

# TITLE: CINNAMON: A CLINICAL APPROACH AS MULTIFARIOUS NATURAL REMEDY WITH ABSOLUTE IMMUNITY

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## ABSTRACT

*Plants are the oxygen support for our planet and all living things. They can be considered as “mothers of medicine”. As mothers take care of a child, Plants do the same for all human beings and animals. Medicinal plants have therapeutic properties that produce a beneficial pharmacological effect on the animal and human body. In recent years plants are surveyed as new drugs and gain attention to the discovery of new bioactive compounds. Hippocrates quoted “Let thy food be thy medicine, and thy medicine shall be thy food”. The flavor, aroma, taste, and nutritional properties make the Cinnamon offers a wide range of health benefits. The present study explores the connection between the Cinnamon plant and medicine, our food, modern science.*

**Keywords:** Cinnamon, essential oil (EO), Cinnamaldehyde, COVID-19.

## Introduction

Cinnamon is an ancient spice, belonging to the family Lauracea. It comes from the bark of Cinnamomum genus. It is native to Sri Lanka, Myanmar, Malabar Coast of India, South America, Carribean, Southeast Asia and the West Indies (Pie et al., 2014). People have been used this spice since 2000BC in Ancient Egypt. In Egypt, it was more valuable than gold and was sought for religious and embalming purposes. Ancient Hebrews used Cinnamon in religious ceremonies and in the preparation of holy anointing oil as mentioned in the Bible. Cinnamon commonly known as ‘Dalchini’ and in Sanskrit ‘Twak’. Its tree is scattered all over the world and around 250 species have been identified. The Cinnamon tree is small evergreen tree and grows in moist well drained soil with aromatic bark of 6-8 m in height and rarely reaches more than 15 meter. Its leaves are commonly known as ‘Tejpatra’. Cinnamon has quite popular as a healing agent. The dry inner bark of a cinnamon spice is brown in colour with delicately fragrant aroma and a warm sweet flavour. Its bark is used as culinary spice. Dalchini is made by cutting the stems of cinnamon trees and its inner bark is extracted and the woody parts was removed. When the woody parts dries, it converted in strips that curl

in to the rolls which is called cinnamon sticks. Cinnamon powder is formed by grinding these sticks. As per Ayurveda its taste is pungent, sweet and hot. Cinnamon has a long history as a traditional medicine including for bronchitis, gastrointestinal problems, diabetes and loss of appetites. It also increase salivation and to improve digestive functions as reported in Indian Ayurveda also. It is used as flavouring agent in confections to carries to beverage and bakery. Oily part of cinnamon gives the flavour and distinct smell which contain the compound cinnamaldehyde which has an antipyretic activity (Marongiu et. al. 2007). As per the U.S. Department of Agriculture, 1(tsp), weighing 2.6gm of ground cinnamon has energy: 6.42 calories, carbohydrates: 2.1 g, calcium: 26.1 mg, iron: 0.21 mg, magnesium: 1.56 mg, phosphorus: 1.66 mg, potassium: 11.2 mg, vitamin A: 0.39 µg. It also having the traces of vitamins B and K and the antioxidants choline, beta-carotene, alpha-carotene, beta-cryptoxanthin, lycopene, lutein, and zeaxanthin. Its essential oil that extracted from bark fregments is used in perfumes, drugs, liquor and food. It is most commonly used in market as as an aromatic condiment and flavouring additive in the variety of cuisines, tea and traditional foods. The aroma of the cinnamon derive from its essential oil that makes up 0.5 to 1% of its composition and most common component, 'cinnamaldehyde', as well as numerous other constituents, such as 'eugenol'. Its pungent taste and aroma come from cinnamaldehyde (which is found to be about 90% of the essential oil from the bark), and with matter of time when it keeps reacting with oxygen when exposed to air, it darkens in colour and forms resinous compounds. Initially it was used as flavouring agent because of its mouth refreshing effects and ability to cure bad breath, dental problems and toothache (Jakheta et al., 2010). Various research confirms that its oil play a role in treating various types of infections. It reduces the risk of colon cancer (Wondrak et al., 2010) and having the gastro-protective effect and anti-ulcer agent (Alqasoumi, 2012). In human body it prevent bleeding (Hossein et al., 2013) and act as coagulant. Cinnamon has the substance with powerful medicinal properties Cinnamon contains anti-Inflammatory properties (Chao et al. 2005; Tung et al. 2010) and antioxidants (Mancini-Filho et al.,1998; Mathew et al., 2006), anti-HIV (Connell et al. 2016), anticancer (Lu et al, 2010), anti-diabetic activity (Kim et al., 2006) and insecticidal activity (Cheng et al., 2009).



