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Review Article

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CINNAMON: A PHARMACOLOGICAL REVIEW

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ABSTRACT

Cinnamon (*Cinnamomum zeylanicum Nees*), the evergreen tree of tropical area, a member of family Lauraceae, has been used in day to day routine as a spice and condiment in India. Literature review on cinnamon revealed that it chiefly contains essential oils and all other categories like cinnamic acid, cinnamaldehyde and cinnamate. It has got good anti-inflammatory, anti-oxidant, anti-ulcer, anti-microbial, hypoglycemic and hypolipidemic potential. In clinical reports it was found very safe and useful in allergic conditions also. Current review describes the pharmacological potential of cinnamon in preclinical and clinical scenario.

Keywords: Cinnamon, Cinnamaldehyde, Clinical studies

INTRODUCTION

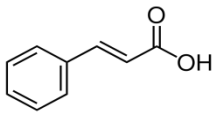
Cinnamon (*Cinnamomum verum*, synonym *C. zeylanicum*) is a small evergreen tree, 10-15 meters (32.8-49.2 feet) tall, belonging to the family Lauraceae, native to Sri Lanka and South India. The flowers, which are arranged in panicles, have a greenish colour and have a distinct odour. The fruit is a purple one-centimeter berry containing a single seed. Its flavour is due to an aromatic essential oil which makes up 0.5 to 1% of its composition.

In medicine it acts like other volatile oils and once had a reputation as a cure for colds. It has also been used to treat diarrhoea and other problems of the digestive system. *Cinnamon* is high in antioxidant activity. The essential oil of *Cinnamon* also has antimicrobial properties, which aid in the preservation of certain foods. "*Cinnamon*" has been reported to have remarkable pharmacological effects in the treatment of type II diabetes. *Cinnamon* has traditionally been used to treat toothache and fight bad breath and its regular use is believed to stave off common cold and aid digestion.

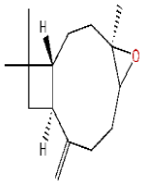
CHEMISTRY

The *Cinnamon* is having essential oils, resinous compounds, Cinnamic acid, Cinnamaldehyde and Cinnamate. Essential oil such as trans-cinnamaldehyde, caryophyllene oxide, L-borneol, L-bornyl acetate, eugenol, b-caryophyllene, E-nerolidol, and cinnamyl acetate was reported by Tung et al. Some other constituents are Terpinolene, α-Terpineol, α-Cubebene, and α-Thujene[1]. Singh et al. reported that pungent taste and scent come from cinnamaldehyde and, by the absorption of oxygen as it ages; it darkens in colour and develops resinous compounds[2].

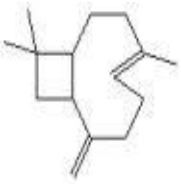
Chemical Structures of some important chemical constituents of *Cinnamon are* given below:



