Review Article

Anti-inflammatory effect of cinnamon (*Cinnamomum verum*)

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**A R T I C L E  I N F O**

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**A B S T R A C T**

Inflammation happens when a physical factor triggers an immune reaction. When not treated it begins to contribute to several chronic diseases and lead to tissue breakdown and impairment of the immune system. Cinnamon is a popular spice often used to flavor baked treats. Studies have shown that the spice has anti-inflammatory, anti-bacterial, antioxidant, anti-diabetic and many other activities. The present review is conducted to evaluate the anti-inflammatory effect of various cinnamon species which can ease swelling and prevent inflammatory diseases. It was found effective in which its chemical constituents present in cinnamon is mainly responsible for anti-inflammatory property of the spice.

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1. Introduction

Cinnamon is a flavor additive which helps in improving odor, taste and color of meals for a long time. It is derived from the inner bark of several tree species from the genus Cinnamomum widely spread in the Mediterranean region, Sri Lanka and India. Cinnamon is high in antioxidants such as polyphenols and glutathione; therefore, it could be regarded as a powerful anti-inflammatory agent and may protect against cancer. Overall, approximately 250 species have been identified among the cinnamon genus, with trees being scattered all over the world. *Cinnamomum verum* (also known as Cinnamomum zeylanicum, Ceylon cinnamon, or true cinnamon) and Cinnamomum cassia (also known as Cassia cinnamon or Chinese cinnamon) are the most popular species in the world. Almost every part of the cinnamon tree including the bark, leaves, flowers, fruits and roots, has some medicinal or culinary use. CZ, also known as Ceylon cinnamon (the source of its Latin name, *zeylanicum*) or ‘true cinnamon’ is indigenous to Sri Lanka and southern parts of India. Cinnamon possesses beneficial health effects such as anti-inflammatory properties, antimicrobial activity, reducing cardiovascular disease, boosting cognitive function and reducing risk of colonic cancer.

1.1. Vernacular names of cinnamon

<table>
<thead>
<tr>
<th>Language</th>
<th>Names</th>
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<tbody>
<tr>
<td>Bengali</td>
<td>Dalchini</td>
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<tr>
<td>Gujarati</td>
<td>Dalchini</td>
</tr>
<tr>
<td>Hindi</td>
<td>Dalchini</td>
</tr>
<tr>
<td>Kannada</td>
<td>Dalchini</td>
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<tr>
<td>Marathi</td>
<td>Dalchini</td>
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<tr>
<td>Malayalam</td>
<td>Lavanga pattai</td>
</tr>
<tr>
<td>Tamil</td>
<td>Lavanga pattai</td>
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<tr>
<td>Telugu</td>
<td>Lavanga pattai</td>
</tr>
</tbody>
</table>

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1.2. Botanical classification of cinnamon

- Kingdom: Plantae
- Division: Magnoliophyta
- Class: Magnoliopsida
- Order: Laurales
- Family: Lauraceae
- Genus: Cinnamomum
- Species: Cinnamomum verum, Cinnamomum cassia, Cinnamomum loureirii

2. Anti-inflammatory Activity

Inflammation plays an important role in the host immune defense response to harmful stimuli such as damaged cells, irritants, and pathogens. This complex process not only eliminates the primary cause of infection or tissue injury, it also eradicates apoptotic/necrotic cells and damaged tissue and initiates tissue repair. Immune cells, including macrophages, neutrophils, and lymphocytes respond to infectious agents by modulating an inflammatory response.

2.1. In-vitro studies

Periodontal diseases are bacteria-induced inflammatory disorders that lead to the destruction of the tooth-supporting tissues. This study was performed to characterize the anti-inflammatory properties of a polyphenolic cinnamon fraction. Chromatographic and mass spectrometry analyses of composition of the cinnamon fraction revealed that phenolic acids, flavonoids (flavonols, anthocyanins, flavan-3-ols), and procyanidins make up 9.22%, 0.72%, and 10.63% of the cinnamon fraction, respectively. Macrophage model stimulated with lipopolysaccharides (LPS) from E. coli was used to show that the cinnamon fraction dose-dependently reduced IL-6, IL-8, and TNF-α secretion. The result showed that the cinnamon fraction reduces LPS binding to monocytes, which may contribute to its anti-inflammatory properties. It was concluded that cinnamon exhibit a therapeutic potential for the treatment of periodontal diseases due to its anti-inflammatory properties.

