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On barks of *Cinnamomomum zeylanicum Nees*

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Abstract

Cinnamon (*Cinnamomum zeylanicum Nees*), the evergreen tree of tropical area, a member of family Lauraceae, has been used in day to day routine as a spice and condiment in India. Literature review on cinnamon revealed that it chiefly contains essential oils and all other categories like cinnamic acid, cinnamaldehyde and cinnamate. It has got good antiinflammatory, antioxidant, antiulcer, antimicrobial, anticancer hypoglycemic and hypo lipidemic potential. In clinical reports it was found very safe and useful in allergic conditions also. Current review describes the pharmacological potential of cinnamon in preclinical and clinical scenario.

Keywords: Anticancer, anti-inflammatory, antiulcer, *Cinnamomum zeylanicum Nees,*, pharmacological activities

Introduction

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 SriLanka 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. It has also been used to treat diarrhoea and other problems of the digestive system. Cinnamonis 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 [6].

The herb which people use in daily food items is the best source for remedy or prevention of different ailments. *Cinnamomum zeylanicum, Blume* 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.Cinnamon spice is obtained by drying the central part of the bark and is marketed as quills or powder. The production of cinnamon is mostly limited to the wettest lowland areas of South east Asia and cultivated upto an altitude of 500 meters above mean sea level having the mean temperature 270C and annual rain fall 2000-2400mm. It prefers sandy soil enriched with organic matter. The genus cinnamomum has 250 species and many of them are aromatic and flavouring. There is very little distinction between Cinnamomum verum and Cinnamomum cassia (Chinese cinnamon). Cinnamomum verum provides cinnamon bark of the finest quality and oil cinnamon whereas Cinnamomum cassia provides cassia bark and oil of Cassia (also known as oil of cinnamon).Common names of *Cinnamomum zeylanicum, Blume* among the different races of India and in other countries are as follows:

Fig 1

Bengali and Hindi - Dalchini
English:- Cyloncinnamon, true cinnamon or cinnamon
Sanskrit-Tamalparta
Tamil-Ilayangam
Telgu-Lavanagamu
Frenche cinnamon Cammelle

Cinnamomum zeylanicum,Blume was introduced in West Africa through the National herbarium of Ghana in 1970. Rohwer al1 have reported that among the 2500 specieswhich composed the Lauraceae family, Cinnamomum zeylanicumBlume grown over the world in Sri Lanka Madagasgar, Comor Islands, India and Indochine. In Benin, the plant was usually met in the area of Abomey-Calavi and Cocotomey, two agglomerations near Cotonou, the economic capital of Benin.

EO of *Cinnamomum zeylanicum, Blume* has shown various therapeutic actions. Some people from West Africa (Ghana, Togo) usually enhanced flavor of smoking fishes with *Cinnamomum zeylanicum, Blume* leaves. Essential oil is used as additive in tomatoes and spices

soups as preservative, and against unexpected fermentation of the mixture. Barattaet have reported antimicrobial and antioxidant properties of the EO and its potential use in foods preservation. Simicet have revealed its antifungal activities. Many studies revealed the apoptosis-inducing activity of some compounds near cinnamon like taxol 5, 6. Any previous work was devoted in our knowledge to the antimicrobial properties of *Cinnamomum zeylanicum, Blume* EO in Benin [11].

Cinnamon is one of the oldest spices known. It was mentioned in the Bible and was used in ancient Egypt not only as abeverage flavoring and medicine, but also as an embalming agent. It was so highly treasured that it was considered more precious thangold. Around this time,cinnamon also received much attention in China,which is reflected in its mention in one of the earliest books on Chinese botanical medicine, dated around 2,700 B.C. Cinnamon's popularity continued throughout history.[15]

Some of the varieties

a) Cinnamon verum

Fig 2: *Cinnamomum verum*

Common name in Spanish: Canela
Botanical family: Lauraceae
Medicinal parts:The outer bark, inner bark, leaves and essential oil.

Cinnamomum verum

Local names

Creole (kanel)
English (cinnamon tree,true cinnamon,ceylon cinnamon)
French (cannelle, cannellier, cennellier de Ceylon)
Hindi (elavagnum, vayana, karuva, karuwa, twak)
Indonesian (kayumanis)
Luganda (budalasini)
Malay (kayumanis)
Spanish (canelero, canelalegítima, canela)
Trade name (cinnamon).

Botanic description: *Cinnamomum verum* is an evergreen tree that reaches a height of 8-17 m in the wild. In an unharvested state, the trunk is stout, 30-60 cm in diameter, with a thick, grey bark and the branches set low down.

Leaves stiff, extipulate, opposite, somewhat variable in form and size. Petiole 1-2 cm long, grooved on the upper surface. Lamina usually 5-18 x 3-10 cm, ovate or elliptic; base more or less rounded and the tip tends to be somewhat acuminate. There are 3, sometimes 5, conspicuous longitudinal veins found at the base of the lamina and running almost to the tip. The young leaves of the flush are reddish, later turning dark green above with paler veins and pale glaucous beneath.

