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A LITERARY REVIEW ON MEDICINAL PROPERTIES OF ALKALOIDS, PHENOLS, AND STEROIDS OF *CINNAMOMUM ZEYLANICUM*

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ABSTRACT

Cinnamon (*Cinnamomum zeylanicum*) is used as a medicinal remedy because of its nutritional properties. Cinnamon has enough quantity of micro and macronutrient and additionally fatty acids, carbohydrates, amino acids, etc. Phytochemicals which include secondary metabolites, increase their medicinal value. Quantitative and qualitative content material is recognized via different tools like IR Spectroscopy (Infrared spectroscopy), GLC (gas-liquid chromatography), MS (Mass spectrometry), and HPLC (High-pressure liquid chromatography). Scientists and researchers used to detect techniques for the identification of different concentrations of phytochemicals. Phenols, alkaloids, tannins, steroids, flavonoids, saponins, carbohydrates, proteins, terpenoids, coumarins, and some vitamins are found in cinnamon oil, an extract of cinnamon that has excessive medicinal value. These phytochemicals reduce inflammation and microbial activity and also increase antioxidant effects. These phytochemicals contain anticancer, anti-mutagenic, and antidiabetic compounds. Additionally, the preservative compound also detects bacteria and pathogens.

Keywords: *Cinnamomum zeylanicum*, phytochemicals, secondary metabolites, anti-microbial, phenols, vitamins

INTRODUCTION

Condiments have so prolonged history which travelled throughout the world. Spices are not only important for their curative properties but also considerable in politics and trade. Spices and condiments were used as a remedy from the historic era. In Ancient Egypt, it turned into used as a mummification factor, and cinnamon oil was used as perfumes occupied by royals only [1]. Some civilizations viewed cinnamon as an aphrodisiac. Cinnamon is capable of energizing both body and soul. The name "*Cinnamomum zeylanicum*" comes from the Greek word "kinnaon" or "kinnaomum," which denotes sweet wood. It is also derived from the Hebraic and Arabic word "amomon," which refers to a plant that produces pleasant-smelling spices [2]. India is distinguished for its spices and condiments all over the world, not for only their aroma and taste, but also their medicinal value. Cinnamon is applied directly to the skin, administered orally and even inhaled for diseases such as tuberculosis. It is used in combination with different herbs because of its healing agent. *Cinnamomum zeylanicum* is habitually noted as Cinnamon or true cinnamon and Ceylon cinnamon. *Cinnamomum zeylanicum* is approximately 10-15 m tall, a tropical, and evergreen tree, much famous for its bark. *Cinnamomum*

zeylanicum is pale, tan, and light in colour [Figure 1]. Aroma is lightly fragrant, sweet flavour, and less firm and its stick is the denser centre with thin layers. The north-eastern region of India cultivates cinnamon. It is one of the most significant spices due to its rare essence and aromatic essential oil. *Cinnamomum zeylanicum* is related to the family Lauraceae because the presence of phenol, alkaloid, flavonoid, and steroids boosts its medicinal value. Cinnamon contain different type of organic compound. *Cinnamomum zeylanicum* consists of essential aromatic oils of cinnamic acid, cinnamaldehyde, and cinnamate. Iron, manganese, calcium, and dietary fibre in cinnamon are all recognised to be present in adequate amounts. Additionally, there are sodium, sugar, carbohydrates, fatty acids, and amino acids. Cinnamon is always considered a cure for the common disorder. Diarrhoea, influenza, cough, dyspepsia, flatulence, palpitation, infection control, and blood sugar reduction in diabetics mediated by cinnamon. Sufficient properties of anti-cancer, antimycotic, anti-clotting, anti-inflammatory, insecticidal, antibacterial, antipyretic, analgesic, and antioxidant properties are present in phytochemicals in cinnamon [3]. The bark accommodates cinnamaldehyde

which has vasodilator, hypoglycaemic characteristics, respiratory, digestive, and gynaecological disorders, analgesic, and antipyretic properties contain in eugenol [4-5]. The chromatographic instruments HPLC (High-pressure liquid chromatography), IR Spectroscopy (Infrared spectroscopy), GLC (gas-liquid chromatography) Datta *et al.*, (1962), Bhramaramba and Sidhu (1963), MS (Mass spectrometry) and TLC (Thin layer chromatography) extracted the exact value of phytochemicals present in the volatile oil [7-8]. Ross in 1976 evaluate the cinnamon bark and leaf aromatic oils for eugenol and cinnamic aldehyde using the chromatography technique of HPLC. Commercially, cinnamon oils are checked through HPLC for quality control [9]. Infrared spectroscopy (IR) is

