Pharmacological Prospective and Health Benefits of Clandestine 'True' Cinnamon (*Cinnamomum zeylanicum* Nees): A Systematic Review

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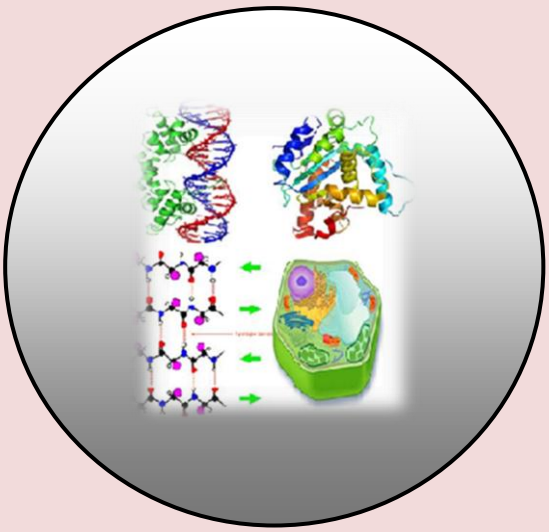

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REVIEW ARTICLE

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Pharmacological Prospective and Health Benefits of Clandestine 'True' Cinnamon (*Cinnamomum zeylanicum* Nees.): A Systematic Review

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ABSTRACT

A wide range of essential oils, such as* trans-*cinnamaldehyde, cinnamyl acetate, eugenol, L-borneol, caryophyllene oxide, b-caryophyllene, L-bornyl acetate, E-nerolidol,* α-*cubebene,* α-*terpineol, terpinolene, and* α-*thujene, occur in cinnamon. In addition to being an antioxidant, anti-inflammatory, antidiabetic, antimicrobial, anticancer, lipid-lowering, and cardiovascular-disease-lowering compound, cinnamon has also been reported to have activities against neurological disorders, such as Parkinson's and Alzheimer's diseases. From the beginning of its use for various purposes such as anointment, embalming and various ailments, it has instigated the interest of many researchers. This systematic review underlines the superfluous health benefits of this surreptitious ingredient and the scope of further research in these clinical scenarios.

Keywords: Anti-inflammatory, Antidiabetic, Antimicrobial, Anticancer, Cinnamaldehyde and Cinnamic acid.

INTRODUCTION

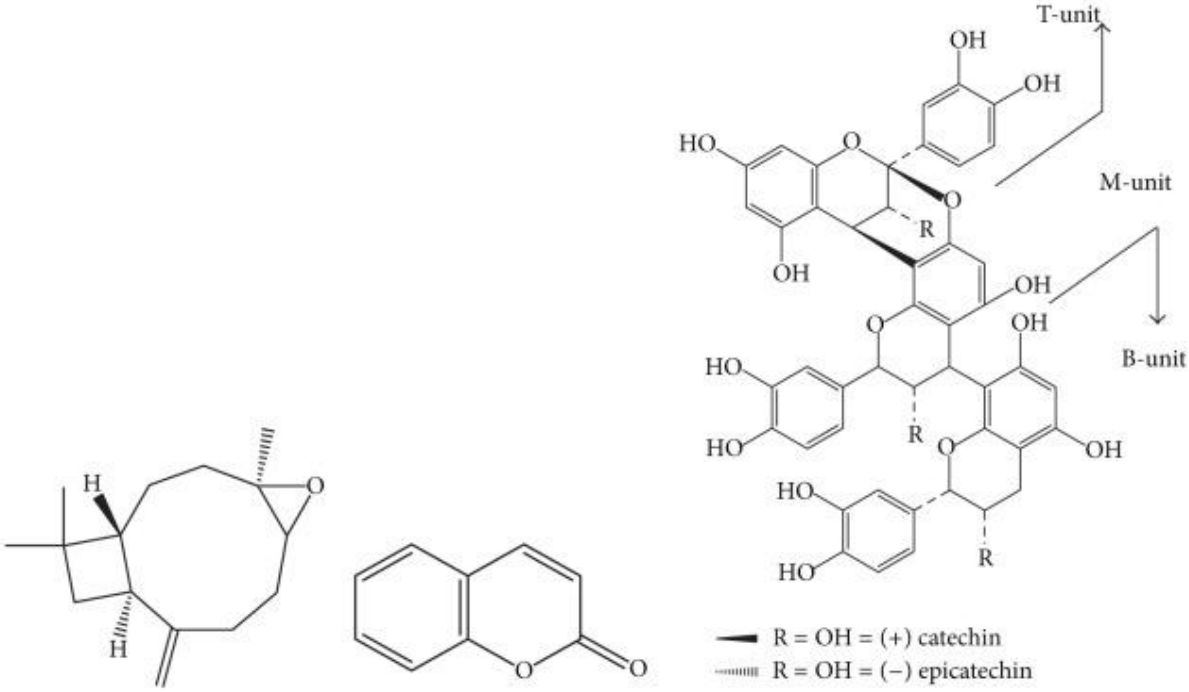
Cinnamon (*Cinnamomum zeylanicum*, *and Cinnamon cassia*), the eternal tree (Fig. 1)of tropical medicine, belongs to the Lauraceae family. Cinnamon is one of the most important spices used daily by people all over the world. Cinnamon has been used as a spice in daily life without any side effects. Cinnamon an indigenous spice is found in almost every household.