Figure 1. Cinnamon bark



Figure 2. Cinnamon Plant (Leaves known as tejpatra)

### Plant Taxonomy

Domain:	Eukarya
Kingdom:	Plantae
Phylum:	Magnoliophyta
Class:	Magnoliopsida
Order:	Lurales
Family:	Lauraceae
Genus:	Cinanamomum

### Chemical constituents present in different part of the Cinnamomum

Cinnamomum contains some of the compounds including cinnamaldehyde, cinnamate, cinnamic acid, eugenol, ethyl cinnamate, methyl chavicol, linalool and  $\beta$ -caryophyllene. The presence of spicy taste and fragrance are due to its main component cinnamaldehyde which occurs due to the absorption of  $O_2$ . It also contains polyphenols, a natural antioxidants, which are seen in help in regulating blood sugar levels. Studies have also shown that the small tree thrives in India, Egypt, Sri Lanka, Brazil, Indonesia and Vietnam having natural cinnamaldehyde, is found to act as a natural hormone balancing agent in humans, by increasing the progesterone hormone and decreasing the level of testosterone in women. *Cinnamomum zeylanicum* in cinnamomum genus is generally known a reputed spice which was used for foods and pharmaceuticals since olden times. Cinnamon bark and leaf are also being used in food flavours, cosmetics and pharmaceuticals. Benzyl benzoate chemotypes of cinnamon bark and leaf oils and linalool chemotype of cinnamon leaf oil were also testified. Studies regarding essential oils of fruit, fruit stalk, flower, bud, leaf petiole of cinnamon were also considered and (E)-Cinnamyl acetate was found to be the main component. The oil of cinnamon bud was found to be rich in sesquiterpenoids. A recent studies showed that significant activities were possessed by the oils of fruit stalk, the phenolic and flavonoid compounds isolated from the fruits stalk and the extract from supercritical fluid extraction using carbon-dioxide of cinnamon bark. Synthetic material can be replaced by (E)-Cinnamyl acetate which comes from cinnamon fruit or fruit oil which presently serves in perfumery and flavouring of food materials. Thus different types of essential oils are obtained from cinnamon that can be commercially utilized as per the preference and uses as nutraceuticals and health supplements. The various chemical constituents are present in various parts are listed below (Vangalapati et al., 2012; Jayaprakasha et al., 2002).

S.No.	Chemical constituents	Plant part	Percentage
1.	Cinnamaldehyde	Leaves and barks	1 to 5%, 65 to 80%
2.	Eugenol	Leaves and barks	70 to 95%, 5 to 10%
3.	Camphor	Root barks	60%
4.	Trans-cinnamyl acetate	Fruits	42 to 54%
5.	Caryophyllene	Fruits	9 to 14%
6.	Terpene hydrocarbon	Flower bud	78%
7.	$\alpha$ -Bergamotene	Flower bud	27.38%
8.	$\alpha$ -copaene	Flower bud	23.05%
9.	Oxygenated terpenoid	Flower bud	9%
10.	(E)- cinnamyl acetate	Flower	41.98%
11.	trans- $\alpha$ -Bergamotene	Flower	7.97%
12.	Caryophyllene oxide	Flower	7.20%

Table 1. Main chemical constituents present in various parts of genus *Cinnamomum*