Flowers borne in lax axillary and terminal panicles on the ends of twigs. Peduncles creamy white, softly hairy, 5-7 cm long. Individual flowers very small, about 3 mm in diameter, pale yellow, with a foetid smell, each subtended by a small, ovate, hairy bract. The calyx is campanulate and pubescent with 6 acutely pointed segments. Corolla absent. Fruit a fleshy ovoid drupe, black, 1.5-2 cm long when ripe, with the enlarged calyx at the base.

The etymology of cinnamon is derived from the Greek word 'kinnamomon' (meaning spice). The Greeks borrowed the word from the Phoenicians, indicating trade with the East from early times. Cinnamon is recorded in Sanskrit, the Old Testament, and in Greek medicinal works and was employed by the Egyptians for embalming purposes as early as 1485 BC.A species synonym, 'zeylanicum', refers to the place of origin, the island of Ceylon (Sri Lanka).

b) Cinnamomum tamala

Lauraceae Nees & Eberm.

Local names: Bengali (tejpat,tamala); English (Indian cassia lignea); Gujarati (tejpat,tamalapatra); Tamil (talishapattiri)

Botanic description: *Cinnamomum tamala* is a moderate sized evergreen tree attaining a height of 8 m, and a girth of 150 cm. Its bark produces mucilage.

Leaves lanceolate, glabrous; alternately placed, opposite and short stalked. 3-nerved from the base.

c) Cassia cinnamon

Most cinnamon sold in super markets in North America comes from the less expensive variety, Cassia cinnamon. It has a darker color and the quills are harder. Unlike Ceylon cinnamon, it can't be easily ground into a powder using a coffee grinder. It is mainly produced in China "Tung Hing Cassia", Vietnam "Saigon cassia" and Indonesia "Korintje cassia"& "Madagascar Cinnamon".

Also Known As

Bastard Cinnamon, CanelaMolida, Canton Cassia, Cassia, Cassia Aromaticum, Cassia Bark, Cassia Lignea, Cassia Twig, Chinese Cinnamon, Cinnamomi Cassiae Cortex, Cinnamon, Cinnamon Essential Oil, Cinnamon Twig, Cinnamoni Cortex, Cinnamonomi Cortex, Cortex Cinnamomi, Cinnamon Flos, False Cinnamon, GuiZhi, Keishi, Nees, Ramulus Cinnamomi, Rou Gui, Sthula Tvak, Taja, Zimbluten.

Scientific Name

Cinnamomum aromaticum, synonyms Cinnamomum cassia, Cinnamomum ramulus. Family: Lauraceae.

Aim of present study

It has various application in herbal therapy such as Applications in Herbal Therapy

- To treat upset stomach and diarrheoa.
- For the treatment of gastric ulcers.
- Cinnamon bark may possess a potentiating effect on insulin, and can be useful in the treatment of type 2 diabetes; as well as lowering triglyceride levels and serum cholesterol
- For the treatment of bronchitis, coughs and other respiratory ailments.
- Against nervous disorders.
- For loss of appetite and dyspepsia.
- To promote conception, cinnamon is sometimes used alternately with damiana.
- For the treatment of hypertension (high blood pressure).
- As an invigorating tonic.
- Externally as a poultice to treat minor bacterial and fungal infections of the skin.
- The essential oil is employed in aromatherapy as a rub to promote blood circulation.
- Some of the plant constituents have proven value against bacteria and fungi, including the molds that produce the carcinogenic aflatoxins.
- Cinnamon constituents possess antioxidant action and may prove beneficial against free radical damage to cell membranes.
- Its essential oil contains both antifungal and antibacterial principles that can be used to prevent food spoilage due to bacterial contamination.

Pharmacological Activities

➢ **Cancer**

Cancer also known as a malignant tumor or malignant neoplasm, is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. Not all tumors are cancerous; benign tumors do not spread to other parts of the body. Possible signs and symptoms include: a new lump, abnormal bleeding, a prolonged cough, unexplained weight loss, and a change in bowel movements, among others. While these symptoms may indicate cancer they may also occur due to other issues. There are over 100 different known cancers that affect humans.

Tobacco use is the cause of about 22% of cancer deaths. Another 10% is due to obesity, a poor diet, lack of physical activity, and drinking alcohol. Other factors include certain infections, exposure to ionizing radiation, and environmental pollutants. In the developing world nearly 20% of cancers are due to infections such as hepatitis B, hepatitis C, and human papillomavirus. These factors act, at least partly, by changing the genes of a cell. Typically many such genetic changes are required before cancer develops. Approximately 5–10% of cancers are due to genetic defects inherited from a person's parents. Cancer can be detected by certain signs and symptoms or screening tests. It is then typically further investigated by medical imaging and confirmed by biopsy.

