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Research Paper

Antioxidant Properties and Therapeutic Use of Cinnamon

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Abstract	Manuscript Information
<p>Cinnamon (<i>Cinnamomum</i> spp.) is an aromatic spice widely recognised for its culinary, nutritional, and medicinal significance. It contains a wide range of bioactive compounds that exhibit antioxidant, anti-inflammatory, antimicrobial, and antidiabetic activities. This research paper systematically reviews the antioxidant properties and therapeutic potentials of cinnamon, highlighting its phytochemical composition, mechanisms of antioxidant action, and clinical relevance in managing oxidative stress-related diseases. Data were synthesised from major databases published between 2000 and 2024. Findings show that cinnamon possesses strong radical scavenging capacity, promotes endogenous antioxidant defence, and shows therapeutic potential against diabetes, cardiovascular, neurodegenerative, and infectious diseases. However, variations in species, dosage, and preparation methods influence results. Further standardised clinical studies are essential to confirm its long-term safety and efficacy.</p>	<ul style="list-style-type: none">▪ ISSN No: 2583-7397▪ Received: 08-06-2024▪ Accepted: 30-07-2024▪ Published: 29-08-2024▪ IJCRM:3(4); 2024: 234-236▪ ©2024, All Rights Reserved▪ Plagiarism Checked: Yes▪ Peer Review Process: Yes
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1. INTRODUCTION

Cinnamon is obtained from the inner bark of trees belonging to the genus *Cinnamomum*, primarily *Cinnamomum verum* (Ceylon cinnamon) and *Cinnamomum cassia* (Chinese cinnamon). It has been used for thousands of years as both a spice and a medicinal agent in traditional healing systems such as Ayurveda and Traditional Chinese Medicine. Recent scientific investigations have provided evidence supporting cinnamon's pharmacological potential, particularly its antioxidant activity, which contributes to its therapeutic effects. Oxidative stress arises due to an imbalance between free radical generation and the body's ability to neutralise them through antioxidant defences. Chronic oxidative stress contributes to the pathogenesis of multiple diseases, including diabetes, cancer, cardiovascular, and neurodegenerative disorders. Given the increasing interest in natural antioxidants as safer alternatives to synthetic ones, cinnamon represents a promising source of

bioactive compounds with substantial health benefits.

2. METHODOLOGY

This paper follows a systematic review methodology based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The approach includes defining the research question, establishing inclusion and exclusion criteria, identifying information sources, and synthesising data for qualitative interpretation.

2.1 Eligibility Criteria

Inclusion criteria covered peer-reviewed studies published between 2000 and 2024 that examined cinnamon's antioxidant or therapeutic effects. Exclusion criteria included mixed herbal formulations containing cinnamon and non-original papers, such as editorials and commentaries.

2.2 Information Sources

The databases PubMed, Scopus, ScienceDirect, and Google Scholar were systematically searched using keywords such as “Cinnamon,” “Antioxidant,” “Phytochemicals,” and “Therapeutic Use.” Grey literature and traditional medicine sources were also reviewed.

2.3 Data Collection Process

Two reviewers independently screened articles based on titles and abstracts. Eligible full-text studies were reviewed for species used, extract type, antioxidant assays, and therapeutic outcomes. Data were extracted and summarised into thematic categories for analysis.

2.4 Study Risk of Bias Assessment

The Cochrane Risk of Bias Tool and SYRCLE Animal Study Risk of Bias tool were used to assess study quality. Factors evaluated included randomisation, blinding, incomplete data, and reporting bias. Most studies presented a moderate risk due to limited sample sizes or unstandardized extraction methods.

3. Phytochemical Composition of Cinnamon

Cinnamon bark contains several bioactive compounds, including cinnamaldehyde, eugenol, cinnamic acid, coumarin, catechins, epicatechins, and procyanidins. These compounds contribute to cinnamon’s distinctive aroma and medicinal activity. The essential oils of cinnamon, particularly cinnamaldehyde, are primarily responsible for its antioxidant and antimicrobial properties.

