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A systematic review on Cinnamomum zeylanicum

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Abstract:

This review explores the diverse pharmacological properties of Cinnamomum zeylanicum, covering its botanical description, phytochemical composition, and diverse health benefits, commonly known as cinnamon. From its antioxidant and anti-inflammatory effects to potential benefits in managing and improving cardiovascular health, the study delves into the scientific evidence supporting its medicinal uses. Beyond its medicinal uses, cinnamon holds a prominent place in culinary traditions worldwide, adding warmth and depth to both sweet and savory dishes. From spiced desserts to savory curries, cinnamon's versatility knows no bounds. However, despite its numerous benefits, caution is advised regarding its consumption in large quantities, particularly for individuals with certain medical conditions or those taking specific medications. Overall, this review underscores the multifaceted nature of cinnamon, therapeutic potential, and culinary significance.

1.Introduction:

The bark from different cinnamon species holds significant importance as a widely used spice globally, not just in culinary practices but also in both traditional and modern medicinal applications. The cinnamon genus comprises around 250 identified species, with trees distributed across the world.[1,2]

The primary utilization of cinnamon is in the fragrance and essence industries, leveraging its aromatic qualities that can enhance various food items, perfumes, and medicinal products [3]. Cinnamon's essential components, namely cinnamaldehyde and trans-cinnamaldehyde (Cin), found in its essential oil, play a crucial role in both its fragrance and the diverse biological activities associated with cinnamon [4]. Research on Cinnamomum osmophloeum (C. osmophloeum) revealed that the essential oil extracted from cinnamon leaves possesses a notable concentration of Cin. As a result, C. osmophloeum is employed as a substitute spice for C. cassia [5]. (E)-cinnamaldehyde, a significant component in the essential oil derived from C. zeylanicum, exhibits antityrosinase activity [6], with cinnamaldehyde identified as the primary compound responsible for this particular activity [7].

Procyanidins and catechins are present in cinnamon bark [8]. The procyanidins in cinnamon bark encompass both A-type and B-type linkages [9–11]. The procyanidins obtained from both cinnamon and berries exhibit antioxidant properties [10, 12].

Scientific Classification of Cinnamon

Kingdom: Plantae

Division: Tracheophyta

Class: Magnoliopsida

Order: Laurales

Family: Lauraceae

Genus: Cinnamomum

Species: Zeylanicum

Botanical name: Cinnamomum zeylanicum [13, 14]

Vernacular names

English name: Cinnamon

Tamil: Karuva/ Ilavangam

Sinhala: Kurundu

Urdu: Darchini [15]

Description of the Cinnamon

Tree:

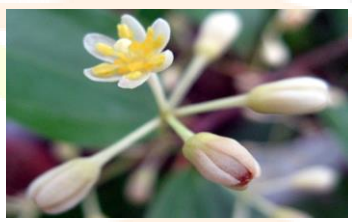
Cinnamon (Cinnamomum zeylanicum), a moderate sized or large tree with a rather thick, reddish bark, glabrous young parts and finely silky buds.

Leaves:

Simple, opposite or sub-opposite without stipules, variable in size, 7.5-25cm long, oval or lanceolate-oval, subacute at base, slightly acuminate, obtuse, glabrous, stiffy coriaceous, strong, 3 or 5-nerved.with fine, reticulate venation, shining above, slightly paler beneath, bright pink when young, petioles 1.2-2.5 cm long, stout, flattened above.

Flowers:

Regular, bisexual or monoecious, pale yellow, small, numerous on rather long, slightly pubescent pedicels in subterminal panicles longer than leaves, lax peduncles often clustered, glabrous or pubescent, bracts absent; perianth about 0.6 cm long, silky, tube short-campanulate, segments 6, oblong-lanceolate, acute or obtuse, usually persistent, imbricated in two rows; stamens 9 in three rows, perigynous, anthers 4-celled, filaments of the first and second rows without glands and filaments of the third row with glands, staminodes 3, sagittate forming the fourth row; ovary superior, unilocular with a solitary ovule pendulous from the top, style shorter than stamens, stigma bilobed.