Definitions

Cancers are a large family of diseases which involve abnormal cell growth with the potential to invade or spread to other parts of the body. They form a subset of neoplasms. A neoplasm or tumor is a group of cells that have undergone unregulated growth, and will often form a mass or lump, but may be distributed diffusely.

Six characteristics of cancer have been proposed:

1. Self-sufficiency in growth signalling
2. Insensitivity to anti-growth signals
3. Evasion of apoptosis
4. Enabling of a limitless replicative potential
5. Induction and sustainment of angiogenesis
6. Activation of metastasis and invasion of tissue.

The progression from normal cells to cells that can form a discernible mass to outright cancer involves multiple steps known as malignant progression.

Sign and Symptom

Symptoms of cancer metastasis depend on the location of the tumor. When cancer begins, it invariably produces no symptoms. Signs and symptoms only appear as the mass continues to grow or ulcerates. The findings that result depend on the type and location of the cancer. Few symptoms are specific, with many of them also frequently occurring in individuals who have other conditions. Cancer is the new "great imitator". Thus it is not uncommon for people diagnosed with cancer to have been treated for other diseases which were assumed to be causing their symptoms.

Local Effects

Local symptoms may occur due to the mass of the tumor or its ulceration. For example, mass effects from lung cancer can cause blockage of the bronchus resulting in cough or pneumonia; esophageal cancer can cause narrowing of the esophagus, making it difficult or painful to swallow; and colorectal cancer may lead to narrowing or blockages in the bowel, resulting in changes in bowel habits. Masses in breasts or testicles may be easily felt. Ulceration can cause bleeding which, if it occurs in the lung, will lead to coughing up blood, in the bowels to anemia or rectal bleeding, in the bladder to blood in the urine, and in the uterus to vaginal bleeding. Although localized pain may occur in advanced cancer, the initial swelling is usually painless. Some cancers can cause buildup of fluid within the chest or abdomen.

Systemic Symptoms

General symptoms occur due to distant effects of the cancer that are not related to direct or metastatic spread. These may include: unintentional weight loss, fever, being excessively tired, and changes to the skin. Hodgkin disease, leukemias, and cancers of the liver or kidney can cause a persistent fever of unknown origin.

Some cancers may cause specific groups of systemic symptoms, termed paraneoplastic phenomena. Examples include the appearance of myasthenia gravis in thymoma and clubbing in lung cancer.

Causes

The great majority of cancers, some 90–95% of cases, are due to environmental factors. The remaining 5–10% are due to inherited genetics. Environmental, as used by cancer researchers, means any cause that is not inherited genetically, such as lifestyle, economic and behavioral

factors, and not merely pollution. Common environmental factors that contribute to cancer death include tobacco (25–30%), diet and obesity (30–35%), infections (15–20%), radiation (both ionizing and non-ionizing, up to 10%), stress, lack of physical activity, and environmental pollutants.

It is nearly impossible to prove what caused a cancer in any individual, because most cancers have multiple possible causes. For example, if a person who uses tobacco heavily develops lung cancer, then it was probably caused by the tobacco use, but since everyone has a small chance of developing lung cancer as a result of air pollution or radiation, then there is a small chance that the cancer developed because of air pollution or radiation. Excepting the rare transmissions that occur with pregnancies and only a marginal few organ donors, cancer is generally not a transmissible disease.

Classification

Cancers are classified by the type of cell that the tumorcells resemble and is therefore presumed to be the origin of the tumor. These types include:

- **Carcinoma:** Cancers derived from epithelial cells. This group includes many of the most common cancers, particularly in the aged, and include nearly all those developing in the breast, prostate, lung, pancreas, and colon.
- **Sarcoma:** Cancers arising from connective tissue (i.e. bone, cartilage, fat, nerve), each of which develop from cells originating in mesenchymal cells outside the bone marrow.
- **Lymphomaandleukemia:** These two classes of cancer arise from hematopoietic (blood-forming) cells that leave the marrow and tend to mature in the lymph nodes and blood, respectively. Leukemia is the most common type of cancer in children accounting for about 30%.
- **Germ cell tumor:** Cancers derived from pluripotent cells, most often presenting in the testicle or the ovary (seminoma and dysgerminoma, respectively).
- **Blastoma**: Cancers derived from immature "precursor" cells or embryonic tissue. Blastomas are more common in children than in older adults.