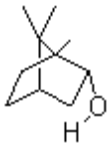
Cinnamic acid



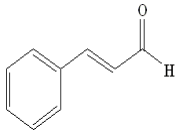
caryophyllene oxide



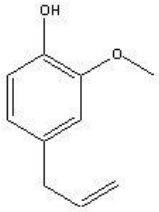
b-caryophyllene



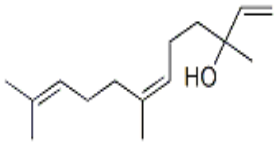
L-borneol



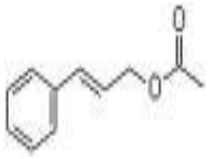
cinnamaldehyde



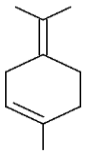
Eugenol



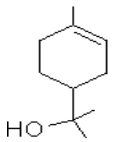
E-nerolidol



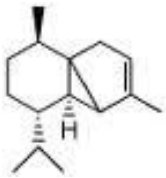
cinnamyl acetate



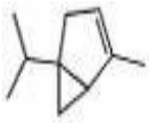
Terpinolene



α-Terpineol



α-Cubebene



α-Thujene

PHARMACOLOGY OF CINNAMON

Antioxidant

Shahidi et al. have reported that antioxidants are often added to foods to prevent the radical chain reactions of oxidation, and they act by inhibiting the initiation and propagation step leading to the termination of the reaction and delay the oxidation process[3]. However, Madhavi and Salunkhe have reported that the commonly used synthetic antioxidants such as butylated hydroxyanisole (BHA) and butylated hydroxy toluene (BHT) are restricted by legislative rules because of doubts over their toxic and carcinogenic effects[4]. Therefore, there has been a considerable interest in the food industry to find natural antioxidants to replace synthetic compounds in food applications, and a growing trend in consumer preferences for natural antioxidants, all of which has given more impetus to explore natural sources of antioxidants.

In India, herbs and spices have been added to different types of food to impart flavour as well as to improve storage stability, since ancient times. Many herbs and spices have been shown to impart antioxidant effects in food; the active principles are phenolics[3, 5-6]. A wide variety of phenolic substances derived from herbs and spices possess antioxidant properties.

Mathew and Abraham have reported that methanolic extract of *Cinnamon* contains a number of antioxidant compounds which can effectively scavenge reactive oxygen species including superoxide anions and hydroxyl radicals as well as other free radicals under *in vitro* conditions[7]. Jayaprakasha et al shown that the fruit of *Cinnamon*, an under-utilized and unconventional part of the plant, contains a good amount of phenolic antioxidants to counteract the damaging effects of free radicals and may protect against mutagenesis[8]. Mitochondrial dysfunction, decrease in ATP formation, oxidation and free radical generation can fasten the aging process. Ustaa et al. have postulated mitochondria as an another possible target of the actions of spices or toxicity whereby deranging mitochondrial functions would lower ATP level, which then may influence cell growth, viability and aging process[9].

Anti-ulcer

In sum, the utilization of *Cinnamon* extract to inhibit both growth and urease activity of *H. pylori in-vitro* has in our hands proved to be more effective than thyme extract[10-11]. The efficiency of *Cinnamon* extracts in liquid medium and its resistance to low pH levels may enhance its effect in an environment such as the human stomach reported by Tabak et al.

Kreydiyyeh et al. have reported its inhibitory effect on the intestinal and kidney Na^+/K^+ ATPase activity and on alanine transport in rat jejunum[12].

Anti-microbial

Matan et al. have reported Antimicrobial activity of *Cinnamon* bark. The volatile gas phase of combinations of *Cinnamon* oil and clove oil showed good potential to inhibit growth of spoilage fungi, yeast and bacteria normally found on IMF (Intermediate Moisture Foods) when combined with a modified atmosphere comprising a high concentration of CO_2 (40%) and low concentration of O_2 (<0.05%). *A. flavus*, which is known to produce toxins, was found to be the most resistant microorganism[13].

Anti-diabetic

Sung Hee et al. have reported data of anti-diabetic activity of *Cinnamon* in db/db transgenic mice[14]. It has been shown by Subash et al. that oral administration of cinnamaldehyde produces significant antihyperglycemic effect lowers both total cholesterol and triglyceride levels and, at the same time, increases HDL-cholesterol in STZ-induced diabetic rats. This investigation reveals the potential of cinnamaldehyde for use as a natural oral agent, with both hypoglycemic and hypolipidemic effects[15].

Cao et al. reported novel findings that *Cinnamon* extract and polyphenols with procyanidin type-A polymers exhibit the potential to increase the amount of TTP (Thrombotic Thrombocytopenic Purpura), IR (Insulin Resistance), and GLUT4 (Glucose Transporter-4)in 3T3-L1 Adipocytes.[16] The results reported in the study suggest that the mechanism of *Cinnamon*'s insulin-like activity may be in part due to increase in the amounts of TTP, IRβ, and GLUT4 and that *Cinnamon* polyphenols may have additional roles as anti-inflammatory and/or anti-angiogenesis agents.

Anti-inflammatory

Tung et al.demonstrated that essential oil of *C. osmophloeum* twigs has excellent anti- inflammatory activities and cytotoxicity against HepG2 (Human Hepatocellular Liver Carcinoma Cell Line) cells. Furthermore, it also indicated that the constituents of *C. osmophloeum* twig exhibited excellent anti-inflammatory activities in suppressing nitric oxide production by LPS (Lipopolysaccharide)-stimulated macrophages[1].

