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A REVIEW ON CINNAMOM WITH THEIR VARITIES AND PHARMACOLOGICAL ACTION

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ABSTRACT

A spice is a dried seed, fruit, root, bark or flower of a plant or an herb used in small quantities for flavor, color or as a preservative. The spices and Herbs used for flavor, aroma and medicinal properties derive a special value from the said factors. Long before modern medicine, spices were valued for their ability to help individuals in disease prevention and health promotion. Various civilizations relied on herbs and spices for both food and medicine. Cinnamon is a spice obtained from the inner bark of trees belonging to the family 'Lauraceae' and genus 'Cinnamomum'. Cinnamon is found widely in Sri Lanka but also distributed in South and South-East Asia. This study was carried out to give an overview on Cinnamon, to differentiate the varieties of Cinnamon in the view of therapeutic and commercial purposes and to review the recent scientific evidences phytochemical and pharmacological studies systematically. There are over 250 plant species in the cinnamon genus. But only 4 types or varieties of Cinnamon are used for commercial purposes. Such as, Ceylon cinnamon (Cinnamon zeylanicum Blume.), Cassia cinnamon (Cinnamomum aromaticum), Korintje cinnamon (Cinnamomum burmanni) and Saigon cinnamon (Cinnamomum loureiroi). Ceylon cinnamon (Cinnamomum zeylanicum Blume), a variety native to Sri Lanka, sometimes referred to "true" cinnamon" globally, is one of the oldest and most important spice crops used for culinary purposes in Sri Lanka for centuries.

Keywords: Ceylon, Cinnamon, Darchini, Spices, Sri Lanka

INTRODUCTION

Cinnamomum zeylanicum Blume (Family Lauraceae) which Is popularly known as cinnamon is classified in the botanical Division Magnoliophyta, class Magnoliopsida. Generally in India, Cinnamomum zeylanicum is cultivated in south India. But it originates from the island of SriLanka (formerly called Ceylon), south east of India. The aroma and flavour of cinnamon derive from its essential oil and principal component, cinnamaldehyde, as well as numerous other constituents including eugenol. Only a few Cinnamomum species are grown commercially for spice. Cinnamomum verum is sometimes considered to be "true cinnamon", but most cinnamon in international commerce is derived from the related species Cinnamomum cassia, also referred to as "cassia". In 2018, Indonesia and China produced 70% of the world's supply of cinnamon, Indonesia producing nearly 40% and China 30%.[1]

Fig: Cinnamon

Cinnamon (Cinnamomum verum, synonym C. zeylanicum) is a small evergreen tree, 10-15 meters (32.8-49.2 feet) tall, belonging to the family Lauraceae, native to Sri Lanka and South India. The flowers, which are arranged in panicles, have a greenish colour and have a distinct odour. The fruit is a purple one-centimeter berry containing a single seed. Its flavour is due to an aromatic essential oil which makes up 0.5 to 1% of its composition. In medicine it acts like other volatile oils and once had a reputation as a cure for colds.[2] It has also been used to treat diarrhoea and other problems of the digestive system. Cinnamon is high in antioxidant activity. The essential oil of Cinnamon also has antimicrobial properties, which aid in the preservation of certain foods. "Cinnamon" has been reported to have remarkable pharmacological effects in the treatment of type II diabetes. Cinnamon has traditionally been used to treat toothache and fight bad breath and its regular use is believed to stave off common cold and aid digestion.[3]

Botanical Classification

Kingdom – Plantae

Sub kingdom - Tracheophytes

Super division - Angiosperms

Division - Magnoliids Class - Magnoliopsida

Order – Laurales

Family - Lauraceae

Genus - Cinnamomum

Species - C. verum

HISTORY & ORIGIN

Cinnamon is native to Sri Lanka (formerly Ceylon), the neighbouring Malabar Coast of India, and Myanmar (Burma) and is also cultivated in South America and the West Indies. The spice, consisting of the dried inner bark, is brown in colour and has a delicately fragrant aroma and a warm sweet flavour. Cinnamon has been known from remote antiquity. It was imported to Egypt as early as 2000 BC, but those who reported that it had come from China had confused it with cinnamon cassia, a related species. In Ancient Egypt, cinnamon was used to embalm mummies. From the Ptolemaic Kingdom onward, Ancient Egyptian recipes for kyphi, an aromatic used for burning, included cinnamon and cassia. The gifts of Hellenistic rulers to temples sometimes included cassia and cinnamon. During the 1500s, Ferdinand Magellan was searching for spices on behalf of Spain, and in the Philippines found Cinnamomum mindanaense, which was closely related to C. zeylanicum, the cinnamon found in Sri Lanka.[4]

