Review Article

Anti-inflammatory effect of cinnamon (Cinnamomum verum)

Likhitha K R1, Manasa R1, Rajeshwari J2, Shekhar Naik R1, Mahesh Shivananjappa1,*

1 Dept. of Food Science and Nutrition, Yuvaraja’s College, Mysuru, Karnataka, India
2 Dept. of Food Science and Nutrition, Maharani’s Science College for Women, Mysuru, Karnataka, India

ARTICLE INFO

Article history:
Received 14-01-2022
Accepted 15-01-2022
Available online 17-02-2022

Keywords:
Cinnamon
Cinnamomum verum
Anti-inflammatory activity
Vernacular names

ABSTRACT

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.

This is an Open Access (OA) journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

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.1 Overall, approximately 250 species have been identified among the cinnamon genus, with trees being scattered all over the world.2 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.3

1.1. Vernacular names of cinnamon

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

*Corresponding author.
E-mail address: mayavishiva@gmail.com (M. Shivananjappa).
1.2. Botanical classification of cinnamon

1. Kingdom: Plantae
2. Division: Magnoliophyta
3. Class: Magnoliopsida
4. Order: Laurales
5. Family: Lauraceae
6. Genus: Cinnamomum
7. 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.4

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 (flavanols, 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.5

Xuesheng and Tory studied the effect of cinnamon (Cinnamomum zeylanicum) bark essential oil (CBEO) on human dental fibroblast system, a model of chronic inflammation and fibrosis. CBEO 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 chemotactant, 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, CBEO significantly modulated global gene expression and altered signaling pathways, many of which are important in inflammation, tissue remodeling, and cancer biology.6 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.7

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.8

The bacterial translocation induced by colitis may cause the organ failure and sepsis. The study aims to examine E-coil 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 powdered 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</th>
<th>Parameters</th>
<th>Result</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqueous extract of <em>C. burmannii</em> bark</td>
<td>Macrophage model stimulated with lipopolysaccharides</td>
<td>250 μg/ml</td>
<td>ELISA</td>
<td>Secretion of IL-6, IL-8 &amp; TNF-α LPS binding to monocytes</td>
<td>6</td>
</tr>
<tr>
<td>Leaf essential oil of <em>C. osmophloeum</em></td>
<td>50 patients with migraine</td>
<td>3 capsules/day each containing 600mg of C for 2 months</td>
<td>Serum levels of IL-6, CGRP &amp; NO</td>
<td>Serum conc of IL-6 &amp; NO</td>
<td>3</td>
</tr>
<tr>
<td>C. bark essential oil [C. cassia]</td>
<td>6, 6week old female dextran sodium sulfate [DSS] induced colitis mouse (KM)</td>
<td>10 mg/kg BW orally</td>
<td>Hemoglobin content Myeloperoxidase activity Histopathological observation</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>70% aqueous ethanol of bark of <em>C. verum</em></td>
<td>Patients suffering from allergy/asthma to grass pollen</td>
<td>1 ml/kg body weight orally</td>
<td>Basophil extraction test WST-8 cell proliferation assay kit</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td><em>C. zeylanicum</em> bark powder</td>
<td>36 women with rheumatoid arthritis</td>
<td>500 mg C. powder daily for 8 weeks</td>
<td>Fasting blood sugar Lipid profile Liver enzyme Tumor necrosis factor-α Serum levels of C-reactive protein</td>
<td>↓ serum levels of CRP Diastolic BP</td>
<td>10</td>
</tr>
<tr>
<td>Bark of EO of <em>C. zeylanicum</em></td>
<td>Cell culture of human dermal fibroblasts (HDF3CGE)</td>
<td>0.0012 %</td>
<td>Protein-based readouts RNA isolation</td>
<td>Inhibited all 17 biomarkers production of inflammatory cytokines ↓ levels of macrophage colony-stimulating factor ↓ production of IL-6 &amp; TNF-α</td>
<td>7</td>
</tr>
<tr>
<td>Ethanolic extract of <em>C. verum</em></td>
<td>Lipopolysaccharide stimulated polymophonuclear cells</td>
<td>50 g C. powder</td>
<td>Trypan blue exclusion test Immunoassay HPLC analysis</td>
<td>↓ IL-8 expression Inhibition of NF-Kb activation</td>
<td>11</td>
</tr>
<tr>
<td><em>C. cassia</em> bark</td>
<td>H. pylori (193C) infected gastric epithelial cells</td>
<td>50 μg/ml</td>
<td>ELISA Immunoblast analysis Western blotting Colon macroscopic scoring system</td>
<td>↓ bacterial translocation in 0.125 &amp; 0.063% colorectal tissue injury</td>
<td>12</td>
</tr>
<tr>
<td><em>C. zeylanicum</em> essential oil</td>
<td>Female mice of imprinting control regions weighing 23-28 g</td>
<td>0.5 %, 0.25%, 0.125%, 0.063% for starting 21 days</td>
<td>Colon macroscopic scoring system Serial dilution Randall selitto assay Serum turbidity measurement</td>
<td>Should AI effect at 4.8 &amp; 25 mg/kg BW Inhibition of edema</td>
<td>13</td>
</tr>
<tr>
<td>Extraction of TAPP from bark of <em>C. zeylanicum</em></td>
<td>24 carrageenan induced wistar rat paw edema in rats of either sex (130-200)</td>
<td>2, 4,8 &amp; 25 mg/kg BW orally 1hour before carrageenan injection</td>
<td>Serum levels of TNF-Serum levels of TNF-α &amp; interleukin (IL)</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Aqueous extract of <em>C. cassia</em> bark</td>
<td>male BALB mice</td>
<td>20, 100, 500 mg/kg BW for 6 days orally</td>
<td></td>
<td>↓LPS induced TNF-α in serum</td>
<td>5</td>
</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


Author biography

Likhitha K R, PG Student
Manasa R, Research Scholar
Rajeshwari J, Associate Professor
Shekhara Naik R, Professor and Head
Mahesh Shivananjappa, Assistant Professor