CLINICAL REPORTS

Several clinical studies have been carried out for evaluating the potential of *Cinnamon* against several complications, such as diabetes, nasal allergy/rhinitis, plasma lipids and urinary oxalate excretion (Details of clinical trials are given in Table-1).

S.N.	Conditions / disease	Study type	Author/ Year	No. of Patients	Statistically significant	Comments	Dose
1.	Postprandial blood glucose-attenuating and satiety-enhancing effect	On healthy human volunteers	Mettler et al., 2009 [19]	27	Yes	Reducing the blood glucose and enhance satiety postprandial.	4g for once in the meal
2.	HbA1C in patients with type 2 diabetes	A randomized, controlled trial	Crawford, 2009 [20]	109	Yes	Taking cinnamon could be useful for lowering serum HbA1C in type 2 diabetics with HbA1C (>7.0) in addition to usual care	1 g/day for 90 days
3.	People with impaired fasting glucose that are overweight or obese	A double-blind placebo-controlled trial	Roussel et al., 2009 [21]	22	Yes	The inclusion of water soluble cinnamon compounds in the diet could reduce risk factors associated with diabetes and cardiovascular disease.	250 mg two times a day for 12 weeks
4.	Gastric emptying, satiety, and postprandial blood glucose, insulin, glucose-dependent insulinotropic polypeptide, glucagon-like peptide 1, and ghrelin concentrations	A crossover trial on Healthy volunteer	Hlebowicz et al., 2009 [22]	15	Yes	Cinnamon have got the potential to modulate gastric emptying, satiety, and postprandial blood glucose, insulin, glucose-dependent insulinotropic polypeptide, glucagon-like peptide 1, and ghrelin concentrations	1-3 g
5.	Nasal allergy/ Allergic rhinitis	A pilot randomized double-blind placebo-controlled trial.	Corren et al., 2008 [23]	>20	Yes	Cinnamon has got the potential clinical utility in patients with allergic rhinitis.	Not specified
6.	Urinary oxalate excretion, plasma lipids	randomly assigned, crossover study in healthy volunteers	Tang et al., 2008 [24]	11	NO	Cinnamon has no effect on urinary oxalate excretion and plasma lipid profile	Consumed in the diet
7.	*In vivo* glucose tolerance	A randomized-Healthy male volunteers crossover design	Solomon and Blannin, 2007 [25]	7	Yes	cinnamon spice supplementation may be important to in vivo glycaemic control and insulin sensitivity in humans, and not only are its effects immediate, they also appear to be sustained for 12 h.	5g/day
8.	Type 2 diabetes mellitus	single blind randomized, placebo-control trial	Suppapitipom et al., 2006 [26]	60	NO	No significant effect was observed on T2DM	1.5 g/day for 12 weeks
9.	Plasma glucose, HbA, and serum lipids in diabetes mellitus type 2	Double blind randomized, placebo-control trial	Mang et al., 2006 [27]	79	Yes	he cinnamon extract seems to have a moderate effect in reducing fasting plasma glucose concentrations in diabetic patients with poor glycaemic control	3 g/day for 4 months

Table No. 1: Summary of Clinical Studies carried out on Cinnamon

TOXICITY PROFILE

Cinnamon is used as a spice in food material in Asia so its safety is quite obvious. Budavari et al. have reported acute toxicity of *Cinnamon* in the animals is very low i.e. Benzaldehyde (LD50 orally, 1300 mg/kg rat), cinnamaldehyde (LD50 orally, 2220 mg/kg rat), linalool (LD50 orally, 2790 mg/kg rat), and salicylaldehyde (LD50 orally, 520 mg/kg rat) [17]. Satoshi found that its toxigenicity is low so utilization of this compound may be expected as an antifungal agent in foods and as a treatment of dermatomycosis[18].

