Abstract

Cinnamon is from the Lauraceae family. It is considered as important spices, flavoring agents and medicine all over the world. The primary constituents of cinnamon include vital oils and other derivatives, example cinnamaldehyde, cinnamic acid, and cinnamate. Moreover, it is an aromatic spice which is derived from the dried, peeled and rolled bark of SE Asian Tree. Cinnamon is loaded with antioxidant properties, and can be used as an antidiabetic, antimicrobial, antibacterial, anticancer, liquid lowering, and cardiovascular-disease-lowering compound. It is such spices which can reduce the risk of heart disease to a great extent. It is an expensive spice due to its many useful properties and its increasing demand. This review provides summary of the applications of cinnamon and about cassia which is used as a substitute of cinnamon by many shopkeepers due to its cheap price. Also, this review provides the difference between cassia and cinnamon. Cassia is actually an adulterated product.

Keywords: -Cinnamon, spice, cassia, medicine, flavoring agent, adulterated, bark

Introduction

A common spice cinnamon, which is used worldwide, is well known for its flavoring and medicinal properties. It is obtained from the bark of tropical evergreen trees of the genus *Cinnomomum*. The term “cinnamon” is also used to describe the colour it possess, ‘dark-brown’. The aromatic spice belongs to the Lauraceae family which also contains about 250 different species of plants known at present. There are only few species of cinnamon which are commercially cultivated throughout the world. *Cinnmomomum verum*, known as the ‘true cinnamon tree’ or ‘Ceylon cinnamon tree’, is native to Sri Lanka. It is a small evergreen tree which is categorized under family Lauraceae and the cinnamon from this species is considered as superior to others. The tree grows up to a height of 7m but under cultivation the plant is grown as a bush just up to a height of 3m or even less. The bark of the tree has delicate scent with aromatic taste. Cinnamon is produced when the bark of the tree is harvested, dried and fermented, then its outer layer is removed. Cinnamon is harvested in spring season. When the outer bark gets dried, the inner bark curls into thin strips, or quills. It is used as a food flavoring agent, medicine, preservative, cosmetics etc. all over the world. It is considered as one of the most important and expensive spice used in the early times, as also mentioned in the Holy Bible. The tree from which cinnamon spice is obtained is called *Cinnamomum zeylanicum*. Cassia and cinnamon both are derived from the bark of a tree of the Lauraceae family and is also harvested in the similar way as the cinnamon is harvested. But cassia has more strong flavors compared to cinnamon.
Cinnamon is intensively cultivated in Sri Lanka. The major producer of cinnamon is Indonesia, China, Sri Lanka, Vietnam and India. In India it is produced in the southern areas - Kerala, Tamil Nadu and Karnataka. The main products from cinnamon tree are bark oil, leaf oil and bark oleoresin. Among all the 250 species of cinnamomum, one of the important species includes *Cinnamomum cassia* also known as Chinese cinnamon. Oil and the cinnamon powder obtained from the *Cinnamomum verum* (true cinnamon or Ceylon cinnamon) are of superior grade than the oil and bark of cassia cinnamon. These two varieties look similar and cassia can be mistaken for true cinnamon. Though they look similar they are not the same and their bark can be somewhat different in appearance. Due to their similarities cassia is mainly used as an adulterant in cinnamon, i.e. consumers are given cassia instead of true cinnamon because of their similar appearance. Both cinnamon and cassia must be regarded as different in the aspect of health as well as nutrition. Precisely only Ceylon cinnamon from *cinnamomum zeylanicium* is the true cinnamon. Cassia is sold in place of cinnamon due to its cheaper price in comparison to cinnamon. Cassia is used for baking purposes and is light brown to reddish brown colour. Cinnamon leaf oil is cheaper than bark oil. Both oils are used in food industries and pharmaceutical industry. Therefore, cinnamon and cassia are not precisely same but they are closely related to each other.

<table>
<thead>
<tr>
<th>Sno.</th>
<th>Species/varieties</th>
<th>Vernacular names</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>Cinnamomum cassia</em></td>
<td>(Chinese cinnamon or commercial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cinnamon)</td>
</tr>
<tr>
<td>2.</td>
<td><em>C. burmannii</em></td>
<td>(Padang cassia or Indonesian</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cinnamon)</td>
</tr>
<tr>
<td>3.</td>
<td><em>C. loureiroi</em></td>
<td>(Saigon cinnamon, Vietnamese</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cassia or Vietnamese cinnamon)</td>
</tr>
<tr>
<td>4.</td>
<td><em>C. verum</em></td>
<td>(Srilanka cinnamon/ ceylone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cinnamon)</td>
</tr>
<tr>
<td>5.</td>
<td><em>C. citrodorum</em></td>
<td>(Malabar cinnamon)</td>
</tr>
<tr>
<td>6.</td>
<td><em>C. Tamale</em></td>
<td>(Indian cinnamon)</td>
</tr>
<tr>
<td>7.</td>
<td><em>C. burmaniiBlumes</em></td>
<td>(Cassia vera, Batavia cassia, Java</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cassia, Macassar cassia)</td>
</tr>
</tbody>
</table>

Table 1. Showing various species of cinnamon with their common names which are used for commercial purposes.