normally treated as a tool that is complementary to GLC, TLC, and CC in quality assessment. For the usual research of essential aromatic oils, Carrol and Price (1964) employed IR [10]. After standardising the procedure, Wijesekera and Fonseka (1974) demonstrated the application of IR as a technique to establish the potency of Sri Lankan cinnamon oils by quantitatively rapidly assessing their key ingredients [11]. Leaf oil contains the chemicals eugenol, acetyl eugenol, cinnamyl acetate, cinnamic aldehyde, and benzyl benzoate. The oils of the stem bark and camphor contain cinnamyl acetate, eugenol, and cinnamic aldehyde, while the oils of the root bark contain 1,8-cineol and cinnamic aldehyde.

Classification	
Domain	Eukarya
Kingdom	Plantae
Subkingdom	Viridiplantae
Infrakingdom	Streptophyta
Super division	Embryophyta
Division	Tracheophyta
Subdivision	Spermatophytina
Phylum	Magnoliophyta
Class	Magnoliopsida
Superorder	Magnoliales
Order	Laurales
Family	Lauraceae
Genus	Cinnamomum
Species	<i>Cinnamomum zeylanicum</i>

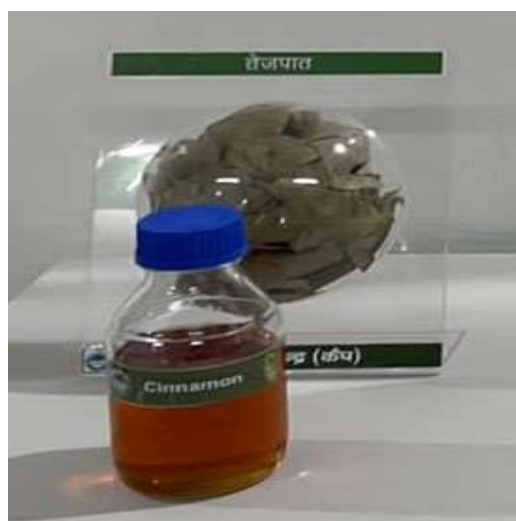


Figure 1: Cinnamon leaves and oil

MORPHOLOGICAL DESCRIPTION

Cinnamomum zeylanicum commonly known as cinnamon (Dalchini in Hindi), exists in the Lauraceae family. *Cinnamomum zeylanicum* origins from Sri Lanka and India as well as the further zone of Indochina and Madagascar. Cinnamon grows in Sumatra, Malabar, Eastern Islands, Mauritius, Brazil, Jamaica, and other countries too. Cinnamon is cultivated as shrubs, averagely sized, and an evergreen tree. Cinnamon sticks, scrapped peel, quilling, chips, powder, cinnamon bark, and leaf oil are the trading products. There are more than 250 species present. Leaves are reversed sides on the same twig, alternately stiff and tough, but flexible, sweet-smelling, depilated, the pinkish when young. The *Cinnamomum zeylanicum* has a colour of tan brown. With several layers and curls inward from both edges, it is thin, soft, and paper-like in texture. Floral morphology is identical to further species. Stomata are present on the underside of the leaf, epidermal cells highly sinuous on one and the other side, glabrous except in one morphotype, venation acrodromous, areoles tetragonal to polygonal, variable in size occur in all morphotypes [2]. In *Cinnamomum zeylanicum*, leaf length is approximately 8.7 to 22.7 cm, and leaf breadth is between 3.3–8.3 cm. *Cinnamomum zeylanicum* is more expansive than cassia.

Cinnamomum zeylanicum contain 0.04% of coumarin.

Leaves

Cinnamon leaves appear red or pink in colour in juvenile condition and dark green to light brown, and the lower surface is paler in a mature state. Leaves are fragile, smooth, thin, with a papery texture, and small to medium in size. Leaf shape is acute, deep vein distribution pattern present. Alternate leaves, exotic aroma with a mild sweet taste [6]. Leaves contain cinnamaldehyde 1-5% and eugenol 70-95 % compound [12].