Fig: Flowers of Cinnamon

TYPES OF CINNAMON

1. Indonesian Cinnamon

It is also known as Korintje cinnamon. Around 70% of North America uses Cassia Cinnamon. Indonesia is the chief supplier of Cassia Cinnamon. This is because it is much cheaper than Ceylon Cinnamon which tends to be expensive because of the hand-crafted process needed to harvest it and roll it in multiple thin layers. Cassia Cinnamon is a hard bark that is spicy, smells pretty strong and sometimes bitter. [5]

2. Saigon Cinnamon

This is another Cinnamon which has gained in popularity recently. Originating in Vietnam this cinnamon admittedly makes a good first impression in terms of sheer aroma and taste. It tends to be even more spicy and strong and sweet at the same time. It's a little more expensive than Cassia Cinnamon but has the highest levels of Coumarin, also known as Vietnamese Cassia cinnamon. Extra spicy yet sweeter in taste, Contains high level of Coumarin at around 8%.[6]

3. Chinese Cinnamon

The quality of Chinese cinnamon is not great. While part of the Cassia Cinnamon family it tends to be more pungent, less sweet and slightly bitter. Possibly because of the soil conditions. Cinnamon quality can vary depending on soil conditions. Most Chinese Cinnamon probably stays in China, used in many of the Chinese medications for coughs, phlegm and other illnesses.[7]

4. Ceylon Cinnamon

Ceylon Cinnamon grows best in sandy soil. The tree grows to about 49 feet in its natural state but is cut earlier for commercial purposes. It has a thin bark. The leaves are shiny and leathery on top and dull on the underside. The flowers are white with an oval sized fruit which becomes bluish with white spots when ripe. The leaves when crushed are spicy and hot to taste while peeling away the outer bark of the tree yields a very strong cinnamon smell, also called as True cinnamon, also known as Mexican cinnamon, because Mexico is biggest importer of Ceylon cinnamon from Sri Lanka. Made of thin, fragile layers rolled into a quill-like shape. Has a mild, subtle sweet taste with fragrant smell, Light brown in colour.[8]

DESCRIPTION OF THE CINNAMON

Tree: Cinnamon (Cinnamomum zeylanicum Blume), 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.[9]

Table: Comparison of Main categories of Cinnamon

Main Category	Ceylon Cinnamon	Cassia
Bark	Inside filled with thin concentric layer composed of multiple layers rolled like cigar-quill	Hollow thick and hard layer one thick piece of bark strip curled inward on both sides
Colour	Golden brown	Dark reddish brown
Texture	Smooth	Rough
Taste	Soft and sweet aromatic fragrance	Hot or Spicy
Smell	Sweet, pleasant fragrance	Strong scent
Price	Three to four times expensive than Cassia	Cheaper
Country of origin	Native to Sri Lanka	Native to China, Indonesia
Coumarin Content	Very Low	High

CHEMISTRY

The Cinnamon is having essential oils, resinous compounds, Cinnamic acid, Cinnamaldehyde and Cinnamate. Essential oil such as trans-cinnamaldehyde, caryophyllene oxide, L-borneol, L-bornyl acetate, eugenol, bcaryophyllene, E-nerolidol, and cinnamyl acetate was reported by Tung et al. Some other constituents are Terpinolene, α-Terpineol, α-Cubebene, and α-Thujene. Singh et al. reported that pungent taste and scent come from cinnamaldehyde and, by the absorption of oxygen as it ages; it darkens in colour and develops resinous compounds.[10]

