Guest Articles

Phytochemicals and Importance of Cinnamon

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Ancient Sri Lanka was well known as it was situated at the centre of the Silk Road. **Ceylon cinnamon** has become one of the main exports over a long period of time. According to "Mahavamsa" or the great chronicle of Sri Lanka, the first European invaders, the Portuguese, came after the aroma of this sweet cinnamon.

Amongst the many species of cinnamon that can be found in the *Cinnamomum* genus (Family: Lauraceae); the most popular species around the world are the true/sweet cinnamon or Ceylon cinnamon (*Cinnamomum verum* or *C. zeylanicum*), Chinese cinnamon (*C. cassia* and *C. wilsonii*), Saigon or Vietnamese cinnamon (*C. loureirii*) and Java or Indonesian cinnamon (*C. burmannii*). Ceylon cinnamon is expensive and has a higher demand in the world market compared to the other species. There are nine *Cinnamomum* species found in Sri Lanka, among which *C. verum* is considered as the most important one, contributing to 70 % of the world's true cinnamon bark production. *C. verum* has been found in Matara, Kalutara, Galle, Rathnapura, Kurunegala and Hambantota districts.

Bark oil and leaf oil are the two important essential oils that are extracted from this cinnamon plant. Scientists have discovered that Ceylon cinnamon or "Canela" has a remarkable medicinal value to cure diseases such as diabetes, high cholesterol, high blood pressure *etc.* when compared to other *Cinnamomum* species.

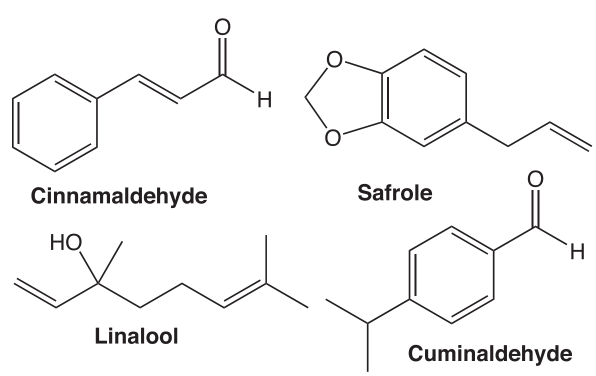
Constituents of cinnamon oil

The composition of the phytochemicals depends on part, age, growing season, demography, and the extraction method.

Cinnamon bark

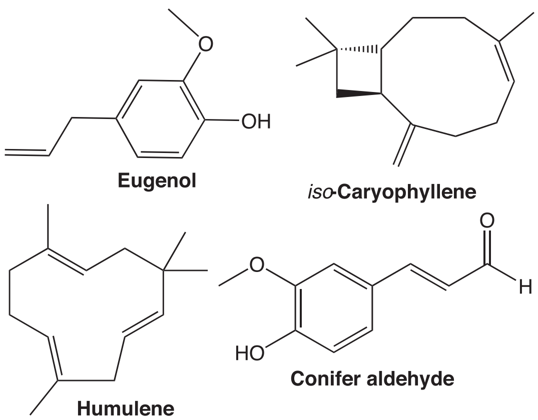
Cinnamon bark contains at least 90 volatile compounds. Cinnamaldehyde (55-76%), eugenol (5-18%) and safrole (up to 2%) are the main compounds present in the bark. Cinnamyl acetate, cinnamyl alcohol, eugenol acetate, methyl eugenol, benzaldehyde, benzyl benzoate, cumin aldehyde, linalool, and monoterpene hydrocarbons are some of the other volatiles that can be found in the essential oil extracted from cinnamon bark.

According to Sri Lanka Standards (SLS), cinnamon bark oil should contain a refractive index between 1.555-1.580 and specific gravity between 1.010-1.030. In Sri Lanka, manufacturers produce four grades of bark oils (depending on the percentage of cinnamaldehyde); superior grade contains not less than 60% m/m, special grade (55-60% m/m), average grade (45-55% m/m) and ordinary grade (30-45% m/m). However, phenol content in the oil should not exceed 18% in superior, special, and average grades.

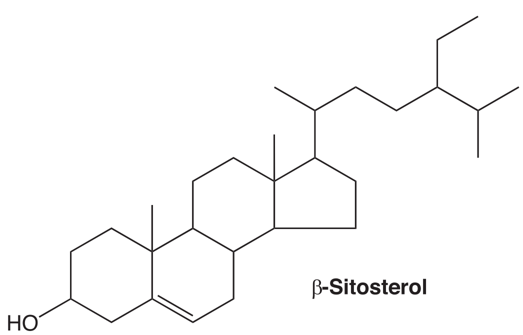


Cinnamon leaves

Eugenol (80%) and cinnamaldehyde (16%) are the two main components present in the leaf oil; eugenol acetate, benzaldehyde, benzyl benzoate, humulene, isocaryophyllene, α-ylangene, methyl cinnamate, ethyl cinnamate and conifer aldehyde are the other chemicals that can be extracted from the leaf. SLS Institute has recommended the consumption of cinnamon leaf oil which has a refractive index between 1.530-1.540 and specific gravity 1.034-1.050.

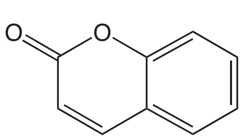


Oligopolymeric procyanidins and phenolic acids are volatiles of cinnamon essential oil, which are present in minor quantities, while coumarin, flavanol glucosides, β-sitosterol, cinnamic acid, cinncassiols and cinnzeylanol are some of the non-volatile chemical compounds that can be found in cinnamon oil.