### **Cinnamon as immunity Booster**

Nature is a gift for maintaining healthy and happy life. Ayurveda is a plant based science that are helpful in uplifting and maintaining the healthy life. In the present time, the whole world is suffering from COVID-19 pandemic and it is necessary to know the importance of the enhancement of immunity naturally. As the deadly corona virus is targeting the person with low immune system so in that case the importance of traditionally using herbs for the improvement of the human immune system and also help in decreasing the effect of infection. As of now, there is no medicine for corona virus, so it is good to build immunity in the time of COVID-19. To boost the body's immunity against corona virus, a recipe of a herbal decoction has been formulated by the ministry of AYUSH (Ayurveda, Yoga, Unani, Siddha and Homoeopathy). In the formulation of coronavirus various herbs like Sunthi (dry ginger powder), Krishna marich (black pepper) and tulsi (Basil leaves) are also sold along with Dalchini (Cinnamon bark) as "Ayush Kwath" or "Ayush Joshanda". The formulation of Ayush Kwath is already available in the form of tablets or powder form. Dalchini is an important herb in Indian traditional system that act as immunity booster and keep many disease away. Dr. Pratibha Bagwe, a Naturopathist recommends decoction for improving the respiratory system and how to protect from viral infection. The main constituent of decoction are Bell patri, Dalchini, Tulsi leaves, Ginger, pepper, turmeric powder, water. Ayurveda said that Dalchini and honey can treat almost any problem and no side effect such as various skin related problem, in the treatment of arthritis pain, destroy bladder germs, treat gums and teeth infection, to regulate cholesterol and help in weight loss and also prevent fat accumulation in the body. Cinnamon is also the active constituent of herbal tea for curing cough. Cold and flu. Ayush ministry said that Healthy Immune System in turns help in recovery of various infections. Cinnamon is of the major component which help to increase our immunity as well as to cure of many disease. Antiviral effects against RNA virus shown by Cinnamon extract was investigated (Zuang et al., 2009). Researcher showed that cinnamon extract suppressed wild-type SAR-CoV in vitro having IC<sub>50</sub> of 43 $\mu$ M. The mechanism of action was also proposed via endocytosis by blocking cell entry. Antiviral treatment of Gene-Eden-VIR/Novirin is a patented herbal broad spectrum formula. This formula contain five

ingredient-1) 100mg extract of quercetin 2) 150 gm extract of green tea 3) 50 mg extract of cinnamon 4) 25 g extract of liquorice 5) 100µg of selenium. It was shown by the clinical trial that the Gene-Eden VIR/Novirin is effective against various viruses include human papillomavirus and cytomegalovirus, herpes simplex virus (Polansky et al., 2018) and Epstein-Barr Viruses.



Figure 3: Cinnamon as an important ingredient in making kadha

### As Antidiabetic Agent

Diabetes mellitus (DM) is one of the endocrine human disorder which is commonly effecting many countries all over the world. Improvement has not done much in bringing about a viewable change in the reduction of diabetic patient and now are moving towards clinical trials of drugs containing hypoglycemic agents of natural source, specifically in the developing nations. Universally accepted medicinal plant, Cinnamon is being commonly used in daily routine by people all over the world, which has a potential to reduce diabetes and its relatable issue without having any side effects.(Zare et. al., 2018) reported the effect of Cinnamon supplementation in patients having Cinnamon bark powder in 500mg capsules twice daily for 3 months. Cinnamon supplementation showed to positive improvement of all anthropometric (BMI, visceral fat, body fat), glycemic (Insulin resistance, FPG, fasting Insulin, 2hpp, Hb<sub>A1C</sub>) and lipids outcome (Total cholesterol, LDL-c and HDL-c). The results are more prominent in patients with higher baseline BMI (BMI  $\geq$  27). Cinnamon has the ability to manage diabetes by boosting insulin function. Methylhydroxychalcone polymer (MHCP) are found in Cinnamon and it acts as insulin mimetic in 3T3-L1 adipocytes (Anderson et al., 2004). The polymer MHCP activates the auto-phosphorylation of the insulin receptor, unregulated glucose uptake, glycogen synthesis and glycogen synthase (GS) activity in 3T3-L1 adipocytes and lower the activity of glycogen synthase kinase-3 $\beta$  (GSK-3 $\beta$ ) activity. The aqueous fraction of Cinnamon showed *invitro* insulin-potentiating activity. The major active components in Cinnamon is MHCP is shown in figure. The *invitro* insulin increasing activity in epididymal fat cell is govern by monomers or oligomers present as polyphenolic compounds.