Table: Chemical Composition of different parts of Cinnamon

Part of Plant	Compound	Percentage
Leaves	Cinnamaldehyde:	1.00 to 5.00
	Eugenol	70.00 to 95.00
Bark	Cinnamaldehyde	65.00 to 80.00
	Eugenol	5.00 to 10.00
Root bark	Camphor	60.00
Fruit	trans-Cinnamyl acetate	42.00 to 54.00
	Caryophyllene	9.00 to 14.00
C. zeylanicum buds	Terpene hydrocarbon	78.00
	alpha-Bergamotene	27.38
	alpha-Copaene	23.05
	Oxygenated terpenoids	9.00
C zeylanicum flower	(E)- Cinnamyl acetate	41.98
	trans-alpha-Bergamotene	7.97
	Caryophyllene oxide	7.20

Active constituents

Major active constituents of C. cassia are cinnamaldehyde (75-90%), coumarin (7%) and essential oil (4%) (Ng and Wu, 2011). The other constituents present in trace amount include eugenol, benzoic acid, cinnamic acid, salicylic acid, cinnamyl alcohol and the corresponding esters and aldehydes (Ng and Wu, 2011). The average daily intake (ADI) of cinnamaldehyde permitted by Food and Drug Administration and World Health Organization (FDA/WHO) for an adult male is 1.25mg/kg (Ng and Wu, 2011).[11]

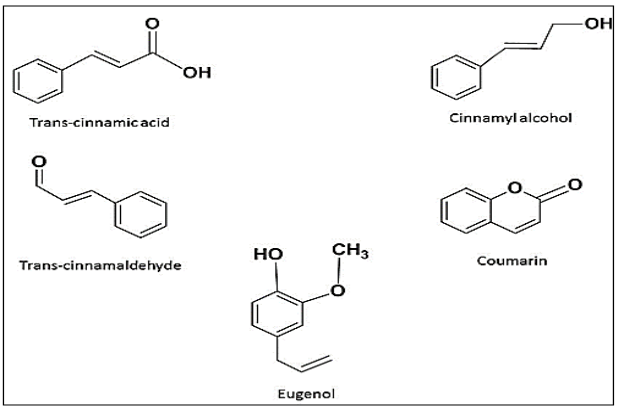

Fig: Chemical Composition of Cinnamon

PHARMACOLOGY OF CINNAMON

1. Antioxidant

Shahidi et al. have reported that antioxidants are often added to foods to prevent the radical chain reactions of oxidation, and they act by inhibiting the initiation and propagation step leading to the termination of the reaction and delay the oxidation process. However, Madhavi and Salunkhe have reported that the commonly used synthetic antioxidants such as butylated hydroxy anisole (BHA) and butylated hydroxy toluene (BHT) are restricted by legislative rules because of doubts over their toxic and carcinogenic effects. Therefore, there has been a considerable interest in the food industry to find natural antioxidants to replace synthetic compounds in food applications, and a growing trend in consumer preferences for natural antioxidants, all of which has given more impetus to explore natural sources of antioxidants. In India, herbs and spices have been added to different types of food to impart flavour as well as to improve storage stability, since ancient times. Many herbs and spices have been shown to impart antioxidant effects in food; the active principles are phenolics. A wide variety of phenolic substances derived from herbs and spices possess antioxidant properties.[12]

2. Anti-ulcer

In sum, the utilization of Cinnamon extract to inhibit both growth and urease activity of H. pylori in-vitro has in our hands proved to be more effective than thyme extract. The efficiency of Cinnamon extracts in liquid medium and its resistance to low pH levels may enhance its effect in an environment such as the human stomach reported by Tabak et al. Kreydiyyeh et al. have reported its inhibitory effect on the intestinal and kidney Na+ /K+ ATPase activity and on alanine transport in rat jejunum. [13]

3. Anti-microbial

Matan et al. have reported antimicrobial activity of Cinnamon bark. The volatile gas phase of combinations of Cinnamon oil and clove oil showed good potential to inhibit growth of spoilage fungi, yeast and bacteria normally found on IMF (Intermediate Moisture Foods) when combined with a modified atmosphere comprising a high concentration of CO2 (40%) and low concentration of O2.[14]