Coumarin

Coumarin is a well-known hepatotoxic phytochemical and the optimum dose to consume is 0.1 mg/day per kg. Chinese cinnamon is composed of 3.6 g coumarin per kg of cinnamon whereas for Ceylon cinnamon, the ratio between this toxin to 1 kg of cinnamon is 0.017 g/kg.



Coumarin

Extraction methods

As mentioned previously, leaves and inner bark of the shoots are taken as the ingredients to extract essential oils using conventional methods such as steam distillation, Soxhlet distillation, and advanced methods such as supercritical fluid extraction (SFE), ultrasound-assisted extraction, microwave-assisted distillation, *etc*.

Uses of cinnamon

Cinnamon is considered as a "holy" plant in various cultural and religious societies. As an example, according to the bible, Moses had used sweet cinnamon for someone holy. In ancient Egypt, dead bodies of Royals were preserved as mummies, using true cinnamon as an embalming agent due to its antimicrobial properties. In addition, the ancestors of Egyptians had been using the aroma of cinnamon as a perfume.

Parts of this amazing plant have been used as a folk medicine for eye-inflammations, rheumatism, toothaches, loss of appetite, bronchitis, itching, urinary disease, cold, influenza, fever, and wounds.

Most Asian housewives use cinnamon bark as a spice for several reasons such as enhancing the appetite for food, increasing the pleasant appearance (due to a fragrant aroma) and for preserving food. People who live in European countries, add cinnamon powder while preparing chocolates, desserts (such as apple pie, doughnuts, cinnamon buns, *etc*.), soups, canned fruits, tea, coffee, *etc*. "Cinnamon liquor" is one of the popular beverages among western society.

Various types of cancers cause agony, misery, and severe pain for many cancer patients. Due to the inevitable side effects of radiotherapy and chemotherapy, modern scientists have attempted discovering medicines from phytochemicals. Eugenol, cinnamaldehyde and β-caryophyllene interfere with the viability of cancer cells.

Over 350 million of the world population suffers from diabetes. There are two types of diabetes: defects *in-vivo* insulin production are known as type-1 diabetes, while the dysfunction of insulin production is considered as type-2 diabetes. Patients were forced to control diabetes by taking oral drugs or insulin injections. Nowadays, people prefer to use alternative herbal medicines to control/cure diabetes. Ceylon cinnamon can lower the prandial glucose absorption in the intestine by inhibiting the enzymes involved in carbohydrate metabolism.

Saponins, tannins and phenolic compounds in cinnamon act as anti-diarrhea, anti-cancer and antioxidant agents. Cinnamon is also known to reduce unwanted mucus and low-density lipids (LDL) in the body.

Cinnamon oil is one of the well-known broad-spectrum natural anti-microbial agents. Eugenol acts against both gram-negative and positive bacteria. Therefore, cinnamon oil destroys pathogens which are present in respiratory and gastrointestinal tracts. Similarly, cinnamaldehyde destroys 17 species of micromycetes and repels disease causing vectors such as mosquitoes.

The strong aroma, non-toxicity to humans and eco-friendly nature of cinnamon oil, influence the use of it as an agricultural pesticide.

The latest trend in cinnamon oil is the use of it as a corrosion inhibitory agent for stainless steel. Researchers have found that amine (NH_2), carbonyl (CO), and aldehyde (CHO) groups can adsorb onto the metal surface and disperse as a defensive layer. There are several advantages for the use of cinnamon oil for this purpose; this is mainly due to low cost, non-toxicity, and high effectiveness.

Though cinnamon has prodigious medicinal value, there is a recommended dosage for daily consumption. If you are a healthy person you may consume 1 - 4 g per day as a solid or 0.05 - 0.2 g per day as oil. Cinnamon lowers the menstruation pain (which is known as dysmenorrhea), however it is not recommended for consumption during pregnancy and breast-feeding.

In ancient times, Sri Lanka was named "The Isle of Cinnamon", since no one could find "divine/holy" cinnamon in any other part of the world.

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Guest Articles

Natural product inspired molecular therapeutic development and micro-wave-assisted organic synthesis as a tool in drug discovery

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The translation of basic research discoveries from chemical synthesis of compound libraries, medicinal science, into therapeutic medicines is an iterative, multidisciplinary, and challenging journey. Chemical synthesis attempts the practical/scalable production of potential drug-lead compound libraries with reduced structural complexity and improved drug-likeness. Natural products have famously been used as structural platforms for small molecular drug syntheses. Structurally, the major biosynthesis of active constituents of plants are complex and nature is the best chemist. Therefore chemical-biology oriented synthetic research is a way that synergises the discovery of bioactive products in order to generate target leads towards therapeutic applications.[1] Natural products encompass a wealth of structural diversity. The last two decades have demonstrated the success of synthesis of many natural products. Whilst natural product total synthesis is always exciting and here to stay, the lengthy, time-consuming, less-energy-efficient synthetic methodologies have limited their translation and multi-scale production towards drug leads.

The knowledge translation for the generation of biologically relevant/valuable therapeutic molecules is a major challenge that synthetic chemists face. Chemical sciences are at the heart of methodological advances/ productiveness that evolve, generate useful quantities of natural and simpler structures of complex natural products. To develop a drug to target a specific disease, researchers try to understand the biological mechanism responsible for that condition. If the biochemical pathways leading up to the disease are understood, scientists attempt to design drugs that will block one or several steps of the disease's progress. Once the drug's structure is known, the drug can serve as a prototype or "lead compound" for designing more effective therapeutic agents of similar chemical structure. Lead compounds are molecules that have some biological activity with respect to the condition under investigation. However, the lead compound may not be effective in combating the disease, or it may produce undesirable side effects. To overcome that, lead optimizations are performed which