  Cancers are usually named using *-carcinoma*, *-sarcoma* or *-blastoma* as a suffix, with the Latin or Greek word for the organ or tissue of origin as the root. For example, cancers of the liver parenchyma arising from malignant epithelial cells is called *hepatocarcinoma*, while a malignancy arising from primitive liver precursor cells is called a hepatoblastoma, and a cancer arising from fat cells is called a *liposarcoma*. For some common cancers, the English organ name is used. For example, the most common type of breast cancer is called *ductal carcinoma of the breast*. Here, the adjective *ductal* refers to the appearance of the cancer under the microscope, which suggests that it has originated in the milk ducts.
- **Benign tumors** (which are not cancers) are named using *-oma* as a suffix with the organ name as the root. For example, a benign tumor of smooth muscle cells is called a *leiomyoma* (the common name of this frequently occurring benign tumor in the uterus is *fibroid*). Confusingly, some types of cancer use the *-noma* suffix, examples including melanoma and seminoma.

  Some types of cancer are named for the size and shape of the cells under a microscope, such as giant cell carcinoma, spindle cell carcinoma, and small-cell carcinoma.

Prevention

Cancer prevention is defined as active measures to decrease the risk of cancer. The vast majority of cancer cases are due to environmental risk factors, and many, but not all, of these environmental factors are controllable lifestyle choices. Thus, cancer is considered a largely preventable disease. Greater than 30% of cancer deaths could be prevented by avoiding risk factors including: tobacco, overweight /obesity, an insufficient diet, physical inactivity, alcohol, sexually transmitted infections, and air pollution. Not all environmental causes are controllable, such as naturally occurring background radiation, and other cases of cancer are caused through hereditary genetic disorders, and thus it is not possible to prevent all cases of cancer.

Mechanism of action of cinnamon as anticancer drug

Anticancer Activity

C. cassia has been reported to be antimutagenic by its modulator effect on the xenobiotic bioactivation and detoxification processes. It also has apoptosis inducing activity by different mechanisms. Sharma *et al.* studied the antimutagenic properties of *C. cassia* against two mutagens, viz. benzo[a]pyrene (B[a]P) and cyclophosphamide (CP) by the Ames test, *in vivo* chromosomal aberration (CA) and micronuclei tests. It was observed in the Ames test, bone marrow chromosomal aberration assay and micronucleus test that *C. cassia* exerted significant antimutagenic effects against B[a]P and CP in animals treated with the plant extract. *C. cassia*pretreatment decreased cytochrome P450 content, but increased the glutathione (GSH) content and the activity of glutathione-dependent antioxidant enzymes, viz. glutathione-*S*-transferase (GST), glutathione reductase (GR) and glutathione peroxidase (GPX).

C. cassia has been evaluated for its apoptosis-inducing activity in order to develop a new apoptosis inducer. The effects of cinnamaldehyde, an active compound isolated from the stem bark of *C. cassia*, have been studied on the cytotoxicity, induction of apoptosis and the putative pathways of its actions in human promyelocytic leukemia cells. Results showed that cinnamaldehyde is a potent inducer of apoptosis and it transduces the apoptotic signal via reactive oxygen species (ROS) generation, thereby inducing mitochondrial permeability transition (MPT) and cytochrome *c* release to the cytosol. It induced the death of HL-60 cells by the mechanism of mitochondrial transmembrane potential and the activity of caspase-3. The reduced mitochondrial transmembrane potential and increased caspase-3 activity were observed within 12-36 h after administration.

Koppikar reported the anti-neoplastic activity of the

aqueous cinnamon extract (ACE-c) in cervical cancer cell line, SiHa. Cinnamon alters the growth kinetics of SiHa cells in a dose-dependent manner. Cells treated with ACE-c exhibited reduced number of colonies compared to the control cells. The treated cells exhibited reduced migration potential that could be explained as due to the down-regulation of matrix metalloproteinase (MMP)-2 expression. Interestingly, the expression of Her-2 oncoprotein was significantly reduced in the presence of ACE-c. Cinnamon extract induced apoptosis in the cervical cancer cells through increase in intracellular calcium signalling as well as loss of mitochondrial membrane potential, so it could be used as a potent chemopreventive drug in cervical cancer. It strongly inhibited tumour cell proliferation *in vitro* and induced active cell death of tumour cells by up-regulating pro-apoptotic molecules while inhibiting NF-kappa B and AP1 activity and their target genes such as *Bcl-2*, *BcL-xL* and survivin. Oral administration of cinnamon extract in melanoma transplantation model significantly inhibited tumour growth with the same mechanism of action observed *in vitro*. It suggests that the anti-tumour effect of cinnamon extracts is directly linked with enhanced pro-apoptotic activity and inhibition of NF-kappa B and AP1 activities and their target genes in *in vitro* and *in vivo* mouse melanoma model [9].

- **Inflammation**

Inflammation (Latin, *īnflammō*, "I ignite, set alight") is part of the complex biological response of vascular tissues to harmful stimuli, such as pathogens, damaged cells, or irritants.

Inflammation is a protective response involving host cells, blood vessels, and proteins and other mediators that is intended to eliminate the initial cause of cell injury, as well as the necrotic cells and tissues resulting from the original insult, and to initiate the process of repair.