CONCLUSION

Medicinal plants are important for pharmacological research and drug development. One fifth of all the plants found in India are used for medicinal purpose.Out of these the bark of *Cinnamon* is widely used as a spice due to its distinct odour of essential oils.Main chemical constituents are Cinnamic acid, Cinnamaldehyde, Euginol, and essential oils. *Cinnamon* is reported for its anti-oxidant, anti-ulcer, anti-microbial, anti-diabetic and anti-inflammatory activity in scientific literature. *Cinnamon* is found very safe in acute toxicity in animals and being used as spice for ages.

REFERENCES

1. Tung YT, Chua MT, Wang SY, Chang ST. *Bioresource Technology*, 2008; 99: 3908–3913.
2. Singh G, Maurya S, Cesar MP, Catalan AM. *Food and Chemical Toxicology*, 2007; 45:1650–1661.
3. Shahidi F, Janitha PK, Wanasundara PD. *Critical Reviews in Food Science and Nutrition*, 1992; 32: 67–103.
4. Madhavi DL, Salunkhe DK. *Food Antioxidants. Marcel Dekker Inc., New York*; 1995; 267: 45-50.
5. Scwarz K, Bertelsen G, Nissen LR, Gardner PT et al. *European Food Research and Technology*, 2001; 212: 319–328.
6. Tanabe H, Yoshiad M, Tomita N. *Animal Science Journal*, 2002;73: 389–393.
7. Mathew S, Abraham BTE. *Food Chemistry*, 2006;94:520–528.
8. Jayaprakasha GK, Negi PS, Jena BS, Jagan Mohan Rao L. *Journal of Food Composition and Analysis*, 2007;20:330–336.
9. Ustaa S, Kreydiyyehb K, Bajakiana H, Chmaissec N. *Food and Chemical* Toxicology, 2002;40:935–940.
10. Tabak M, Armon R, Neeman I. *Journal of Ethnopharmacology*, 1999;67:269–277.
11. Tabak M, Armon R, Potasman I, Neeman I. *J. Appl. Bacteriol*, 1996; 80: 667–672.
12. Kreydiyyeh SI, Usta J, Copti R. *Food and Chemical Toxicology*, 2000; 38:755–762.
13. Matan N, Rimkeeree H, Mawson A J, Chompreeda P et al. *International Journal of Food Microbiology*, 2006;107:180–185.
14. Kim SH, Hyun SH, Choung SY. *Journal of Ethnopharmacology*, 2006; 104:119–123.
15. Subash Babu P, Prabuseenivasan S, Ignacimuthu S. *Phytomedicine*, 2007;14:15–22.
16. Cao H, Marilyn M, Polansky, Anderson RA. *Archives of Biochemistry and Biophysics*, 2007; 459 Suppl 2 : 214-222.
17. Budavari SB, O'Neil MJ, Smith A, Heckelman PE. 1989; The Merck Index. Merck and Co, Rahway, NJ.
18. Morozumi S. *Applied and Environmental Microbiology*, 1978; 36 Suppl 4: 577-583.
19. Mettler S, Schwarz I, Colombani PC. *Nutr Res*, 2009;29 Suppl 10 : 723-727.
20. Crawford P. *J Am Board Fam Med*, 2009;22 Suppl 5 :507-512.
21. Roussel AM, Hininger I, Benaraba R, Ziegenfuss TN et al. *J Am Coll Nutr*, 2009;28 Suppl 1 :16-21.
22. Hlebowicz J, Hlebowicz A, Lindstedt S, Björgell O et al. *Am J Clin Nutr*., 2009; 89 Suppl 3 : 815-821.
23. Corren J, Lemay M, Lin Y, Rozga L et al. *Nutr J*, 2008 ;14 Suppl 7 :20.
24. Tang M, Larson-Meyer DE, Liebman M. *Am J Clin Nutr*. 2008; 87 Suppl 5 :1262-1267.
25. Solomon TP, Blannin AK. *Diabetes Obes Metab*, 2007; Suppl 6 : 895-901.
26. Suppapitiporn S, Kanpaksi N, Suppapitiporn S. *J Med Assoc Thai*, 2006; 89 Suppl 3: 200-205.
27. Mang B, Wolters M, Schmitt B, Kelb K et al. *Eur J Clin Invest*, 2006;36 Suppl 5 : 340-344.