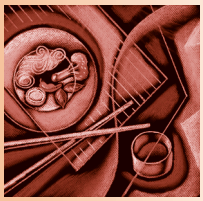

Cinnamon

Overview of Health Benefits

Keith Singletary, PhD

Cinnamon is a spice that has been used for thousands of years both for its enhancement of taste and for its potential medicinal benefits. It has a history of use for medicinal purposes as far back as China in the third millennium BC, ancient Egypt, and medieval Europe. It is derived from the brown bark of the cinnamon tree and comes in 2 principal varieties, Chinese and Ceylon. The purported health benefits from cinnamon have been linked to a variety of constituents. The scientific literature provides emerging evidence that cinnamon may have health benefits, particularly in improving problematic blood glucose regulation that is a consequence of type 2 diabetes and obesity. A brief summary of potential health benefits, an evaluation of the quality of the scientific research, and suggestions for future research are presented in this article. Nutr Today. 2008;43(6):263–266

Cinnamon is one of the most commonly used spices worldwide next to black pepper. It is prepared from the dried inner bark of evergreen trees grown in South Asia (Ceylon cinnamon, *Cinnamomum zeylanicum*) and Southeast Asia (Chinese cinnamon or cassia, *Cinnamomum cassium*). References to it date back to antiquity, being mentioned in several books of the Bible and in the histories of ancient Rome and Egypt as well as medieval Europe. Its historical uses were quite varied and included applications for flavoring, food preservation, and medicines and even as an embalming agent. Currently, cinnamon has primary uses in foods and fragrances. In foods, it is noted for conveying a sense of sweetness and warmth and is found as a flavoring agent in diverse products such as baked goods, beverages, meat dishes, cereals, and fruit preparations. Oil from the bark is also used in the manufacture of perfumes, cosmetics, shampoos, and toilet soaps. The purported health benefits from cinnamon have been linked to a variety of constituents. A brief summary of potential health benefits, evaluation of the quality of the scientific research, and suggestions for future research are presented below.

Summary

The scientific literature provides emerging evidence that cinnamon may have health benefits, particularly in improving problematic blood glucose regulation that is a consequence of type 2 diabetes and obesity. There is suggestive evidence that cinnamon may improve blood cholesterol concentrations in humans and lower blood pressure in rats. Preliminary evidence in cell culture studies suggests that cinnamon contains antioxidant constituents and possesses anti-inflammatory and antimicrobial properties. An overview of major uses for cinnamon is presented in Table 1, and the strength of the evidence is graded. Points of view or ratings for the strength of the scientific evidence are based on consideration of cell culture and animal and human clinical data from the peer-reviewed scientific literature. Greater strength of evidence was given when there were both preclinical and clinical data, and there was consistency of findings among well-controlled human studies.

The chemical composition of cinnamon has been characterized, with cinnamaldehyde (cinnamic aldehyde, 3-phenyl-2-propenal) being identified as the major constituent from the bark and eugenol (2-methoxy-4-(2 propenyl)phenol) as the primary component in extracts from the leaf. Other constituents in cinnamon include cinnamyl alcohol, coumarin, phenolic acids, terpenes, carbohydrates, and tannins. Cinnamaldehyde, also found in blueberries and cranberries, is generally recognized as safe (GRAS) for use as a flavoring by the Flavoring Extract Manufacturers Association and is approved for food use by the Food and Drug Administration (21 CFR 182.60). There are