The classical signs of acute inflammation are pain, heat, redness, swelling, and loss of function. Inflammation is a protective attempt by the organism to remove the injurious stimuli and to initiate the healing process. Inflammation is not a synonym for infection, even though the two are often correlated (inflammation often being a result of infection), and despite the fact that words ending in the suffix *it is* (which refers to inflammation) are sometimes informally described as referring to infection. (For example, the word *urethritis* means only "urethral inflammation", but, because most cases are caused by infection, even healthcare providers may tell a patient "it means you have an infection.") Although infection is caused by a microorganism, inflammation is one of the responses of the organism to the pathogen. Inflammation can even occur in the absence of infection, although such types of inflammation are usually maladaptive (such as in atherosclerosis). Inflammation is a stereotyped response, and therefore it is considered as a mechanism of innate immunity, as compared to adaptive immunity, which is specific for each pathogen. Progressive destruction of tissue in the absence of inflammation would compromise the survival of the organism. On the other hand, chronic inflammation might lead to a host of diseases, such as hay fever, periodontitis, atherosclerosis, rheumatoid arthritis, and even cancer (e.g., gallbladder carcinoma). It is for that reason that inflammation is normally closely regulated by the body.

Inflammation can be classified as either *acute* or *chronic*. *Acute inflammation* is the initial response of the body to harmful stimuli and is achieved by the increased movement of plasma and leukocytes (especially granulocytes) from the blood into the injured tissues. A cascade of biochemical events propagates and matures the inflammatory response, involving the local vascular system, the immune system, and various cells within the injured tissue. Prolonged inflammation, known as *chronic inflammation*, leads to a progressive shift in the type of cells present at the site of inflammation and is characterized by simultaneous destruction and healing of the tissue from the inflammatory process.

Causes

- Burns
- Chemical irritants
- Frostbite
- Toxins
- Infection by pathogens
- Physical injury, blunt or penetrating
- Immune reactions due to hypersensitivity
- Ionizing radiation
- Foreign bodies, including splinters, dirt and debris
- Stress
- Trauma
- Alcohol

Types

Appendicitis	Phlebitis
Bursitis	RSD/CRPS
Colitis	Rhinitis
Cystitis	Tendonitis
Dermatitis	Tonsillitis
	Vasculitis

Table 1: Comparison between acute and chronic inflammation

	Acute	Chronic
Causative agent	Bacterial pathogens, injured tissues	Persistent acute inflammation due to non-degradable pathogens, viral infection, persistent foreign bodies, or autoimmune reactions
Major cells involved	neutrophils (primarily), basophils (inflammatory response), and eosinophils (response to helminth worms and parasites), mononuclear cells (monocytes, macrophages)	Mononuclear cells (monocytes, macrophages, lymphocytes, plasma cells), fibroblasts
Primary mediators	Vasoactive amines, eicosanoids	IFN-γ and other cytokines, growth factors, reactive oxygen species, hydrolytic enzymes
Onset	Immediate	Delayed
Duration	Few days	Up to many months, or years
Outcomes	Resolution, abscess formation, chronic inflammation	Tissue destruction, fibrosis, necrosis

Cardial Sign

Infected ingrown toenail showing the characteristic redness and swelling associated with acute inflammation

Acute inflammation is a short-term process, usually appearing within a few minutes or hours and ceasing upon the removal of the injurious stimulus. It is characterized by five

Cardinal signs: The acronym that may be used for this is "PRISH" for Pain, Redness, Immobility (loss of function), Swelling and Heat.

The traditional names for signs of inflammation come from Latin

Dolor (pain)
Calor (heat)
Rubor (redness)
Tumor (swelling)
Functiolaesa (loss of function).

The first four (classical signs) were described by Celsus (ca. 30 BC–38 AD), while loss of function was added later by Galeneven though the attribution is disputed and the origination of the fifth sign has also been ascribed to Thomas Sydenham and Virchow.

Redness and heat are due to increased blood flow at body core temperature to the inflamed site; swelling is caused by accumulation of fluid; pain is due to the release of chemicals such as bradykinin or histamine that stimulate nerve endings. Loss of function has multiple causes.

These five signs appear when acute inflammation occurs on the body's surface, whereas acute inflammation of internal organs may not result in the full set. Pain happens only where the appropriate sensory nerve endings exist in the inflamed area—e.g., acute inflammation of the lung (pneumonia) does not cause pain unless the inflammation involves the parietal pleura, which does have pain-sensitive nerve endings.

Inflammatory disorders

Inflammatory abnormalities are a large group of disorders that underlie a vast variety of human diseases. The immune system is often involved with inflammatory disorders, demonstrated in both allergic reactions and some myopathies, with many immune system disorders resulting in abnormal inflammation. Non-immune diseases with etiological origins in inflammatory processes include cancer, atherosclerosis, and ischaemic heart disease.