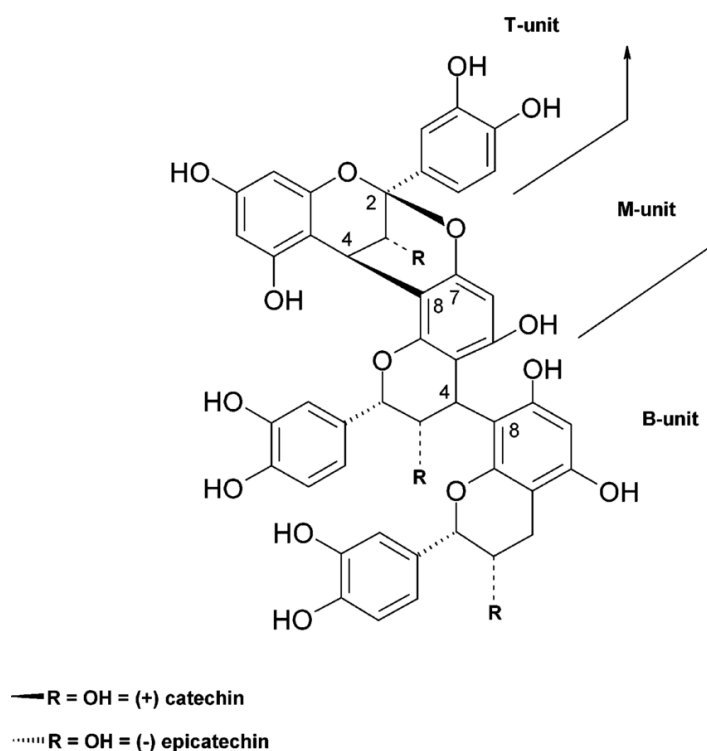


Figure 4. Structure of doubly linked procyanidin type-A polymers found in cinnamon that enhance insulin activity (Anderson et al., 2004).

(Khan et al., 2004) investigated Cinnamon as a regulator of glucose and lipids of people with type 2 diabetes. The study was done on total of 60 people with diabetes type 2 (30 men and 30 women of around of age 52.2+/-6.32 years). They divided into six groups 1, 3 or 6g of Cinnamon from the species of *Cinnamomum cassia* were given to the first three groups and the other three groups were given placebo capsules. The Cinnamon was given for 40 days followed by a 20 days period. After 40 days, the first group who were taking Cinnamon found to lowering the mean fasting serum glucose (18-29%), low density lipoprotein (LDL), cholesterol (7-27%), total triglycerides (23-30%). There is no significant changes in HDL cholesterol and in the placebo group and proved the advantages of Cinnamon supplementation at low levels (1-6 g/day)

### As Insecticidal Agent

There is an urgent need for the development of effective insecticide that create no harm to the environment and non-target organisms. In this direction, plant-based insecticide are potential alternatives because of the presence of the presence of bioactive secondary metabolites that reduces the risks to the environment and less effect on human health. The essential oil of Cinnamon were investigated for their insecticidal activity against nymphs and adults of planthopper *Metcalfa pruinosa*. Leaf-dipping bioassay method was used for the evaluation of the toxicity of the Cinnamon oil constituents against the nymph of *M. pruinosa*. The  $LC_{50}$  value of hydro-cinnamic acid and the geranic acid (Kim et al., 2015) was found to 1.55mg/cm<sup>2</sup> and 1.59 mg/cm<sup>2</sup> respectively based on 24 h. The  $LC_{50}$  value of cinnamaldehyde including 11 of the compound was found between 1.60 mg/cm<sup>2</sup> and 4.94 mg/cm<sup>2</sup>. The

toxicity of the plant oil and 21 cinnamaldehyde based compounds were evaluated using a direct spray method against *M. Pruinosa*. The LC<sub>50</sub> values of 9 compounds having cinnamaldehyde were between 59.16 mg and 96.70 mg and other 15 compounds showed low toxicity and no toxicity. The Cinnamon bark and green leaf oil showed 82.3% and 82.9% mortalities by the spray formulation. This study proved the insecticidal potency and stabilizing by the usage of the essential oils as novel insecticide. The essential oil of *C. cassia* showed strong larvicidal and repellency activity against several mosquitoes. The present study found the trans-cinnamaldehyde was the main constituents of essential oil of *C. cassia* against the Booklice, *Liposcelis bostrychophila*. Total 35 components were identified and the main components were trans-cinnamaldehyde (49.33%), acetophenone (6.94%), trans-cinnamic acid (5.45%), cis-cinnamaldehyde (4.44%), O-methoxycinnamaldehyde (3.48%), coumarine (3.42%) and E-cinnamyl alcohol (3.21%). The contact toxicity having LC<sub>50</sub> value of 55.68 µg/cm<sup>2</sup> and fumigant toxicity with LC<sub>50</sub> 1.33 µg/cm<sup>2</sup> against *L. bostrychophila*. The E.O. having trans-cinnamaldehyde showed strong contact and fumigant toxicity of LC<sub>50</sub> 43.40 µg/cm<sup>2</sup> and 1.29 µg/cm<sup>2</sup> respectively. This research proved that trans-cinnamaldehyde are the source for the development of natural insecticide or fumigants for the treatment of booklice (Liu et al., 2014).