Used mainly as a flavoring agent, it has been a major constituent of our food since a long time. For a long time, it has been used as a remedy for respiratory and digestive ailments. Several reports have dealt with the numerous properties of cinnamon in the forms of bark, essential oils, bark powder, phenolic compounds, flavonoids, and isolated components (Abdo-ElBaky et al., 2013, Jayaprakashaet al., 2002, Jayaprakasha and Rao, 2002). Each of these properties plays a key role in the advancement of human health. The antioxidant (antioxidant compounds present in foodstuffs play a vital role in human life, acting as health-protecting agents. In addition to this role, antioxidants are one of the key additives used in fats and oils. Even in the food processing industry, antioxidants have been used to delay or prevent food spoilage (Jayaprakasha et al., 2003, Baratta et al., 1998, Ranasinghe et al., 2013). Spices and medicinal plants have received rapid consideration as sources of beneficial antioxidants against various diseases. Antioxidants have been considered the most important drivers in the progress and existence of humans, as they respond to free radicals and damage in metabolic diseases and age-related syndromes of humans and other animals and antimicrobial activities may occur through the direct action on oxidants or microbes, whereas the anti-inflammatory, anticancer, and antidiabetic activities occur indirectly via receptor-mediated mechanisms (Elumalai et al., 2010, Shrishrimal et al., 2016, Mollazadeh and Hosseinzadeh, 2016, Rao and Gan, 2014, Sangal, 2011).

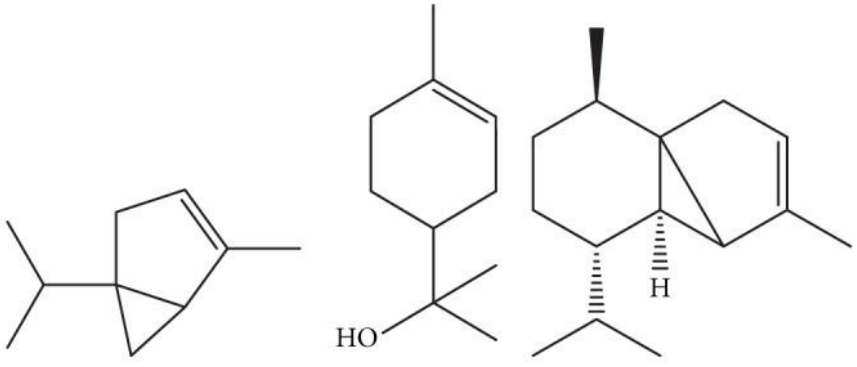
Figure 1. Cinnamon Tree.

Figure 2. *Cinnamomum zeylanicum*, Ceylon cinnamon, or true cinnamon.

Figure 3 and 4. *Cinnamomum cassia* (also known as Cassia cinnamon or Chinese cinnamon).



