

Application of Tannin-Rich Sources in Food and Pharmaceutical Industries: Biological Properties and Health Benefits

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Structured Abstract

Background: Tannins are polyphenolic compounds abundantly found in various plant sources such as bark, leaves, fruits, and seeds. Known for their bioactive properties, tannins are gaining attention for applications in the food and pharmaceutical industries. However, their incorporation into commercial products is still limited due to gaps in understanding regarding their biological functions, extraction efficiency, and health benefits. This study aims to provide a comprehensive review of tannin-rich sources and evaluate their biological properties and associated health benefits to support industrial integration.

Methods: A systematic review was conducted using Scopus, Web of Science, and PubMed databases. Articles published between 2014 and 2025 were selected through a structured search and screening process. A total of 22 articles were included and grouped into themes related to tannin-rich plant sources and extraction methods, biological activities such as antioxidant and antimicrobial properties, and various health-promoting applications. Data were synthesized based on plant parts used, extraction techniques, and types of biological assays reported.

Results: The review identified diverse plant parts such as pseudobulbs, husks, and leaves with high tannin content. Soxhlet and percolation-based extraction methods were shown to yield higher concentrations. Biologically, tannins demonstrated strong antioxidant, antimicrobial, antibiofilm, antimutagenic, and anti-inflammatory activities, primarily through membrane disruption and free radical scavenging. Additionally, several studies supported their potential for gut modulation, antidiabetic effects, and lipid-lowering actions. Despite promising results, limitations remain in compound-specific identification and in vivo validation.

Conclusion: This review highlights the significant potential of tannin-rich extracts in enhancing food preservation, supporting therapeutic interventions, and promoting human health. However, further studies are required to isolate specific tannin compounds and confirm efficacy in clinical models. The findings contribute to future product development and sustainable applications in both food and pharmaceutical industries.

Keywords: Tannins, Extraction Methods, Biological Properties, Health Benefits

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