A large variety of proteins are involved in inflammation, and any one of them is open to a genetic mutation which impairs or otherwise dysregulates the normal function and expression of that protein.

Examples of disorders associated with inflammation include:

1) Acne vulgaris
2) Asthma
3) Autoimmune diseases
4) Auto inflammatory diseases
5) Celiac disease
6) Chronic prostatitis
7) Glomerulonephritis
8) Hypersensitivities
9) Inflammatory bowel diseases
10) Pelvic inflammatory disease
11) Reperfusion injury
12) Rheumatoid arthritis
13) Sarcoidosis
14) Transplant rejection
15) Vasculitis
16) Interstitial cystitis.

Systemic effects:

An infectious organism can escape the confines of the immediate tissue via the circulatory system or lymphatic system, where it may spread to other parts of the body. If an organism is not contained by the actions of acute inflammation it may gain access to the lymphatic system via nearby lymph vessels. An infection of the lymph vessels is known as lymphangitis, and infection of a lymph node is known as lymphadenitis. When lymph nodes cannot destroy all pathogens, the infection spreads further. A pathogen can gain access to the bloodstream through lymphatic drainage into the circulatory system.

-When inflammation overwhelms the host, systemic inflammatory response syndrome is diagnosed. When it is due to infection, the term sepsis is applied, with the terms bacteremia being applied specifically for bacterial sepsis and viremia specifically to viral sepsis. Vasodilation and organ dysfunction are serious problems associated with widespread infection that may lead to septic shock and death.

Mechanism of action of cinnamon as Anti-inflammatory drug

Anti-inflammatory Activity

C.cassia has been reported to have anti-inflammatory activity through the potent inhibition of nitric oxide (NO) and cyclooxygenase. Leeevaluated the inhibitory effects of *C.cassia* bark derived material on NO production in RAW 264.7 cells through the evaluation of NO production and expression of inducible nitric oxide (iNOS). The activity was compared to the effects of three commercially available compounds, cinnamyl alcohol, cinnamic acid and eugenol. Potent inhibitory effects of cinnamaldehyde against NO production were found to be 81.5%, 71.7% and 41.2% at 1.0, 0.5 and 0.1 µg/µl, respectively. Little or no activity was observed for cinnamic acid and eugenol. Also, *C. cassia* extract has shown potent inhibition of cyclooxygenase-2 (COX-2) activity with >80% inhibition at a dose of 10 µg/ml in lipopolysaccharide (LPS)-induced mouse macrophages RAW 264.7 cells. These active extracts mediating (COX-2) and iNOS inhibitory activities so future investigation for development of new cancer or anti-inflammatory agents is needed.

Several of the cinnamaldehyde derivatives were synthesised from cinnamic acid, such as 2′-hydroxycinnamaldehyde (HCA) isolated from the bark *C. cassia*. Derivatives were investigated to compare their NO production and nuclear factor (NF)-kappa B activity from Raw 264.7 cell. The present results provided evidence that HCA, among the cinnamaledhyde derivatives, has the most inhibitory effect on NO production through inhibition of NF-kappa B activation at IC (50) values of 8 and 22 µM, respectively, and thus can be used as an anti-inflammatory agent.[9]

- **Ulcer**

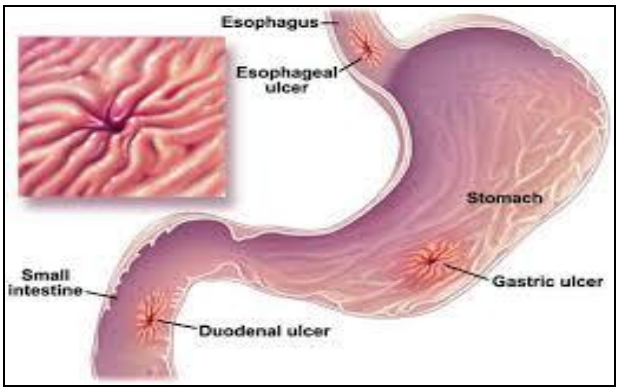

Fig 3

An Ulcer is a discontinuity or break in a bodily membrane that impedes the organ of which that membrane is a part from continuing its normal functions.

Common forms of ulcers recognized in medicine include:

Ulcer (dermatology), a discontinuity of the skin or a break in the skin.

- Pressure ulcers, also known as bedsores
- Genital ulcer, an ulcer located on the genital area
- Ulcerative dermatitis, a skin disorder associated with bacterial growth often initiated by self-trauma
- Corneal ulcer, an inflammatory or infective condition of the cornea
- Mouth ulcer, an open sore inside the mouth
- Aphthous ulcer, a specific type of oral ulcer also known as a canker sore
- Peptic ulcer, a discontinuity of the gastrointestinal mucosa (stomach ulcer)
- Venous ulcer, a wound thought to occur due to improper functioning of valves in the veins
- Stress ulcer, located anywhere within the stomach and proximal duodenum
- Ulcerative sarcoidosis, a cutaneous condition affecting people with sarcoidosis
- Ulcerative lichen planus, a rare variant of lichen planus
- Ulcerative colitis, a form of inflammatory bowel disease (IBD).
- Ulcerative disposition, a disorder or discomfort that causes severe abdominal distress, often associated with chronic gastritis.