Fruit:

Fruit about 1.2 cm long, oblong-ovoid, surrounded by much enlarged perianth, dry or fleshy, dark purple, seed without endosperm. [16, 17]

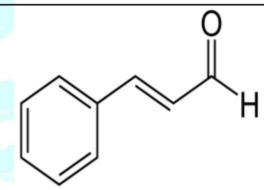
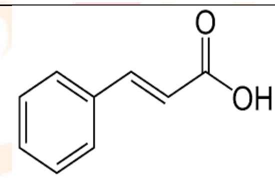
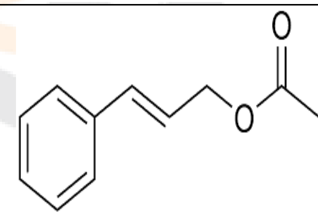
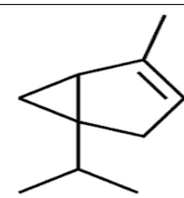
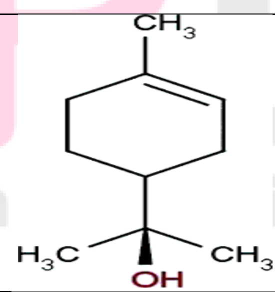
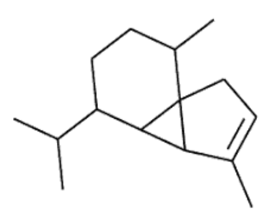
2. Methodology

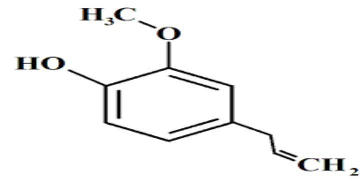
This review systematically examined the literature on the medicinal plant cinnamon from 1982 to 2013. A thorough and organized search was conducted using multiple databases, such as PubMed (http://www.ncbi.nlm.nih.gov/pubmed), Science Direct (http://www.sciencedirect.com/), Scopus (http://www.scopus.com/), Scirus (http://www.scirus.com/), and Google Scholar (http://www.scholar.google.com/).

3. Chemical Constituents

Cinnamon comprises diverse resinous compounds, including cinnamaldehyde, cinnamate, cinnamic acid, and various essential oils.[18] The occurrence of an extensive array of essential oils, including trans-cinnamaldehyde, cinnamyl acetate, eugenol, L-borneol, caryophyllene oxide, β-caryophyllene, L-bornyl acetate, E-nerolidol, α-cubebene, α-terpineol, terpinolene, and α-thujene, has been documented.[19, 20]

The chemical structures of some important constituents of cinnamon are shown in Table,

Name	Structure
Cinnamaldehyde	
Cinnamic acid	
Cinnamyl Acetate	
α-Thujene	
α-terpineol	
α-cubebene	

Eugenol	

4. Traditional Uses:

Besides its role as a spice and flavoring agent, cinnamon finds application in flavoring chewing gums, thanks to its mouth-refreshing effects and capability to combat bad breath. [21] Cinnamon also has the potential to enhance colon health, thereby lowering the risk of colon cancer. [22]

Cinnamon functions as a coagulant, preventing bleeding.[23]Cinnamon additionally enhances blood circulation in the uterus and promotes tissue regeneration.[24] While playing a crucial role as a spice, this plant's essential oils and other constituents exhibit significant activities, including antimicrobial, antifungal, antioxidant, and antidiabetic properties.[25,26,27]

Cinnamon has been employed as an anti-inflammatory, antitermitic, nematicidal, mosquito larvicidal, insecticidal, antimycotic, and anticancer agent. Traditionally, cinnamon has been utilized as tooth powder to address toothaches, dental problems, oral microbiota, and bad breath.[28,29]

5. Anti-Inflammatory Activities:

Cinnamon has been found to possess anti-inflammatory properties in numerous studies focusing on medicinal plants and their constituents. [30, 31] Several studies have documented the anti-inflammatory properties exhibited by cinnamon and its essential oils. [32, 33, 34] As of now, numerous flavonoid compounds such as gossypin, gnaphalin, hesperidin, hibifolin, hypolaetin, oroxindin, and quercetin have been identified and exhibit anti-inflammatory properties. [35, 36, 37]

A recent research study revealed that 2-hydroxycinnamaldehyde, derived from C. cassia bark, demonstrated inhibitory effects on nitric oxide production by suppressing the activation of nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB). This suggests its potential as an anti-inflammatory agent. [38] The ethanolic extract from C. cassia demonstrated notable anti-inflammatory effects by decreasing the activation of Src/spleen-tyrosine-kinase- (Src/Syk-) mediated NF-κB. [39, 40] Compounds found in C. ramulus exhibit anti-inflammatory properties by inhibiting the expression of inducible nitric oxide synthesis (iNOS), cyclooxygenase-2 (COX-2), and nitric oxide (NO) production in the central nervous system (CNS). This suggests that C.ramulus has the potential to be utilized for therapeutic treatment or prevention of neurodegenerative diseases associated with inflammation. [41] Moreover, the cinnamon's aqueous extract reduces the levels of tumor necrosis factor-α in the serum induced by lipopolysaccharide. [42] Alzheimer's disease results in a significant decrease in 56 kDa Aβ oligomers, leading to a reduction in plaques and enhancement of cognitive performance in transgenic mouse models. [43]