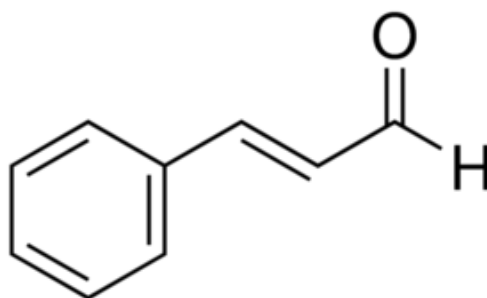


Figure 5. Structure of trans-cinnamadehyde

Insecticidal activity of the essential oil of *Cinnamomum camphora* leaves was investigated against *Lasioderma serricorne*. The fumigant and contact toxicity was found to be LC<sub>50</sub>/LD<sub>50</sub> value of 2.5 mg/L and 21.25 µg/adult respectively. The main component present in the *Cinnamomum camphora* was D-camphor (40.54%), linalool (22.92%), Cineole (11.26%) and 3,7,11-trimethyl-3-hydroxy-6,10-dodecadien-1-yl-acetate (4.50%). The component D-camphor and linalool exhibited strong fumigant and contact toxicity of LC<sub>50</sub> of 2.336 and 18.04 mg/l and LD<sub>50</sub> 13.44 and 12.74 µg/adult respectively against *L. serricorne*. The results proved that the *C. camphora* act as a natural fumigants and insecticide for the treatment of *L. serricorne* (Chen et al., 2014).

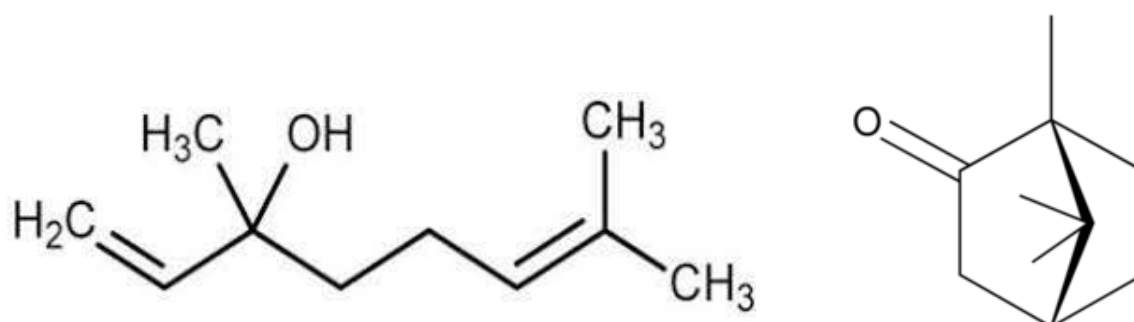


Figure 6. Structure of Linalool and D-camphor respectively.

### As Anti-inflammatory Agent

The essential oil of Cinnamon has been known in Ayurvedic medicine for the treatment of aching joints and numb pain. The Cinnamon essential oil was reported for their activity towards chronic inflammation and fibrosis. The essential oil from the bark of *Cinnamomum zeylancium* was evaluated on 17 protein biomarkers and tested for inflammation and tissue remodelling. The EO from *C. zeylancium* exhibited strong anti-proliferative activity on skin cells and restricted the production of several inflammatory biomarkers including vascular and intercellular adhesion molecule-1, monocyte chemoattractant protein-1, interferon-inducible T-cell  $\alpha$ -chemoattractant, interferon  $\gamma$ -induced protein 10 and monokine induced by  $\gamma$ -interferon. The bark EO was also investigated for global gene expression and altered signalling pathways which was very useful in cancer biology, tissue remodelling and inflammation studies (Han et al., 2017). Various non-steroidal anti-inflammatory drugs (NSAIDs) are used for the inflammation and musculoskeletal disorders but they produced various types of serious gastrointestinal toxicity as they form stomach ulcer and gastro-bleeding. Some NSAIDs also cause heart failure, increased blood pressure and occurrence of thrombosis and myocardial infarction. The anti-inflammatory activity of two species of Cinnamon i.e. *Cinnamomum zeylancium* and *C. cassia* were reported. The two compound E-cinnamaldehyde and o-methoxy cinnamaldehyde were found in DCM extract in both the species at the highest concentration of 31 and 34mg-1 of cinnamon and found the most potent towards anti-inflammatory activity in RAW 264.7 and J774A.1 macrophages. The cinnamon and its component can be used in the treatment of amelioration of age-related inflammatory condition (Gunawardena et al., 2015). The extract from the bark of *Cinnamomum verum* are known for their anti-inflammatory effect from thousands of years. The identification of active compounds and their combinations influence the TLR2 and TLR4 signalling pathways. The component trans-cinnamaldehyde with p-cymene, cinnamyl alcohol, Eugenol, benzylbenzoate was responsible for synergistic anti-inflammatory effect. The phosphorylation experiments showed that the cinnamon extract inhibit the pro-inflammatory signal transduction of early TLR2 and TLR4 signalling event and 4-hydroxycinnamaldehyde-galactosamine was responsible to inhibit the phosphorylation of Akt in different stimulated cell system (Schink et al., 2018).