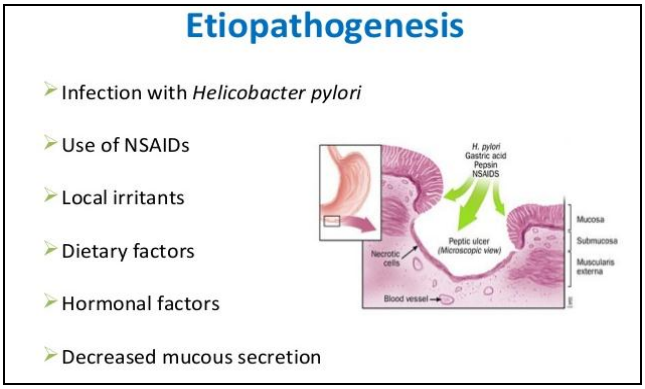

Fig 4

Mechanism of action of cinnamon as antiulcer drug

Antiulcer Activity

C. cassia has effective antiulcer activity probably by potentiating the defensive factors through the improvement of the circulatory disorder and gastric cytoprotection.

Akira found that the intraperitoneal administration of an aqueous extract of *C. cassia* to rats at a dose of 100 mg/kg body weight prevented the occurrence of stress ulcers under exposure to a cold atmosphere 3-5°C or on restraint in water 22-24°C. It also strongly inhibited gastric ulcers induced by a subcutaneous injection of serotonin in rats. The preventive effect of compounds 3-(2-hydroxyphenyl)-propanoic acid and its *O*-glucoside, which are isolated from the stem bark of *C. cassia* in serotonin-induced ulcerogenesis, was evaluated. The former compound at a dose of 40 µg/kg body weight also inhibited gastric ulcers induced by the other ulcerogens such as phenylbutazone, ethanol and water immersion stress, although it failed to prevent indomethacin-induced ulcers. 3-(2-hydroxyphenyl)-propanoic acid hardly inhibited the secretion of gastric acid, but promoted the gastric blood flow.

Antral gastritis, duodenal ulcer and gastric lymphoma are frequently associated with *Helicobacter pylori*infection. *So,eradication* of *H. pylori* has been shown to prevent relapse of these diseases.

Ethanol and methylene chloride extracts of cinnamon were tested for their effect on *H. pylori* growth and urease activity. Methylene chloride extract was found to inhibit the growth of *H. pylori* at the concentration range of common antibiotics, while ethanol extract counteracted urease activity. So, it may be helpful for prevention of ulcers induced by *H. pylori*.[9]

20 Health Benefits of Cinnamon

Why Ceylon Cinnamon maybe the solution for blood sugar control, weight loss, alertness, creating natural disinfectants, cancer prevention, IBS and much more.

1. **Blood Sugar Control** – Several studies have found that Cinnamon has properties that helps those with insulin resistance. It is therefore very popular with Type 2 diabetics who take it to control their blood sugar variations. Ceylon Cinnamon is particularly popular because it has low levels of Coumarin. In case you did not know Coumarin in high doses can cause liver damage.
2. **Anti-Bacterial** - Cinnamon is a powerful anti-bacterial and makes a great natural disinfectant. Dilute it with water to disinfectant kitchen counter tops, sinks, your refrigerator, door knobs, toys and many other things. If you have young children and don't want to use harsh cancer causing chemicals use this.
3. **Food Preservative** – Cinnamon is effective in inhibiting bacterial growth. This maybe one reason be why it is widely used in food preparation in hot Asian countries. In Sri Lanka, virtually every dish has a pinch of Cinnamon in it. In addition to great flavor, Ceylon Cinnamon in combination with other spices like Turmeric and Chili may have been an indigenous solution to preserve food without a refrigerator.
4. **Odor Neutralizer** – Pure Cinnamon Leaf oil not only

smells great but is an effective odor neutralizer as it kills bacteria. All you need is 2-5 drops of Cinnamon leaf oil mixed with water on a diffuser and within minutes all odors are neutralized. It also has the effect of improving your mood. Especially great as a cure for the winter blues.