Another research found that the water-based extract from C. zeylanicum has the potential to diminish tau aggregation and filament formation, key characteristics of Alzheimer’s disease. Additionally, the extract promotes the complete fragmentation of recombinant tau filaments and induces significant alterations in the morphology of paired helical filaments derived from Alzheimer’s disease brains. [44]

6. Anticancer Activity:

The HPLC-derived aqueous extract and cinnamon fraction rich in procyanidins effectively hinder the kinase activity of vascular endothelial growth factor subtype 2 (VEGFR2), consequently impeding angiogenesis associated with cancer. Findings suggest the potential utility of cinnamon in cancer prevention. [45] Cinnamaldehydes were synthesized and assessed for their inhibitory effects on angiogenesis. [46] Jeong and colleagues discovered that

CB403, a compound derived from 2-hydroxycinnamaldehyde found in cinnamaldehyde, demonstrated the ability to hinder tumor growth. The findings from both animal-based and cell culture studies suggest the potential use of cinnamon as an anticancer agent due to the antitumor and growth-inhibitory properties of CB403. [47]

Cabello and colleagues found that cinnamic aldehyde hinders NF-κB activity and suppresses the production of interleukin-8 (IL-8) induced by tumor necrosis factor alpha (TNFα-) in A375 cells. This restraint further reinforces the overlooked potential of cinnamic acid in its role as a potential anticancer agent. [48]

7. Antioxidant Activity:

Antioxidants found in food are essential for human health, serving as protective agents. Apart from their crucial role, antioxidants are integral additives in fats and oils. In the food processing industry, they are utilized to extend the shelf life and prevent spoilage. Spices and medicinal plants are gaining quick recognition as valuable sources of antioxidants with potential health benefits against various diseases. [49] Antioxidants play a crucial role in sustaining human and animal life by combating free radicals and addressing damage associated with metabolic diseases and age-related syndromes. [50, 51]

8. Cardiovascular Diseases:

2-Methoxycinnamaldehyde (2-MCA), an active compound extracted from C. cassia, reduces vascular cell adhesion molecule-1 (VCAM-1) expression in endothelial cells activated by TNFα. This implies that the amelioration of ischemia/reperfusion (I/R) injury is attributed to the induction of hemeoxygenase-1 (HO-1). [52] A recent investigation highlighted the potential impact of two compounds, namely cinnamic aldehyde and cinnamic acid, extracted from C. cassia, in addressing myocardial ischemia. [53] , indicating that cinnamon also has the potential to be used to treat cardiovascular diseases.

9. Cholesterol- and Lipid-Lowering Effects:

Mice administered cinnamon showed a positive impact on their lipid profile, resulting in a decrease in high-density lipoprotein (HDL) cholesterol levels and a reduction in plasma triglycerides. [54] Rats given Cinnamomum cassia powder (15%) for 35 days experienced a decrease in total cholesterol, triglycerides, and low-density lipoproteins. Moreover, cinnamon oils were effective in lowering cholesterol levels in broiler chickens. [55] Khan et al. found that administering cinnamon at daily doses of 1, 3, and 6 g led to decreased serum glucose, triglyceride, total cholesterol, and LDL cholesterol levels in humans, as reported in Evidence-Based Complementary and Alternative Medicine 7. [56]

10. Anti-Diabetic Activity:

Cinnamon has shown promise in helping to lower blood sugar levels and improve insulin sensitivity, which are crucial factors in managing diabetes. Some studies suggest that cinnamon may mimic insulin and help cells absorb glucose, while others indicate that it may slow the breakdown of carbohydrates in the digestive tract. However, more research is needed to fully understand the mechanisms and to determine the most effective dosage and form of cinnamon for managing diabetes. It's always important for individuals with diabetes to consult with their healthcare provider before making any significant changes to their treatment plan. [57, 58]

Conclusion:

Cinnamon has been utilized as a spice in daily life without observable side effects. Numerous reports have delved into the diverse properties of cinnamon, including its bark, essential oils, bark powder, phenolic compounds, flavonoids, and isolated components. Each of these properties plays a pivotal role in advancing human health.

Antioxidant and antimicrobial activities may result from direct action on oxidants or microbes, while anti-inflammatory, anticancer, and antidiabetic activities occur indirectly through receptor-mediated mechanisms. Extensive exploration has unveiled significant health benefits across various types of cinnamon. Further investigations are required to provide additional clinical evidence for the traditional uses of this spice against cancer and inflammatory, cardioprotective, and neurological disorders.

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