Bark

Main cinnamon is the dry inner bark of a semi hardwood twig. Frequently coppice of shoot under cultivation, as a result of which dense bushes are deployed. Bark is smooth, thin, light pinkish to dark brown, about 10 mm thick, with a very intense sweet cinnamon flavour and spicy aroma, burning taste, thin branching, end bud partly silky, bright or light red. Cinnamic aldehyde and camphor are both high substances in stem and root bark oil, respectively. Cinnamaldehyde 65-80% and eugenol 5-10% are the two main components of bark oil [2].

Flower

The flowers are light yellow green. Tepals are oblong-lanceolate, persistent, and the perianth is 8 mm in diameter. The tube is short and bell-

shaped. The flowering is from October to December. When the flowers open, they have a pleasant smell. The flowers display protogynous dichogamy. *Cinnamomum zeylanicum* flower contains (E)-Cinnamyl acetate 41.98%, Caryophyllene oxide 7.20% and trans-alpha-Bergamotene 7.97% [14].

Fruit

The fruit is a cylindrical berry. The fruit ripens from May to June. The fruit is up to 12.5 mm long, deep purple, and ellipsoid to oblong-ovate in shape. *Cinnamomum zeylanicum* fruit is oval and a single-seeded berry. Compound like trans-Cinnamyl acetate (42-54%) and caryophyllene (9-14%) are present in cinnamon fruit [13].

Seed

The young seeds are pink and turn deep purple at maturity. The mature seeds are non-endospermic. The adult embryo occupies the entire seed and is made up of two large cotyledons that encircle the radicle and plumule, which are the leaf primordia [2].

Root

It has a tough, deep and comprehensive root system. *Cinnamomum zeylanicum* trunk is small and plumpy, and the twigs are brown, yellow or pinkish when young. Between 0.9 to

2.8% percent oil is produced by the cinnamon root's bark [11]. Camphor (60%) is the root bark oil's primary ingredient [14].

PHYTOCHEMICAL COMPOUNDS OF CINNAMOMUM ZEYLANICUM

Phytochemicals are those compounds composed by the plant through secondary metabolism. They are present in a low concentration and act as a chemical messenger in plant cell signalling. Unsurprisingly, phytochemicals possess biological action inside the plant host and are crucial for plant growth and defence against microorganisms, predators, competitors, pathogens, and competitors. Because of the presence of phytochemicals in *Cinnamomum zeylanicum*, it has a high immune booster capacity, and it is used as a medicinal herb and for culinary purposes. It has an aromatic part and secondary metabolites admire as alkaloids, flavonoids, tannins, saponins, terpenes, steroids, resins, coumarins, carbohydrates, glycosides, phenols, carotenoids, and so forth [15]. In cinnamon, there are approximately 53 types of phytochemicals present with major components being cinnamaldehyde about 75%, eugenol about 70-85% and camphor about 56% have been reported [2].