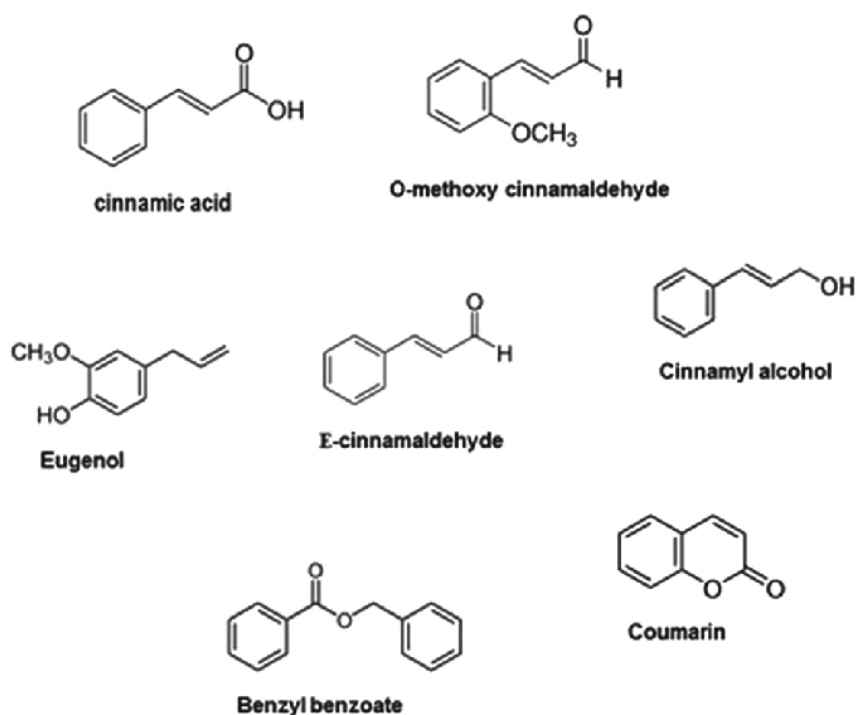


Figure 7. Structures of the identified cinnamom compounds. A total of seven compounds were identified in cinnamom by GC-MS and UPLC-MS analysis, including E-cinnamaldehyde, o-methoxycinnamaldehyde, cinnamyl alcohol, benzyl benzoate, eugenol, coumarin and E-cinnamic acid (Schink et al., 2018).

### As Analgesic Agent

Pain relief drugs are known as analgesics. Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. Analgesics only provides temporary relief pain, but do not affect the specific cause. The ethanolic extract of bark and fruit was reported to have significant analgesic activity. (Tharnizhselvarn et al., 2012) reported the analgesic and antipyretic activity of methanolic extract of *Cinnamomum tamala* in experimental animal model. The time course of anticonception shown by *C. tamala* extract was reported. Oral administration of *C. tamala* extract exhibit significant ( $p < 0.05$ ) analgesic activity. Acetic acid induced writhing assay exhibited the decreased number of stretching episodes in the extract treated groups. The analgesic activity of plant extract was investigated for central (narcotic) and peripheral (non-narcotic) activity. *C. tamala* extract suppress the formation of pain substance in the peripheral tissues and ultimately showed analgesic activity. *Cinnamomum verum* leaf galls were evaluated for their analgesic activity. Gall is an abnormal swelling of plant tissue caused by micro-organism or by external injury. These galls are produced in *Cinnamomum* by the *Trizo* and *Eriophyes boisi* and contain various bioactive compounds. This study explore the analgesic activity of aqueous and ethanol extracts of *C. verum* leaf galls by *invivo* and *invitro* methods. The results from tail immersion test and acetic acid induced writhing test in ethanol extract of plant leaf galls were compared to aqueous extract at a dose of 600 mg/kg. All values were found to be significant at  $p < 0.05$  at 30 minutes and 40 minutes when compared