5. **Cognitive Development** – Cinnamon improved their response times and memory recall. While not scientific, our personal experience suggests pretty good results in alertness and concentration.
6. **Anti-oxidant** – With an ORAC value of 267536 µmol TE/100g, cinnamon is one of the top seven anti-oxidants in the world. Anti-oxidants reduces the formation of Free Radicals that cause cancer. This study found Cinnamon has sufficient anti-oxidant properties and makes for improved food palatability.
7. **Cancer Preventer –** Research shows that Cinnamon oil is a promising solution in the treatment Tumors, Gastric Cancers and Melanomas. Another study found good results with leukemia and lymphoma cancer cells. Cinnamon in its various forms have two chemical constituents called Cinnamaldehyde and Eugenol (From Cinnamon Oil). These have been used to develop nutraceuticals in this study that have been proven fairly effective in fighting Human Colon Cancer Cells (Eugenol) and Human hepatoma cells (Cinnamaldehyde).
8. **Weight Reducer** –Cinnamon has the effect of thinning blood thereby increasing blood circulation. Increased blood flow generally boosts your metabolism which is helpful in weight loss. This blood thinning property of Cinnamon also helps it in acting as an anticlotting agent especially for those suffering from heart disease. However care must be taken to NOT to take it with other blood thinning medication. This effect on blood circulation is why people with cold feet and hands are advised to take Cinnamon as increased circulation cures this issue for suffers.
9. **Arthritis Relief** –The commonly cited Copenhagen University showed that half a teaspoon of Cinnamon powder mixed with a tablespoon of honey vastly reduced arthritis pain. Patients were apparently able to walk without pain after one month.
10. **Massage Therapy**– Cinnamon is a well-known warming agent. Combined with a carrier oil it is highly effective in relaxing and relieving muscle pain. Some out a few drops in their bath and have relaxing bath to sooth tired and aching muscles.
11. **Anti-Fungal** – Got a bad case of athlete's foot? Its powerful anti-fungal properties is the perfect natural alternative to killing the athlete's foot fungus.
12. **Lowering LDL cholesterol & triglycerides** – Cinnamon could lower cholesterol is indirectly via how the body processes sugar and fat. But there is no direct effect on cholesterol. Still in another study Cinnamon reduced triglyceride (23-30%), LDL cholesterol (7-27%), and total cholesterol (12-26%).
13. **E-coli Fighter** – One of the most effective E-coli fighter because of its; anti-microbial properties. Mix cinnamon oil with hydrogen peroxide and spray your cutting board and kitchen sink especially after you have cut meats. Spray it in your refrigerator. It's safe and natural.
14. **Yeast infections** - Cinnamon has shown an amazing ability to stop medication-resistant yeast infections. This applies to Escherichia coli bacteria and Candida albicans fungus. While evidence is hard to find, a cup of Cinnamon tea with honey taken three times a day is worth a try.
15. **Irritable Bowel Syndrome (IBS)** – As a digestive cinnamon dramatically reduces the uncomfortable feelings associated with IBS especially the bloating. It does this by killing bacteria and healing infections in the GI tract and enabling the gastric juices to work normally. A Japanese study apparently showed it to cure ulcers but this cannot be verified. But if you do have stomach cramps or upsets, a cup of Cinnamon tea 2-3 times per day will dramatically reduce the pain.
16. **Tooth Decay and Gum Disease** – Again the anti-bacterial properties of Cinnamon play a crucial role in getting rid of harmful bacteria without damaging your teeth or gums. It's one of the reasons that Cinnamon Oil is often used in chewing gums, mouthwashes, toothpaste and breath mints.
17. **Nutrients** – Each 5g (1 teaspoon) of Cinnamon Powder has 833mg (41.6% DV) Manganese, 61.4g (6.1% DV) Calcium, 19mg (10.5% DV) Iron, and 1.425mg (2.35%). This data was calculated from this site. Manganese apparently works as an enzyme activator and plays an important role in building good structure and bone metabolism according to this site. According to WebMD manganese is therefore useful for for weak bones (osteoporosis), a type of "tired blood" (anemia), and symptoms of premenstrual syndrome (PMS).
18. **Insect Repellant** – Again the anti-microbial qualities of Cinnamon Leaf oil is often used for head lice treatment, black ant control, bed bugs, dust mites, and roaches. It is well known as a defense against Mosquito's. This WebMD article sites a Taiwanese study which found that it not only kills Mosquito larvae but also acts as a bug repellant. This paper suggests that real Cinnamon Oil as opposed to Cinnamon extract is the best for a broad range anti-microbial activity.
19. **Cold, Sore Throat and Cough** – At the first sign (within 5-10 minutes) of sniffles or an itch in your throat take some Cinnamon Tea with Honey. It will stop an impending illness in its tracks, unless of course it is a viral infection that requires antibiotics. Again this related to the anti-bacterial properties and warming properties of Cinnamon and its propensity to increase blood flow and thereby improve blood oxygen levels to fight illness. Chinese traditional medicine commonly recommends Cinnamon for phlegm coughs.
20. **Alzheimer's Disease** – Cinnamon can delay the effects of five aggressive strains of Alzheimer inducing genes. Another study also finds that orally administered Cinnamon extract has had good success in correcting Cognitive Impairment in Alzheimer's disease in Animal Models.

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