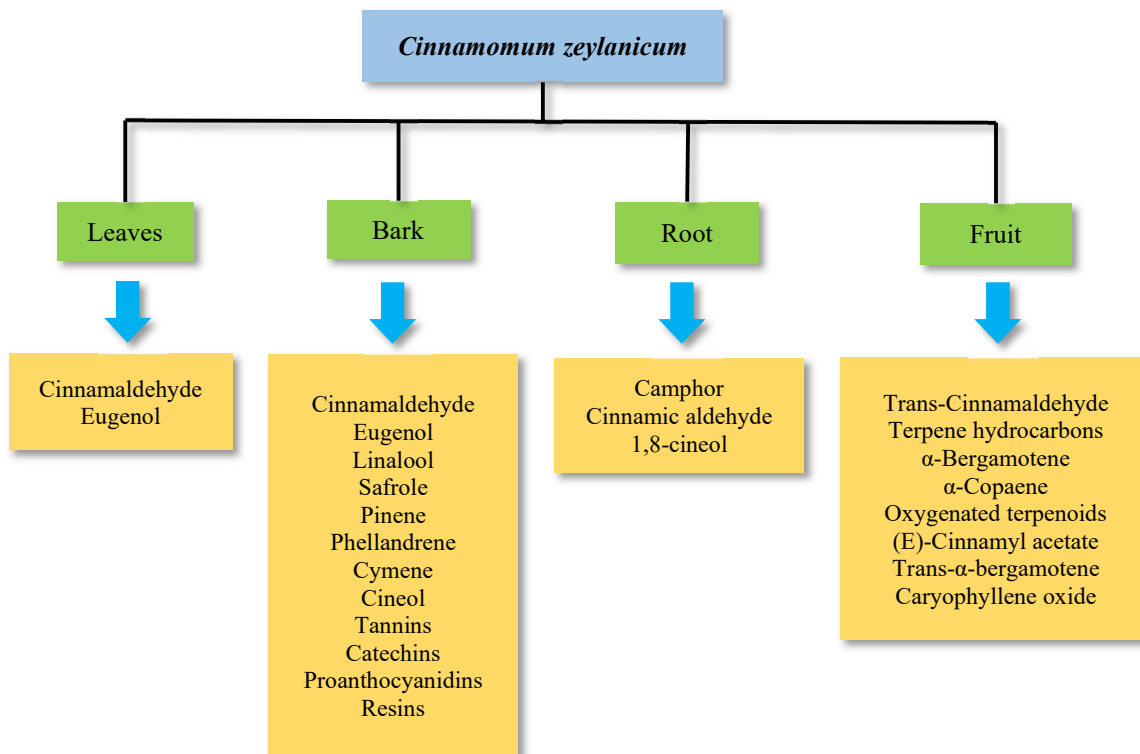


Figure 2: Different types of Phytochemical compounds are contained in parts of *Cinnamomum zeylanicum*

In addition to these compounds, leaf oil contains cinnamic aldehyde, eugenol, cinnamyl acetate, acetyl eugenol, and benzyl benzoate. In stem bark oil cinnamic aldehyde, eugenol, and cinnamyl acetate, as well as some vitamins, are also present. The root bark oil contains cinnamic aldehyde, camphor, and 1,8-cineol [Figure 2]. The presence of vitamins B1 and B2 as well as the maximum concentrations of vitamins A, E, and K are also indicated by the cinnamon extract [16]. *Cinnamomum zeylanicum* contains nutrients like phosphorus, zinc, calcium, sodium, potassium, magnesium, and iron.

MEDICINAL PROPERTIES OF *CINNAMOMUM ZEYLANICUM*

All parts, like leaves, bark, and root of cinnamon, have a significant medicinal value. The natural volatile oil of *Cinnamomum zeylanicum* has healing properties. These components have anti-inflammatory, anticancer, antioxidant, anti-mutagenic and anti-diabetic, anti-toxic, anti-ulcer, anti-tyrosinase, antibacterial, and preservative competence [2, 17, 18]. Cinnamon is an effective treatment for many ailments, including scouring, flatulent dyspepsia, cough, fever, loss of appetite, low energy, loss of taste, influenza, kidney weakness,

rheumatism, bronchitis, arthritic angina, irregular heartbeats, high blood pressure, nervous disorders, and stimulating the circulatory system [19] and capillary circulation, spasms, vomiting, atherosclerosis, arthritis, memory improvement, and as a skin antiseptic and also promote conception [Figure 3]. Cinnamaldehyde or cinnamic aldehyde is the main important component to be found in cinnamon. Cinnamon is utilised as a flavouring ingredient, perfume, and food adulterant because of its aromatic, antifungal, and antibacterial qualities. It also has the property of inhibiting bacterial growth. Cinnamaldehyde has been proven as a secure along, effective insecticide against the mosquito. Eugenol has a pleasant, spicy scent, analgesics, and antipyretic properties. *Cinnamomum zeylanicum*'s phenolic components showed that it can reduce cholesterol production, reduce lipid peroxidation, and improve hyperlipidemia. Immunomodulatory activity is shown in specific concentrations [5]. It was shown that cinnamon boosted only the non-specific serum immunoglobulin levels at low dosages

while stimulating both cellular and humoral immunity at high doses. These benefits include a drop-in blood lipid peroxide levels brought on by better hepatic antioxidant enzyme activities as well as a reduced risk of inflammatory diseases and male infertility. To prevent or delay the deterioration of foods heavy in fats and oils as well as to enhance flavour, these antioxidants have also been used as a primary component or preservative, especially in the food industry, for added health benefits. The bioactive antioxidants included in *Cinnamomum zeylanicum*, cinnamaldehyde, and eugenol work as the main bioactive antioxidant molecules because of the active functional groups present in their structures. The cinnamon extract proved successful in preventing in-vitro human tau protein aggregation [20]. Cinnamaldehyde and proanthocyanidin trimer were thought to be responsible for the action. Every plant part and oil forms antioxidant compounds. It is also used in medicine as a hyperglycaemic, antilipidemic, aflatoxigenic and antimicrobial agent.