4. Anti-diabetic

Sung Hee et al. have reported data of anti-diabetic activity of Cinnamon in db/db transgenic mice. It has been shown by Subash et al. that oral administration of cinnamaldehyde produces significant antihyperglycemic effect

lowers both total cholesterol and triglyceride levels and, at the same time, increases HDL-cholesterol in STZ induced diabetic rats. This investigation reveals the potential of cinnamaldehyde for use as a natural oral agent, with both hypoglycemic and hypolipidemic effects. Cao et al. reported novel findings that Cinnamon extract and polyphenols with procyanidin type-A polymers exhibit the potential to increase the amount of TTP (Thrombotic Thrombocytopenic Purpura), IR (Insulin Resistance), and GLUT4 (Glucose Transporter-4)in 3T3-L1 Adipocytes. The results reported in the study suggest that the mechanism of Cinnamon's insulin-like activity may be in part due to increase in the amounts of TTP, IRβ, and GLUT4 and that Cinnamon polyphenols may have additional roles as anti-inflammatory and/or anti-angiogenesis agents.[15]

5. Diabetes

DM is disorder of glucose metabolism related for deficiency of insulin caused by an autoimmune attack on the β cells of the pancreas and insulin resistance(Kumar, Kumari, and Mishra 2019). Effect of Cinnamon represent by shown to have insulin mimetic properties because its active substances rise glucose uptake by activating IR kinase activity, auto phosphorylation of the IR, and glycogen synthase activity(Medagama 2015). Studies found how can glycemic control in diabetics by increase insulin secretion using limited doses of cinnamon (5, 10, and 20mg/kg). cinnamon doses are reduce OS and protection to β cells(Rao and Gan 2014).(Shi et al. 2017)also investigated the cinnamon consumption to prevention of the metabolic syndrome related to insulin resistance. Cinnamon extracts assisted inhibitor the activity of enzymes to prevent the absorption of glucose in the bloodstream when taking carbohydrate meals. New studies indicate that individuals with T2DM when dosage supplementing with cinnamon extract was had positive treatment indicators with blood sugar markers(Zaidi et al. 2015). Another research detection the amount of GLUT4 receptors also IR, and IRs increase when taking cinnamon(Couturier et al. 2010), this lead to facilitating glucose entry into cells. indicate that CE helps the translocation to the plasma membrane of the GLUT 4 in peripheral tissue by dose- dependent method(Kumar, Kumari, and Mishra 2019).demonstrated an identical impact include a raise the membrane translocation of GLUT4 from 42.8 % to 73.1 % in cinnamon treated animal when compared to controls(Ranasinghe et al. 2017). From results can be focused on the effects of insulin and its mechanism in the body to achieve the therapeutic prospect for CE as similar drug for the treatment of diabetes mellitus.[16]

6. Cardiovascular Diseases

A contemporary study notifies into compounds, CD, and CA, isolated from cinnamon and their activity toward (IHD) (Wavell and Heggland 2020). Another studies (Mohammed, Kadhim, and Abbood 2020) (Song et al. 2013) was investigated the Therapeutic effect of (CA) and (CD) as cardio protective in a rat model of ischemic myocardial disadvantage. This therapeutic efficacy is due to anti- oxidative and anti-inflammatory properties. the result has shown cinnamic aldehyde and cinnamic acid reduce damage occur by myocardial ischemia, decreased levels of lactate dehydrogenase, interleukin- 6, and creatine kinase, and increased serum NO activity. and increased superoxide dismutase activity (Kadhim, Mohammed, and Abbood 2020). Studies demonstrated that compounds extracted from bark cassia had cardio protective effects and anti- oxidative properties, as well as might have contributed their cardio protective drugs to reduce side effect for heart treatment.[17]

7. Neurological Disorders

Cinnamophilin is a novel thromboxane A2 receptor antagonist isolated from C. philippinensis. A study reported that cinnamophilin confers protection against ischemic damage in rat brains when administered at 80 mg/kg at different time intervals (2, 4, and 6 h) after insult. The effects were found to have a considerable effect (by 34–43%) on abridged brain infarction and further enhance neurobehavioral outcomes. Cinnamophilin also dramatically condenses the oxygen glucose deprivation-induced neuronal damage in organotypic hippocampal slices in experimental rats. A substance called procyanidin type-A trimer (trimer 1) isolated from cinnamon's water-soluble extract showed that trimer 1 may reduce cell swelling by controlling the movement of intracellular calcium [Ca2+]i. Trimer 1 also considerably alleviates the oxygen glucose deprivation-induced diminishing effects on glutamate uptake.[18]

