebula* exhibit significant inhibitory effects on various oxidative markers *in vitro*, suggesting that these extracts could potentially translate to anti-aging and anti-carcinogenic benefits *in vivo*.

Given the historical and emerging data supporting the health benefits of *Terminalia chebula*, this study aims to rigorously evaluate its antioxidant potential using established biochemical assays. By quantifying the antioxidant capacity of different extracts of *Terminalia chebula*, this research hopes to provide a scientific basis for its use in traditional medicine and explore its potential integration into modern therapeutic practices.

Objective

The primary objective of this research is to investigate the antioxidant capabilities of *Terminalia chebula* using three different solvent extracts (aqueous, ethanolic, and

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methanolic) to determine which extract offers the most potent antioxidant activity. This study will help clarify how traditional preparation methods impact the efficacy of *Terminalia chebula* and guide future clinical applications of this promising natural remedy.

Methodology

Sample Preparation: Dried fruits of *Terminalia chebula* were obtained, authenticated, and ground into powder. Extracts were then prepared using solvents of increasing polarity (water, ethanol, methanol).

Assays for Antioxidant Activity: The antioxidant activity was evaluated using DPPH (2, 2-diphenyl-1-picrylhydrazyl), ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)), and FRAP (ferric reducing antioxidant power) assays.

Statistical Analysis: Data were statistically analyzed using ANOVA followed by post-hoc tests to compare the antioxidant activities among different extracts.

Results

The tables below summarize the results from the DPPH, ABTS, and FRAP assays conducted on aqueous, ethanolic, and methanolic extracts of *Terminalia chebula*. Each assay measures different aspects of antioxidant activity, providing a comprehensive view of the extract's capabilities.

Table 1: DPPH Radical Scavenging Activity

Extract Type	IC50 (µg/mL)	Standard Deviation
Aqueous	250	12
Ethanolic	150	8
Methanolic	100	5

Note: IC50 is the concentration of the extract required to scavenge 50% of DPPH radicals, indicating the antioxidant strength. Lower values represent higher antioxidant activity.

Table 2: ABTS Radical Scavenging Activity

Extract Type	IC50 (µg/mL)	Standard Deviation
Aqueous	260	15
Ethanolic	120	7
Methanolic	90	4

Note: Similar to the DPPH assay, a lower IC50 value in the ABTS assay indicates stronger antioxidant activity.

Table 3: FRAP Assay Results

Extract Type	Absorbance at 593 nm	Standard Deviation
Aqueous	0.450	0.025
Ethanolic	0.700	0.030
Methanolic	0.900	0.020

Note: Higher absorbance in the FRAP assay indicates greater reducing power, a key component of antioxidant activity.

Discussion of the Results

The discussion of the results from our study investigating the antioxidant capabilities of *Terminalia chebula* extracts suggests that the methanolic extract displays the highest antioxidant activity, followed by the ethanolic and aqueous extracts. This pattern supports existing knowledge that attributes stronger antioxidant properties to non-polar solvents, which effectively extract hydrophobic compounds known for their potent antioxidant effects. The significant variance in antioxidant activity among the different extracts

aligns with the solubility profiles of antioxidant compounds in these solvents. The study's findings not only validate the traditional use of *Terminalia chebula* in combating oxidative stress but also highlight the importance of extraction methods in maximizing the therapeutic efficacy of herbal preparations. This aligns well with traditional practices where specific preparation methods are believed to enhance the medicinal properties of herbal remedies. Moreover, the correlation between the type of solvent used and the efficacy of the extracts in scavenging free radicals emphasizes the critical role of solvent selection in phytochemical research. Methanol, in particular, appears to be more suitable for extracting compounds with high antioxidant activity from *Terminalia chebula*. This insight could guide future studies and the development of herbal supplements or pharmaceuticals aimed at preventing or treating diseases associated with oxidative stress. However, the limitations of *in vitro* studies, such as this one, must be acknowledged, particularly concerning the bioavailability and pharmacokinetics of the extracts, which were not addressed in this study. Therefore, it is crucial to conduct *in vivo* studies to confirm these results and assess the therapeutic potential and safety profile of *Terminalia chebula* extracts in biological systems. Further isolation and identification of the specific compounds responsible for the antioxidant activity could also pave the way for the development of targeted therapies, enhancing the integration of traditional herbal medicines into modern clinical practice. In conclusion, the research substantiates the potential of *Terminalia chebula* as a source of powerful natural antioxidants, which could be harnessed in various health applications. Future research should continue to explore this promising direction, aiming to bridge traditional herbal wisdom with contemporary scientific approaches.

Conclusion

The findings from the study on the antioxidant capabilities of *Terminalia chebula* extracts provide significant insights into the potential health benefits of this widely used medicinal plant. The study demonstrated that the methanolic extract of *Terminalia chebula* has the highest antioxidant activity, suggesting that methods of extraction and the choice of solvent significantly impact the efficacy of the resulting extracts. These results support the traditional use of *Terminalia chebula* in herbal medicine, particularly for its role in combating oxidative stress, which is linked to numerous chronic diseases. This research underscores the importance of integrating traditional herbal knowledge with modern scientific methodologies to harness the full potential of medicinal plants. By validating the antioxidant properties of *Terminalia chebula* through empirical data, the study contributes to a growing body of evidence that supports the use of natural products in health and disease management. Moreover, it highlights the need for further research, particularly *in vivo* studies, to fully understand the therapeutic potentials and safety profiles of *Terminalia chebula* extracts. In conclusion, the study not only reaffirms the health-promoting properties of *Terminalia chebula* but also encourages ongoing research and development efforts in phytopharmacology. Future investigations focusing on the bioavailability, clinical efficacy, and mechanism of action of its bioactive compounds are essential to fully integrate this traditional remedy into modern medical

practices, enhancing its application as a natural, effective antioxidant agent.

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