Taxonomic Hierarchy
Methodology

The current review paper was conducted by downloading available research, review papers and books on cinnamon and its adulteration from - science direct, pdf drive, research gate, Google scholar, pub med. The review was conducted on the cinnamon adulteration which is done by the people in order to increase their yield and make money. Cassia the similar looking product is sold in the market in the name of cinnamon. A systematic review was conducted by strictly following PRISMA guidelines\(^4\). The search of different databases was carried out by using these keywords, cinnamon, spices, cassia, medicine, flavoring agent. The paper gives a detailed description of applications of cinnamon in our daily life and its medicinal benefits.

Application

Cinnamon is used extensively as a flavoring agent in food as well as alcoholic beverages. The essential oils (0.5% to 1% of its composition) present in cinnamon induce the flavor in it. Cinnamaldehyde provides the pungent taste and scent to cinnamon. The use of cinnamon has always been in food since early days, it is used in preparing food dishes to provide a particular flavor and scent. It is mostly used in spices used for making curries. It is also used in beverages like tea, coffee, chocolate drinks and even in wine for providing a spicy flavor. They are also added in desserts made with bread in combination with sugar and also in fruits like apple.(\(^5\))
Fig 2: Illustrates various mystic powers of this wonderful spice

It is added in chewing gums because it leaves a mouth-freshening effect and also it has the ability to reduce bad breath\(^7\). Cinnamon possesses antioxidant properties, and can be used as an antidiabetic, antimicrobial, antibacterial, anticancer, liquid lowering, and cardiovascular-disease-lowering compound. It is such spices which can cut the risk of heart disease to a great extent. It reduces the risk of colon cancer by improving the health of colon\(^8\). It helps in preventing the bleeding as it works as a coagulant. Also, it increases the blood circulation in uterus and advances the regeneration of tissues\(^9\). It is believed to cure many ailments like diarrhea, headache, menstrual problem, vomiting, inflammation etc. They also help in lowering blood sugar levels. They are even used in cosmetics because it is believed to cure acne-prone skin. According to a research it is used in treating neurological disorder like Alzheimer’s disease, Parkinson’s disease etc.(\(^{11}\))

**Cinnamon oil** – It is prepared by condensing the leaves or inner bark. It is mainly used for medicinal purpose either applied externally or orally administered.

**Cinnamon powder** – It is used for treating various diseases like diarrhea, tooth pain, cough, hair fall, insomnia, arthritis etc.

**Bark** – it is used for increasing the appetite, for illness caused by bacteria, worms and also for gastrointestinal problems.

**Chemical constituents**

Parts of cinnamon plant contain distinctive chemical composition\(^7\): -

- Leaves contain about 70 to 85% eugenol, Cinnamaldehyde: 1.00 to 5.00%
- Bark contains 65 to 80% Cinnamaldehyde, Eugenol: 5.00 to 10.00%
- Root bark contain about 60% camphor and small amount of pinnene, dipentene, eugenol, safrole, borneol and possibly cinnamic and benzoic aldehyde
- Flowers contain (E)-cinnamyl acetate: 41.98%, caryophyllene (9.00 to 14.00%)

**Coumarin**
Coumarin is an element present in cassia, which belong to *benzopyrene* family. The presence of coumarin in ceylon cinnamon is too little to have effect on health, whereas content of coumarin is higher in cassia which is sufficient to harm the health if the intake is frequent\(^\text{10}\). The major effect by coumarin is seen in kidney and liver to which it causes hepatotoxicity. It is caused when the intake is on regular basis but the condition is resolved when intake is stopped. People with liver disease can develop hepatotoxicity even with little amount. Cassia also drops glucose level in blood. If combined with some other herbs it can cause additional effect as well as drop glucose level. Reports of skin allergies along with stomatitis from the use of cassia flavored toothpaste have been mentioned\(^\text{11}\).

German federal institute of risk assessment reported, 2100 to 4400 mg of coumarin is present in 1kg cassia which indicates that one teaspoon of cassia contain 5.8 to 12.1 mg coumarin\(^\text{11}\). German FDA have cautioned about the excess use of cassia due to the health risk. They have warned mainly against regular excessive intake of cassia. Coumarin is presently listed by FDA among "Substances Generally Prohibited from Direct Addition or Use as Human Food. Use of cassia in foods is prohibited in European countries and in some countries it is used in the manufacture of rat poison\(^2\).