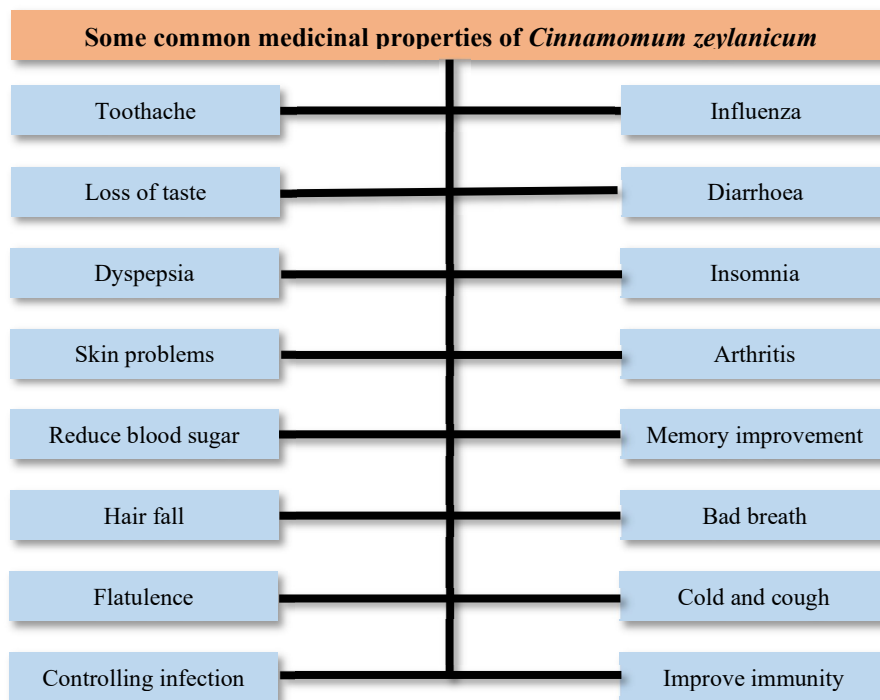


Figure 3: Some common medical properties of *Cinnamomum zeylanicum*

PHARMACOLOGICAL ACTIVITY OF *CINNAMOMUM ZEYLANICUM*

Anti-inflammatory activity

Generally, inflammation is the response of the immune system against any foreign particle in the body. Extensive research has been conducted to determine the phenolic compound in cinnamon and its anti-inflammatory properties. Due to the presence of cinnamaldehyde, the bark of *Cinnamomum zeylanicum* has anti-inflammatory properties. *Cinnamomum zeylanicum* contain a high amount of cinnamaldehyde and other component p-cymene, cinnamyl alcohol, Eugenol, and benzyl benzoate which is responsible for synergistic anti-inflammatory effect. Since it has the vasodilatory impact that

cinnamon exerts, it is a moderate diaphoretic agent [2]. According to Kirthikar and Basu (1975) and Ambasto (1986), *Cinnamomum zeylanicum* has already been associated with anti-inflammatory properties. It alleviates pulmonary inflammation [2].

Anti-oxidant activity

Comparative to other spices and condiments, *Cinnamomum zeylanicum* has the highest level of antioxidant and food preservative action [13]. It was determined that extracts of *Cinnamomum zeylanicum* are advantageous for their antioxidant potential and food prevention using the oxidative beta-carotene/linoleic acid system. Essential oil and some phytochemicals of *Cinnamomum zeylanicum* such as flavonoids illustrate the

activity of free-radical scavenging, antioxidant property, and also significant biological activities [2, 13, 21, 22].

Anti-diabetic activity

An endocrine condition known as diabetes is associated with several complications. According to Shen *et al.*, (2010), cinnamon can lower blood sugar by increasing the amount of glucose that is transported by GLUT4 in adipose and muscle tissue [23]. Cinnamon extract possesses an "insulin-potential factor" according to research [24]. Various polyphenol subtypes have been identified from cinnamon. This category of polyphenols includes rutin, catechin, quercetin, kaempferol, and isorhamnetin among others [25-26]. The insulin-like activity was found in aqueous extracts of polyphenols that Cao *et al.*, (2007) purified using high-performance liquid chromatography (HPLC) [27].