to control. Ethanol extract showed 44.57% inhibition in abdominal stretching than aqueous extract which brought about 37.61% at a dose of 600mg/kg. It is concluded from the study that the presence of high amount of potential biological compounds responsible to high analgesic activity (Pandey et al., 2015). The effects of the bark extract of *Cinnamomum zeylanicum* on nociception and anxiety like behaviour in mice was reported by (Jain et. al., 2019). The extract was administered at the doses of 100, 200 and 400 mg/kg per orally. Antinociceptive activity was investigated by three animal model viz. tail flick, hot plate and formalin test. Results have shown that the administration of *C. zeylanicum* bark extract showed significant analgesic activity at doses of 200 and 400mg/kg when compared to the control group. Plant extract produced inhibitory effect on both heat and chemical induced pain which predict that the plant showed its antinociceptive effect through both peripheral and central action through the regulation of serotonin and  $\gamma$ -aminobutyric acid (GABA) pathways.

### As Antimicrobial Agent

Two important bioactive phytochemical such as cinnamaldehyde and eugenol were responsible for the antibacterial property of Cinnamon. The wide use of *Cinnamomum* in food products and cosmetics are to avoid the bacterial degradation and reduces the chance of infection (Atki et al., 2019). The antibacterial activity of *C. cassia* essential oil and in combination with some antibiotic against three multi drug-resistant bacteria viz. *E. coli*, *S. aureus* and *P. aeruginosa* were investigated. A synergistic interaction was resulted against *S. aureus* with the combination of ampicillin or chloramphenicol and essential oil of cinnamon. The cinnamon essential oil with combination of chloramphenicol was displayed against *E. coli*. These combination of antibiotics and Cinnamon EO proved to be an alternative therapeutic tool which minimize the doses of drugs and possible adverse effects and reduces the cost of treatment also. The antimicrobial activity of *Cinnamomum* is govern by its chemical composition. Cinnamaldehyde is an electronegative molecule that interfere with the cellular biological process contain nitrogen for e.g. protein and nucleic acid. *Cinnamomum* EO kills the bacteria via antiquorum sensing effect reduces cell division, ATPase, biofilm formation membrane porin and mobility, altering the lipid profile (Vasconcelos et al., 2018). The plant essential oil inhibit the growth of microbes by acting cell membrane producing lumps and auto-aggregation (Clemente et al., 2016). Above properties help in the reduction of bacterial susceptibility to antibiotics and minimize the dose of antibiotics used for treatment. This combination method decreases the toxic side effects of the drugs (Fadli et al., 2012). The antimicrobial activity of *C. zeylanicum* essential oil against *Paenibacillus larvae* was investigated (Gende et al., 2008). The *invitro* techniques i.e. tube dilution method and bioautography were used to find the bioactivity of plant EO against *P. larvae*. The antibacterial effects against *P. larvae* due to the cinnamaldehyde and eugenol. MIC and MBC of *C. zeylanicum* EO were found between 25-100  $\mu\text{g/ml}$  and 120-250  $\mu\text{g/ml}$  respectively. *Cinnamomum cassia* and *C. verum* Blume herb was reported for their antimicrobial activities (Ooi et al., 2006). The EO of *C. cassia* were effective in inhibiting the growth of both gram (+) bacteria (*S. aureus*) and gram (-) bacteria and fungi including yeasts filamentous models and dermatophytes. The MIC for bacteria ranged from 75  $\mu\text{g/ml}$  to 600  $\mu\text{g/ml}$ , for yeast 100  $\mu\text{g/ml}$  to 450  $\mu\text{g/ml}$ , for filamentous fungi 75  $\mu\text{g/ml}$  to 150  $\mu\text{g/ml}$  and for dermatophytes from

18.8  $\mu\text{g/ml}$  to 37.5  $\mu\text{g/ml}$ . The results have proved that *C. cassia* oil acts as broad-spectrum antibiotics drugs.

### As Anticancer agent

The Cinnamon extract offers the development of complementary and alternative medicines for curing the illness of diverse cancers. It contains the antineoplastic potential in the treatment of cancer. The anticancer activity of Cinnamon inhibits the proliferation of several human cancer cell lines including leukemia, ovarian, breast and lung tumor cells. Cinnamon is also known for altering liver enzymes and thinning the blood and changing kidney function. (Thompson et al., 2019) reported the anti-cancer properties of Cinnamon oil and its active components. The active constituent (trans-cinnamaldehyde) present in cinnamon oil showed anticancer activity in *in vitro* models of breast cancer showing different tumorigenic and metastatic potential. The trans-cinnamaldehyde showed a dose-response relationship in suppressing cancer cell and migration in a breast cancer representing various tumorigenic and metastatic potential. The molecular mechanism of action of cinnamon and its components on oncogenic regulators and related pathways were described (Dutta et al., 2018). The following figure represents the chemical structures of the various major active components present in Cinnamon.