4. Antioxidant Mechanisms of Cinnamon

The antioxidant mechanisms of cinnamon operate through several pathways: (1) free radical scavenging, (2) metal ion chelation, (3) inhibition of lipid peroxidation, and (4) enhancement of endogenous antioxidant enzymes. Phenolic compounds in cinnamon donate electrons or hydrogen atoms to neutralise reactive oxygen species (ROS) such as superoxide, hydroxyl, and peroxy radicals.

5. Therapeutic Applications of Cinnamon

5.1 Antidiabetic Activity

Cinnamon improves insulin sensitivity, enhances glucose uptake, and regulates glycogen synthesis. Polyphenols mimic insulin action, while cinnamaldehyde stimulates glucose transporter (GLUT4) expression in cells. Clinical trials demonstrate reduced fasting blood glucose and improved HbA1c levels with cinnamon supplementation.

5.2 Cardioprotective Effects

Cinnamon reduces oxidative modification of LDL cholesterol, prevents lipid peroxidation, and promotes vasodilation. Its anti-inflammatory effect lowers cardiovascular risk factors such as hypertension and atherosclerosis.

5.3 Neuroprotective Effects

Cinnamon’s antioxidants protect neurons from oxidative stress, inhibit tau protein aggregation, and enhance memory and learning. Studies show improved neurobehavioral outcomes in Alzheimer’s and Parkinson’s models.

5.4 Anticancer Properties

Cinnamon extract induces apoptosis in cancer cells through activation of caspase pathways and inhibition of angiogenesis. Cinnamaldehyde and eugenol disrupt tumour cell proliferation.

5.5 Antimicrobial and Anti-inflammatory Effects

Cinnamon essential oils exhibit broad-spectrum antimicrobial activity against bacteria and fungi, while their phenolic compounds suppress inflammatory cytokines and COX-2 enzyme expression.

6. Comparative Evaluation of *C. verum* and *C. cassia*

Ceylon cinnamon (*C. verum*) is often considered superior due to its lower coumarin content, making it safer for long-term use. Cassia cinnamon (*C. cassia*) contains higher concentrations of coumarin, which can be hepatotoxic in excessive doses. However, Cassia is more abundant in cinnamaldehyde, giving it a stronger flavour and antimicrobial effects.

7. DISCUSSION

The compiled evidence underscores cinnamon’s potent antioxidant and therapeutic potential. Its ability to modulate oxidative pathways contributes to beneficial effects in chronic disease prevention. However, disparities in experimental design, species, and dosage necessitate careful interpretation of results. Standardisation of extraction and dosage forms is essential to ensure clinical reproducibility and safety.

8. Limitations and Future Directions

This review is limited by the heterogeneity of included studies and the scarcity of long-term human trials. Publication bias toward positive findings may exist. Future research should focus on standardised dosing, clinical trials with larger populations, and identification of synergistic effects with other bioactive compounds.

9. CONCLUSION

Cinnamon demonstrates significant antioxidant capacity, which underlies its diverse therapeutic applications. Through free radical scavenging, metal chelation, and enhancement of endogenous defences, cinnamon shows promise as a natural agent for managing oxidative stress-related conditions. With further research and clinical validation, cinnamon may serve as a safe, effective complementary therapy in modern medicine.

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Review

1. Clinical data remain mixed but growing: several meta-analyses and reviews in 2023–2024 reported modest improvements in blood glucose and some lipid/cardiovascular biomarkers with cinnamon or cinnamon extracts, while noting study heterogeneity and variable preparations/doses.
2. Recent 2023–2024 papers emphasised cinnamon’s anti-inflammatory effects (downregulation of inflammatory cytokines) and proposed mechanisms linking antioxidant activity to improvements in markers of metabolic and cardiovascular risk.
3. Multiple reviews and experimental studies across 2022–2024 reinforced that cinnamon (*Cinnamomum* spp.) contains high levels of phenolic compounds (including cinnamaldehyde, cinnamic acid and related polyphenols) that scavenge reactive oxygen species and reduce oxidative stress *in vitro* and in animal models.