(a) Caryophyllene oxide (b) Coumarin (c) Procyanidin type-A polymer



(a) α-Thujene (b) α-Terpineol (c) α-Cubebene

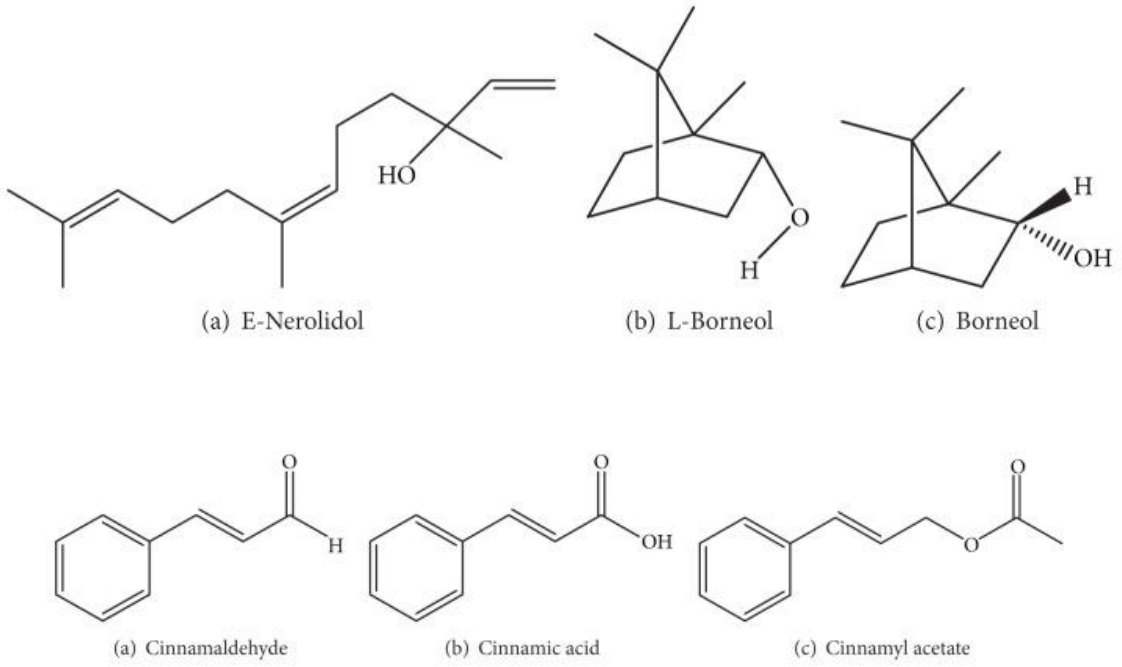


Figure 5. Structures of Chemical Constituents.

Cinnamon (genus *Cinnamomum*, family Lauraceae) is one such spice that is rich in structurally diverse phytochemically active compounds with antioxidant properties. *Cinnamomum verum* (also known as *Cinnamomum zeylanicum*, Ceylon cinnamon, or true cinnamon)-Fig.1, and *Cinnamomum cassia* (also known as Cassia cinnamon or Chinese cinnamon)-Fig. 2 & 3, are the most popular species in the world. These plants are economically important due to their broad uses in the food and pharmaceutical industries. Nevertheless, the genus *Cinnamomum* actually consists of approximately 250 species with distinctive genotype and phenotype. Currently, the compositional and functional properties of most of the species are still not well studied (Jakhetia et al., 2010).

Phytochemical Constituents

Cinnamon has been reported to have significant benefits for human health, particularly as an anti-inflammatory, antitumor, anticancer, antidiabetic, and anti-hypertriglyceridemia agent, mainly due to its phytochemical constituents such as phenolic and volatile compounds (Mathew and Abraham, 2006).

According to the U.S. Department of Agriculture, a teaspoon of ground cinnamon weighing 2.6 g contains: Energy: 6.42 calories; carbohydrates: 2.1 g; calcium: 26.1 milligrams (mg); iron: 0.21 mg; magnesium: 1.56 mg; phosphorus: 1.66 mg; potassium: 11.2 mg; vitamin A: 0.39 micrograms. It also contains traces of vitamins B and K and the antioxidants choline, beta-carotene, alpha-carotene, beta-cryptoxanthin, lycopene, lutein, and zeaxanthin. There are two main types of cinnamon: Ceylon cinnamon (*Cinnamomum verum*) and cassia, or Chinese, cinnamon (*Cinnamomum aromaticum*).

Ceylon cinnamon comes from Sri Lanka. Some people call it “true cinnamon.” Cassia cinnamon, on the other hand, originates from southern China. Cassia is cheaper than Ceylon cinnamon (Subash Babu et al., 2007, Aneja et al., 2009, Gupta et al., 2011, Senanayake et al., 1978, Singh et al., 2007, Lin et al., 2003, Jayaprakasha and Rao, 2011, Geng et al., 2011).