Most People favor cassia more than cinnamon due to intense smell and its rich and deep spicy flavor. According to spices board of India, the requirement of cinnamon is over 11500 tons every year in contrast to its production which is up to 100 tons per annum approximately. So as to meet the increasing requirement of cinnamon and for the profit business, cassia cinnamon is traded from Indonesia and Vietnam.\(^{13}\)

Food safety and standards authority of India (FSSAI) has outlines the difference between cinnamon and cassia. They have provided guidelines regarding the selling of cinnamon with acceptable limit of coumarin not exceeding 0.3%. This will aid to discriminate among cassia and cinnamon due to less coumarin content in cinnamon.\(^{14}\)

### Adulteration

Generally, adulteration is the practice which affects the quality of a product. Some products are added in the original material to make it of poor quality and thus, the original material becomes adulterated. Similarly, cinnamon is adulterated with rough, thick and less aromatic bark of cassia and C.tamala. Schmalpreapartificial cinnamon in 1940 by mixing 3.4% of a mixture of 96% cinnamaldehyde and 4% eugenol with a carrier such as powder of hazelnut or almond shells and then colored the mixture with yellow brown dye\(^8\).

- Leaf oil is generally used to adulterate bark oil.
- Powdered beechnut husks, aromatized and cinnamaldehyde are used to adulterate bark powder. Sugar, ground walnut shells, galangal rhizome, etc. can also be used to adulterate bark oil.
- Another form of adulteration is replacement of cinnamon oil with cassia oil. And this oil sometimes contains resins, oil of cloves and petroleum oil.

### Observations

#### Comparison of various parameters of Cinnamon and cassia

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Cinnamon</th>
<th>Cassia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavor</td>
<td>Sweet and fragile</td>
<td>Strong and spicy</td>
</tr>
<tr>
<td>Color</td>
<td>Subtle brown or tan</td>
<td>Reddish to dark brown</td>
</tr>
<tr>
<td>Appearance</td>
<td>Looks like a cigar which curls from one side and furl up similar to newspaper</td>
<td>It curls form both side toward center</td>
</tr>
<tr>
<td>Texture</td>
<td>Smooth</td>
<td>Rough and irregular</td>
</tr>
</tbody>
</table>
Anita et al (2020): A review of cinnamon

Production
India, Srilanka
China, Vietnam, Indonesia

Coumarin level
Low
High

Table 2: Properties of cinnamon and cassia

<table>
<thead>
<tr>
<th>Parameter</th>
<th>True cinnamon</th>
<th>Cassia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortex</td>
<td>Not present or seen rarely</td>
<td>Present</td>
</tr>
<tr>
<td>Pericyclic fiber</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Scleroids</td>
<td>Present in small size</td>
<td>Dense and larger</td>
</tr>
<tr>
<td>Starch grains</td>
<td>Fewer</td>
<td>More in number</td>
</tr>
<tr>
<td>Oil cells</td>
<td>Larger in number</td>
<td>Fewer in number</td>
</tr>
</tbody>
</table>

Microscopic examination:

Table 3: Microscopic examinations of bark of true cinnamon and cassia sample

Analysis

Table 4: Various tests used for the analysis of Cinnamon for different parameters

Analysis Methods of Cinnamon

- The basic method to detect whether the cinnamon is adulterated or not is examination of its appearance. The cinnamon on a glass plate and then closely examine its bark. The unadulterated cinnamon is very thin and it can be roller easily around a pencil and also has distinct smell. On the other hand the adulterated cinnamon comprises of several layers in between and also it has rough outer and inner surfaces.

- Cinnamon can be tested with iodine. Decoction of sample is prepared which is treated with iodine. True Cinnamon will show slight effect but dense blue color is formed if cassia is present. Concentration of coloration will show the quantity of cassia.

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DNA bar-coding is another approach to distinguish true cinnamon from cassia of inferior quality. DNA markers are now utilized for the detection of adulteration.\textsuperscript{14}

The melting point provides great information about the cinnamon being pure or adulterated. The pure crystal solids have a sharp melting point temperature (133-135ºC) whereas; the adulterated samples will melt at temperature below the melting point.\textsuperscript{14}

Chromatographic techniques i.e. HPLC, TLC are followed for the flavor detection, extraction and purification of the samples.\textsuperscript{1}

DART methods coupled with MS are used to determine adulteration in cinnamon.\textsuperscript{14}

**Conclusion**

Cinnamon is a well-known spice used in our daily life and also used as spices, is also used for health benefits. It is very good for heart and prevents the risk of heart attacks. Cinnamon is frequently adulterated with coumarin of cheaper and inferior quality, which if consumed for prolonged period is not good for health. Even though cassia and cinnamon look similar, they can be differentiated by number of ways - their appearance, characteristics, and with different tests and instrumental methods. There are numerous types of cinnamon which provide significant health benefits. Therefore, cinnamon can be used as a spice in our daily lives without any side effects.

**References:**


11. [https://faculty.psu.edu.sa/filedownload/doc-3-pdf-c42c101f89ec57e54230d611f74d5ae1-original.pdf](https://faculty.psu.edu.sa/filedownload/doc-3-pdf-c42c101f89ec57e54230d611f74d5ae1-original.pdf)