The protective effects of trimer 1 in attenuating the diminution in glutamate uptake are possibly arbitrated via their effects on the mitochondria. Parkinson's disease (PD) is the second major widespread neurodegenerative disorder after Alzheimer's disease, with a prevalence of 2% in people 65 years and older. PD protein 7 (PARK7) is an autosomal recessive form of early-onset parkinsonism caused by alterations in the DJ1 gene. Khasnavis and

Pahan reported that sodium benzoate, a cinnamon metabolite, upregulates DJ-1 by modulating mevalonate metabolites. Cinnamon and its metabolite sodium benzoate also upregulate the neurotropic factors BDNF (brain-derived neurotropic factors) as well as neurotrophin-3 (NT-3) in the mouse central nervous system. PARK7 is one of the main neuroprotective proteins that protects cells from damage and from the further detrimental effects of oxidative stress; therefore, this protein may be an effective molecule that can be incorporated into the therapeutic intervention of Parkinson's disease.[19]

8. Anti-H. pylori and gastro protective

Under the traditional Unani medicinal system of Pakistan, the herb has been consumed for curing gastric complaints of diarrhoea, flatulence and vomiting (Zaidi et al., 2009). H. pylori is one of the common causes of dyspepsia and various other gastric aliments (Muhammad et al., 2012). Although H. pylorus is a non-invasive organism, it stimulates a robust inflammatory and immune response. Bacterial colonization, persistence and virulence, and resulting innate and adaptive host immune responses are all important in the pathogenesis of H. pylori related diseases (Muhammad et al., 2013). An in vitro study performed revealed that ethanol extract of Cinnamon has weak anti-H. pylori activity by blocking the enzyme urease which is involved in the pathogenesis of H. pylori infection of the gut, however, methylene chloride extracts display a strong anti-H. pylori activity, the mechanism of which was not mentioned (Tabak et al., 1999). Human gastric epithelial cells infected with H. pylori exhibits reduced IL-8 secretion when treated with C. cassia. The concentrations of 50µg/ml and 100µg/ml show the most potent effect and almost totally block the H. pylori induced IL-8 secretion. Furthermore, the similar anti-inflammatory effect is also shown in TNF-α (tumour necrosis factor-alpha) stimulated cells, which represent non-infectious inflammatory factors (Zaidi et al., 2012). Furthermore, we also found the inhibition of hummingbird morphology, a characteristic feature of H. pylori-infected cells, by C. cassia and its major constituent, Cinnamaldehyde, in AGS gastric epithelial cells (data not published).[20]

9. Anti-melanin

Guinea pigs were exposed to ultraviolet-B radiation to increase pigmentation of their skin. Cinnamic acid was then applied topically to reduce the pigmentation. Results revealed that cinnamic acid when applied topically reduced skin melanin by 29% without any adverse reactions. Cinnamic acid blocks tyrosinase enzyme to mediate its action, but does not show appreciable activity against dopachrome tautomerase (Kong et al., 2008). Therefore, Cinnamon might be used in cosmetics and beauty products to enhance skin whitening by its effect on melanin bio-synthetic pathway in skin cells. Studies are required to explore possible effect on alpha-melanocyte stimulating hormone and microphthalmia transcription factor (Mitf) expression for de-pigmenting pathway.[21]

10. Anti-allergy

Allergic diseases related to mucosal mast cells, such as food allergies, are thought to be treated by cinnamaldehyde. Inhibitory effects of cinnamaldehyde on phospholipase C (PLC) signalling pathway in human embryonic kidney cells have been shown (Kim et al., 2008). Similar pathways are thought to play a major role in intracellular mobilization of Ca++ ions in mucosal mast cells. Yahara et al. confirms this by showing inhibition of mucosal mast cell activation via suppression of PLCγ1 signalling pathway (Yahara et al., 2011).[22]

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