The most important constituents of cinnamon are cinnamaldehyde and *trans*-cinnamaldehyde (Cin), which are present in the essential oil, thus contributing to the fragrance and to the various biological activities observed with cinnamon. A study on *Cinnamomum osmophloeum* (*C*. *osmophloeum*) indicated that the essential oil from cinnamon leaves contains a high level of Cin. Consequently, *C. osmophloeum* is also used as an alternative spice for *C. cassia*. One of the major constituents of essential oil extracted from *C. zeylanicum* named (E)-cinnamaldehyde has an antityrosinase activity, while cinnamaldehyde is the principal compound responsible for this activity (Aravind et al., 2012, Yang et al., 2012, Mascolo et al., 1987, Matu et al., 2003, Goñi et al., 2009, El-Bassossy et al., 2011, Jayaprakasha et al., 2002, Embuscado, 2015, Wang et al., 2009, Prasad et al., 2009).

Cinnamon bark contains procyanidins and catechins. The components of procyanidins include both procyanidin A-type and B-type linkages. These procyanidins extracted from cinnamon and berries also possess antioxidant activities. Cinnamon consists of a variety of resinous compounds, including cinnamaldehyde, cinnamate, cinnamic acid, and numerous essential oils. It has been reported that the spicy taste and fragrance are due to the presence of cinnamaldehyde and occur due to the absorption of oxygen. As cinnamon ages, it darkens in color, improving the resinous compounds. A wide range of essential oils, such as *trans*-cinnamaldehyde, cinnamyl acetate, eugenol, L-borneol, caryophyllene oxide, b-caryophyllene, L-bornyl acetate, E-nerolidol, *α*-cubebene, *α*-terpineol, terpinolene, and *α*-thujene, occur in cinnamon (Lv et al., 2012, Gupta, 2010, Mueller et al., 2010, Babu et al., 2007, Akilen et al., 2002).

Possible health benefits of cinnamon

Cinnamon is a spice that comes from the branches of trees of the *Cinnamomum* family. It is native to the Caribbean, South America, and Southeast Asia. People have used cinnamon since 2000 BC in Ancient Egypt, where they regarded it highly. In medieval times, doctors used it to treat conditions such as coughing, arthritis, and sore throats. It is now the second most popular spice, after black pepper, in the United States and Europe. As a spice, cinnamon is available in powder form or whole, as pieces of bark (Eckel et al., 2010, De La Torre Torres et al., 2015, Muhammad et al., 2017). People can also use cinnamon essential oil and supplements. There are two main types of cinnamon: cassia and Ceylon. The two have different nutritional profiles. Some studies have suggested that the compounds in cinnamon have antioxidant, anti-inflammatory, antidiabetic, and antimicrobial properties, and that they might offer protection from cancer and cardiovascular disease, among other conditions. However, more evidence is needed to confirm cinnamon’s benefits (Özcan and Arslan, Muhammad et el., Özcan and Arslan, 2011, Brewer, 2011, Pisoschi and Pop, 2015, Durak et al., 2014).

Cinnamon oil may help treat some types of fungal infections. A 2016 laboratory study found that cinnamon oil was effective against a type of *Candida* that affects the bloodstream. This may be due to its antimicrobial properties. If further research confirms these findings, cinnamon oil could play a role in treating this type of infection.

Animal studies have shown that cassia cinnamon may reduce blood sugar levels, according to a 2015 review. The review also noted that after 60 people with type 2 diabetes consumed up to 6 grams (g) of cinnamon per day for between 40 days and 4 months, they had lower serum glucose, triglycerides, low-density lipoprotein cholesterol, and total cholesterol. However, according to the National Center for Complementary and Integrative Health (NCCIH), a 2012 review concluded that cinnamon does not help lower levels of glucose or glycosylated hemoglobin A1c — which are long-term measures of blood glucose control — in people with type 1 or type 2 diabetes. Another small study looked at the impact of cinnamon, calcium, and zinc on blood pressure management in people with type 2 diabetes. The results did not show that this treatment had any impact (Khan et al., 2003, Rao and Gan, 2014, Ranasinghe, 2013, Gruenwald, 2010, Sharma and Rao, 2014, Jayaprakasha and Rao, 2011).