Antibacterial activity

Cinnamon has been used for preservation since the ancient era because of its healing properties. The original report by Chamberland on the antimicrobial properties of cinnamon oil against spores and anthrax bacilli was published in 1944 by Webb and Tanner [2]. At a concentration of 500 ppm essential oil *Cinnamomum zeylanicum* has been reported to inhibit several species of

Mycobacterium, *Enterobacter*, *Streptococcus*, *Enterococcus*, *Proteus*, *Listeria*, *Acinetobacter*, *Klebsiella*, *Candida*, *Clostridium* as well as *Bacillus subtilis*, *Bacillus cereus*, *Escherichia coli*, *Salmonella typhi*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa* [28]. Cinnamon has been proven to have antimicrobial properties in food. Cinnamon has been proven to have antimicrobial properties in food. *Salmonella typhimurium* cell activity can be reduced by up to 52% by adding 5% cinnamon with pasteurised skim milk that has been subjected to a pulsed electric field. Cinnamon was successful in suppressing the development of three different types of *Clostridium botulinum* at concentrations of 150-200 ppm, according to Hall and Maurer (1986) [2]. After 12 hours, the cinnamon powder had an effect against the bacterium *Yersinia enterocolitica*, which is responsible for food poisoning and gastrointestinal infections. Another significant antibacterial property of cinnamon is its ability to inhibit the growth of bacteria such as *Campylobacter jejuni*, *Helicobacter pylori*, *Escherichia coli*, *Listeria monocytogens*, *Clostridium perfringens*, *Bacteroides fragilis*, *Salmonella enteritidis*, *Bifidobacterium bifidum*, *Lactobacillus acidophilus*, *Staphylococcus aureus*, and *Propionibacterium acnes* etc [29-30].

Antifungal activity

There is a potent antifungal ingredient in cinnamon. It kills a variety of pathogenic fungi as a fungicide. All *Aspergillus* fungi were prevented from growing and producing aflatoxins by cinnamon bark or oil. It acts as a stabilizer in fruit juice and other fruit products throughout a wide pH range. According to Tiwari *et al.*, (1994), cinnamon oil significantly suppressed the mycelial development of *Rhizopus arrhizus*, *Alternaria species*, *Aspergillus species*, *Penicillium species*, *Cladosporium species*, *Trichoderma species*, *Fusarium species*, *Mucor species*, *Bipolaris oryzae*, *Curvularia species*, *Phoma species*, *Chaetomium hispanicum*, and *Thelavia terricola*. *Aspergillus flavus*, *Aspergillus niger*, *Aspergillus candidus*, *Aspergillus fumigatus*, and *Rhizopus nigricans* in poultry feed starter mash were the predominant fungi responsible for the contamination [2]. It was cleaned with cinnamon oil between 0.1% and 0.2% w/v, kept for 30 days, and then treated again to remove contamination. *Fusarium moniliforme* is a post-harvest fungal infection that affects cereal crops [2]. Barua *et al.* (1996) tested the antifungal effect against this pathogen and discovered that it fully inhibits fungal growth.

Insecticidal activity

Plant-based extracts of cinnamon are used to prevent the spread of pests and dangerous infestations. In terms of toxicity, repulsiveness, growth inhibition, and ovicidal action, Garcia (1990) investigated extracts of cinnamon and cinnamon oil against the bean weevil, *Callosobruchus chinensis*. Alcoholic and petroleum extracts both indicated concentration-dependent repulsive reactivity. Honeybee diseases could be treated using cinnamon oil. In a study conducted in 1994 by Calderon *et al.*, the oil inhibited the growth of *Ascosphaera apis* for 168 hours and both *Bacillus laevis* and *Bacillus alvei* for 72 hours at a concentration of 10 ppm. A minimum bactericide concentration of 50 mg/kg and a minimum sporicide concentration of 100 mg/kg were found in the oil during nutritional broth testing. Huang and Ho (1998) investigated the antifeedant activities of cinnamaldehyde towards *Sitophilus zeamais* and *Tribolium castaneum*, grain storage insects [2].

CONCLUSION

From the ancient era to the modern age, medicinal herb maintains their importance in human life. Medicinal plants have a richness of alkaloids, steroids, and phenolic components and that's why they are important for human health, beverages, pharmaceutical, cosmeceutical, and drug development. In

order to treat metabolic chronic disease, Cinnamon (*Cinnamomum zeylanicum*) is an appropriate source of phytochemicals, vitamins, and volatile oil. Cinnamaldehyde, often known as cinnamic aldehyde, is the most significant substance present in cinnamon. The effects of phytochemicals on human bodies are minimal or non-existent. *Cinnamomum zeylanicum* may be used as a source of chemicals for clinical trials to further evaluate their ability to inhibit particular diseases.

CONFLICT OF INTERESTS

The authors affirm that there are no competing interests with this article.

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