Xuesheng and Torny studied the effect of cinnamon (Cinnamomum zeylanicum) bark essential oil (CBE0) on human dental fibroblast system, a model of chronic inflammation and fibrosis. CBE0 significantly inhibited the production of several inflammatory biomarkers, including vascular cell adhesion molecule-1, intercellular cell adhesion molecule-1, monocyte chemoattractant protein-1, interferon gamma induced protein 10, interferon-inducible T-cell alpha chemoattractant, and monokine induced by gamma interferon. It also significantly inhibited the production of several tissue remodeling molecules, including epidermal growth factor receptor, matrix metalloproteinase-1, and plasminogen activator inhibitor-1. In addition, it also inhibited macrophage colony-stimulating factor, which is an immunomodulatory protein molecule. Furthermore, CBE0 significantly modulated global gene expression and altered signaling pathways, many of which are important in inflammation, tissue remodeling, and cancer biology. Khaled and others studied anti-inflammatory effect of cinnamon ethanolic extracts on Lipopolysaccharide (LPS)-induced Interlukin-6 (IL-6) and Tumor Necrosis Factor-α (TNF-α) by polymorphonuclear Cells (PMNCs). 50 gm of cinnamon powder mixed in 500 ml of 96% ethanol and kept shaking for one week at room temperature. The concentrations of TNF-α and IL-6 in the supernatant were measured after 24 h and compared using paired-samples t test. Cinnamon extract showed significant reduction in the both IL-6 and TNF-α level. HPLC analysis of cinnamon extract revealed that major compound in the extract was cinnamic acid. Reduction in the levels of IL-6 and TNF-α indicates anti-inflammatory effect.

2.2. Animal studies

Li et al studied the anti-inflammatory effect of cinnamon essential oil on 6, 6-week-old female dextran sodium sulphate (DSS) induced colitis mouse. They were fed with 10mg/kg body weight orally. IBD symptoms were assessed by measuring hemoglobin content, myeloperoxidase activity, histopathological observation, cytokines and TLR4 expression. The alteration of fecal microbiome composition was analyzed by 16S rRNA gene sequencing. Results indicated that oral administration of CEO effectively alleviated the development of DSS-induced colitis. The mice fed with CEO improved the diversity and richness of intestinal microbiota and decreased Helicobacter and Bacteroides and increase in Bacteroidales S24-7 family and short chain fatty acid producing bacteria. Moreover, correlation analysis showed TLR4 and TNF-α was positively correlated with Helicobacter but inversely correlated with SCFA producing bacteria.

The bacterial translocation induced by colitis may cause the organ failure and sepsis. The study aims to examine E-coli anti-translocation activity of cinnamon oil and its ability to reduce colonic damage in mice with TNBS (2,4,6-trinitrobenzenesulfonic acid) induced colitis. Female mice of imprinting control regions weighing 23-28g received cinnamon essential oil in four various concentrations (0.5%, 0.25%, 0.125% and 0.063%) in the powdery commercial rodent diet, starting 21 days before induction of TNBS colitis. The colonic damage was analyzed using the colon macroscopic scoring system (Wallace score). E. coli translocation was evaluated by serial dilutions method for counting bacteria. Bacterial translocation was significantly reduced in first and third group (15.2% or 42.8% in cinnamon oil groups versus 100% in TNBS group). Cinnamon oil was effective against the colonic damage in all cinnamon oil groups (macroscopically scores of grades 9 in TNBS group versus 5.25, 5.63, 5.13 and 3.25 in...
### Table 1: Anti-inflammatory activity of Cinnamon

<table>
<thead>
<tr>
<th>Extract</th>
<th>Model</th>
<th>Dose Parameters</th>
<th>Parameters</th>
<th>Result</th>
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<tr>
<td>Aqueous extract of C. burmannii bark</td>
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<td>250 µg/ml ELISA</td>
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<td>3 capsules/day each containing 600mg of C for 2 months Serum levels of IL-6, CGRP &amp; NO</td>
<td>Serum conc of IL-6 &amp; NO</td>
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<tr>
<td>C. zeylanicum bark powder</td>
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<td>500 mg C. powder daily for 8weeks Fasting blood sugar Lipid profile Liver enzyme Tumor necrosis factor-α Serum levels of C-reactive protein</td>
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<td>Bark of EO of C. zeylanicum</td>
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<td>0.0012 % Protein-based readouts RNA isolation</td>
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<td>20, 100, 500 mg/kg BW for 6 days orally Serum levels of TNF-Serum levels of TNF-α &amp; interleukin (IL)</td>
<td>LPS induced TNF-α in serum</td>
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</tr>
</tbody>
</table>
cinnamon oil groups). It was concluded that administration of cinnamon oil possesses therapeutic effects on bacterial translocation and intestinal wall injury in colitis.12

2.3. Mechanism of anti-inflammatory activity of Cinnamon

Fig. 1: Mechanism of anti-inflammatory activity of Cinnamon

3. Conclusion

Cinnamon is used both in the food and medicinal industries. It can be used as an anti-inflammatory agent for various inflammatory diseases. Inflammation is a localized protective host response to injury or infection. An acute response, which is fast and short-lived, is associated with the elimination of the primary cause of the inflammation and the repair of the affected tissue. However, if the inflammation is not resolved, this results in a chronic state that plays a central role in numerous diseases, including rheumatoid arthritis, asthma, and periodontal disease.15

4. Source of Funding

None.

5. Conflict of Interest

None.

References


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