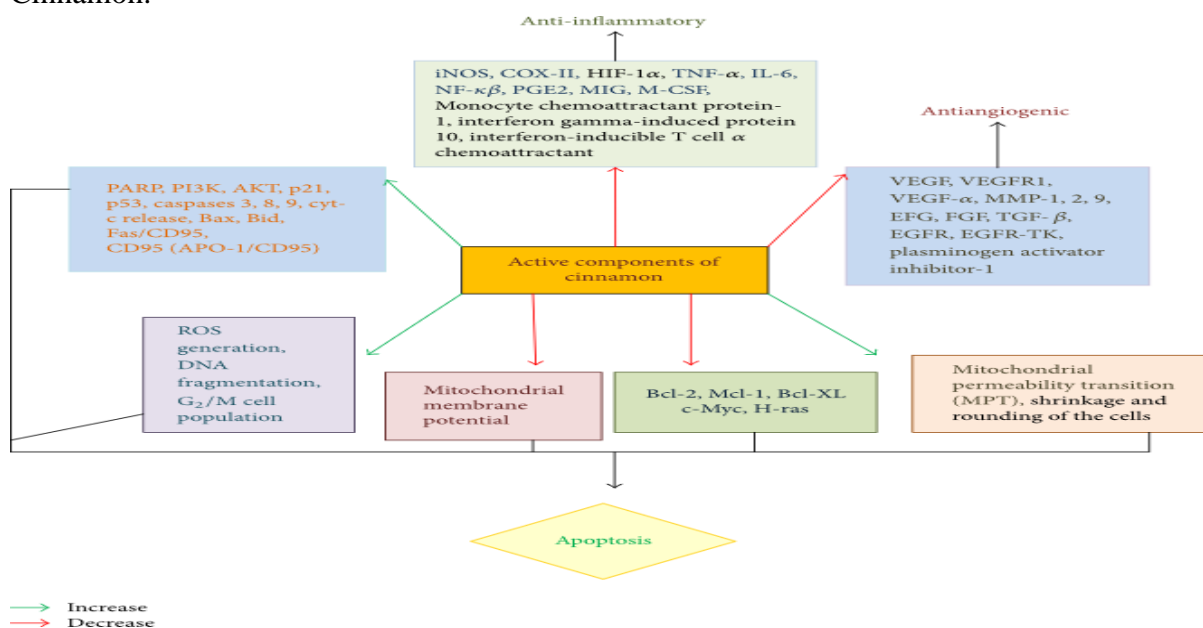


Figure 8. Action of active components of cinnamon on cancer cell growth and differentiation/apoptosis, necrosis, and senescence (Sources: Dutta et al., 2018).

Cervical cancer cell line also exhibits anti-proliferative action of different concentrations of Cinnamon extract (10, 20, 40, 80  $\mu\text{g/ml}$ ) for a time duration of 24, 48, 72 h (Hussain et al., 2016) at 10  $\mu\text{g/ml}$  to 1mM of eugenol for 24 hours decreased the proliferation rate of HeLa cells. Cytotoxic effects of eugenol present in Cinnamon also reported against colon cancer cells HCT-15 and HT-29 (Jaganathan et al., 2011) Eugenol in combination with 2-methoxyestradiol showed cytotoxicity against androgen-independent PC-3 cell lines. Liver cancer cell line HePG2 also affected by cinnamaldehyde present in the Cinnamon and showed 71% of cell proliferation (Ghosh et al. 2009). Cinnamon also exhibits synergistic anti-

cancer properties with popular anti-cancer drugs like doxorubicin and act as co-chemotherapeutic agent.

### Conclusion

Cinnamon contain vital oils and various chemical constituents such as cinnamaldehyde, eugenol, benzyl benzoate, Cinnamyl alcohol, Cinnamic acid, cinnates etc. which are active agents for the treatment of various diseases such as cancer, diabetes, inflammation, microbial diseases etc. and an important part of immunity booster which is the demand of current scenario (*COVID-19 Pandemic*). The use of plants to cure as old as human civilization. Within last century, people disregard the presence or importance of plants and cannot be bothered to grow the plants for medicinal or culinary purposes. Presently, in the time of corona, more and more people are rekindling their connection to nature. Now everyone is seeking the pure and unadulterated benefits that plants offers us. This is the time to start the journey ahead which offer new potential beyond anything that known thus far and come back more and more to the natural healing abilities of plants.

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