Some animal studies have suggested that cinnamon may help prevent Alzheimer's disease. According to researchers, an extract present in cinnamon bark, called CEppt, contains properties that may prevent symptoms from developing. If further research confirms its effectiveness, this extract — but not necessarily whole cinnamon — may be useful in developing therapies for Alzheimer's. In 2000, a study of extracts of Indian medicinal plants found that cinnamon may help protect against HIV. Scientists tested 69 extracts in a laboratory. *Cinnamomum cassia*, or cinnamon bark, and *Cardiospermum helicacabum*, which is the cinnamon shoot and fruit, were most effective in reducing HIV activity. In a 2016 laboratory study, scientists found that an extract from cinnamon showed anti-HIV activity. This does not mean that foods containing cinnamon can treat or prevent HIV, but cinnamon extracts could one day become a part of HIV therapy (Sharma and Rao, 2014).

Experts have tested cinnamon for activity against multiple sclerosis (MS). In one study, researchers gave mice a mixture of cinnamon powder and water and ran some tests. It appeared that cinnamon could have an anti-inflammatory effect on the central nervous system, including parts of the brain. Studies have also suggested that cinnamon may protect regulatory T cells, or "Tregs," which regulate immune responses. People with MS appear to have lower levels of Tregs than people without the condition. In mouse studies, cinnamon treatment has prevented the loss of certain proteins specific to Tregs. Scientists have also found that cinnamon treatment restored myelin levels in mice with MS. MS occurs when the myelin coating on nerve cells becomes damaged. The NCCIH are supporting more research into how cinnamon may help treat MS (Jayaprakasha and Rao, 2011).

Research from 2015 says that scientists have found a way to package antimicrobial compounds from peppermint and cinnamon into tiny capsules that can both kill bacterial biofilms and actively promote healing. In this way, peppermint and cinnamon could become part of a medicine for treating infected wounds. Various compounds in cinnamon may benefit the cardiovascular system.

The authors of one article note that cinnamaldehydes may have antitumor and anticancer properties. Some people use cinnamon supplements to treat digestive issues, diabetes, loss of appetite, and other conditions. It also plays a role in traditional medicine for treating bronchitis. However, according to the NCCIH, "Studies done in people don't support using cinnamon for any health condition (Bandara, 2012, Viuda-Martos et al., 2010).

Cinnamon can also improve the health of the colon, thereby reducing the risk of colon cancer. Cinnamon is a coagulant and prevents bleeding.

Cinnamon also increases the blood circulation in the uterus and advances tissue regeneration. This plant plays a vital role as a spice, but its essential oils and other constituents also have important activities, including antimicrobial, antifungal, antioxidant, and antidiabetic. Cinnamon has been used as anti-inflammatory, antitermitic, nematicidal, mosquito larvicidal, insecticidal, antimycoticand anticancer agent. Cinnamon has also been traditionally used as tooth powder and to treat toothaches, dental problems, oral microbiota, and bad breath (Pragadheesh et al., 2013, Abdelwahab et al., 2013, Vallverdú-Queralt, 2014).

Culinary Uses

Cinnamon, due to its exotic flavor and aroma, is a key ingredient in the kitchen of every household. Cinnamon is the bark of a tree. People can put small pieces of bark in stews, desserts, and other dishes, or they can use ground cinnamon, for example, in cakes or on buns. Cinnamon is mainly used in the aroma and essence industries due to its fragrance, which can be incorporated into different varieties of foodstuffs, perfumes, medicinal products and preparing tea. (Fig. 5) In addition to being used as a spice and flavoring agent, cinnamon is also added to flavor chewing gums due to its mouth refreshing effects and ability to remove bad breath.

Figure 6. Cinnamon Tea.

CONCLUSION

In traditional medicine Cinnamon is considered a remedy for respiratory, digestive and gynaecological ailments. In addition to its culinary uses, in native Ayurvedic medicine Cinnamon is considered a remedy for respiratory, digestive and gynaecological ailments. Almost every part of the cinnamon tree including the bark, leaves, flowers, fruits and roots, has some medicinal or culinary use. The volatile oils obtained from the bark, leaf, and root barks vary significantly in chemical composition, which suggests that they might vary in their pharmacological effects as well.

The different parts of the plant possess the same array of hydrocarbons in varying proportions, with primary constituents such as; cinnamaldehyde (bark), eugenol (leaf) and camphor (root).

Thus cinnamon offers an array of different oils with diverse characteristics, each of which determines its' value to the different industries. For example the root which has camphor as the main constitute, has minimal commercial value unlike the leaf and bark. It is this chemical diversity that is likely to be the reason for the wide-variety of medicinal benefits observed with cinnamon.

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