Table 1. Potential Uses of Cinnamon

Scientific Evidence for Selected Uses	Rating[a]
Antidiabetic agent	E
Preclinical animal studies provide evidence that constituents of cinnamon may decrease blood glucose and insulin levels both in rats genetically predisposed to diabetes and in rats given high doses of sugars.[5–8] Evidence for an antidiabetic action of cinnamon components in humans is inconsistent but suggestive of a possible modest action in lowering blood glucose levels (Table 2).[1,9–20] It should be noted that in 2 studies, cinnamon ingestion improved in vivo glucose tolerance in healthy human subjects.[15,16] Specific constituents of cinnamon responsible for any antidiabetic effect remain to be identified.[21–23] Several agents such as cinnamaldehyde and polyphenolic polymers have been proposed as putative active factors. A meta-analysis and 3 recent reviews have evaluated the evidence for this potential health benefit.[1,17,19,20] This antidiabetic action of cinnamon clearly warrants further study, and the basis for inconsistencies among studies needs to be resolved.	
Cholesterol-lowering actions	P
Human trials of cinnamon extract do not consistently demonstrate a benefit in lowering diabetes-associated blood cholesterol levels or improving blood lipid profiles.[9–11,19,20]	
Blood pressure–lowering effect	P
Cinnamon lowered sugar-induced blood pressure increase in one study of rats predisposed to hypertension.[24] Further study of this action of cinnamon is needed.	
Anti-inflammatory and antioxidant effects	P
Antioxidant components of cinnamon have been identified. There are several reports using cell culture models and an experiment in rats demonstrating that cinnamon and cinnamaldehyde have antioxidant activity and scavenge free radicals.[20,25–27] There is very limited evidence that cinnamon and cinnamaldehyde have immunomodulatory properties and can suppress inflammation processes.[20,28,29] There are few reports of cinnamon being effective as an antioxidant or anti-inflammatory agent in humans.[20]	
Antimicrobial properties	P
There are a number of reports in cell culture studies indicating that cinnamon can inhibit the growth of bacteria associated with food contamination and human infections.[20,27] There is a lack of evidence of an antimicrobial benefit in humans. One trial evaluated cinnamon for its capacity to inhibit the bacterium associated with stomach ulcers and demonstrated no benefit.[30]	
Anticancer actions	P
There is very limited scientific information pointing to a cancer-protective benefit of cinnamon components.[20,31,32]	

[a]Rating: S, strong, convincing evidence; E, emerging, suggestive evidence; P, preliminary, inconclusive evidence.

limited reports of cinnamaldehyde as a skin allergen when used in fragrances and toothpastes.[1–3] Such cases are uncommon, however, and there currently are no safety concerns for its use in fragrances and cosmetics.[4] Cinnamaldehyde as a principal constituent of cinnamon has also been evaluated individually for health benefits similar to those outlined above and is purported to have, based on cell culture and animal studies, antimicrobial, antioxidative, anti-inflammatory, and anticancer actions.

Conclusions

Based on the current scientific evidence, more information is needed on the health benefits of cinnamon—particularly in human subjects. There is suggestive evidence from human studies that cinnamon can lower blood glucose and modulate insulin levels associated with type 2 diabetes. However, the database for using cinnamon in the treatment of diabetes is fairly weak and not yet conclusive. It would be of considerable value to further confirm the benefits of cinnamon intake in improving glucose tolerance and insulin sensitivity on people without diabetes. Evidence that cinnamon also lowers diabetes-associated blood cholesterol and lipid concentrations is inconsistent and inconclusive. Table 2 provides a summary of select trials of cinnamon on diabetes end points.

Cinnamon intakes used in human studies are considerably greater than levels usually consumed as part of a typical diet, with amounts ranging from about 1 to 6 g/d for periods of time varying in length

Table 2. Feeding Studies Evaluating Possible Benefits of Cinnamon for Diabetes Symptoms

Study Authors	No. of Participants	Cassia Daily Dose	Treatment Duration, d	Results	Reference
Khan et al (2003)	60 patients with type 2 diabetes (male and female)	1, 3, or 6 g (powder)	40	Cinnamon decreased fasting blood glucose levels, improved blood lipid profiles	9
Mang et al (2006)	65 patients with type 2 diabetes (male and female)	3 g (water extract)	120	Cinnamon decreased fasting blood glucose levels; did not affect hemoglobin A_{1C} (A1C) or blood lipids	10
Vanschoonbeek et al (2006)	25 postmenopausal patients with type 2 diabetes	1.5 g (powder)	42	No effect of cinnamon on fasting blood glucose or insulin levels, oral glucose tolerance, or blood lipids	11
Suppapitiporn et al (2006)	60 patients with type 2 diabetes (male and female)	1.5 g (powder)	84	No effect of cinnamon on fasting blood glucose levels, A1C, or blood lipid profile	14
Altshuler et al (2007)	57 adolescent patients with type 1 diabetes (male and female)	1 g (powder)	90	No effect of cinnamon on A1C, total daily insulin use, or number of hypoglycemic episodes	13
Blevins et al (2007)	43 patients with type 2 diabetes (male and female)	1 g (powder)	90	No effect of cinnamon on fasting blood glucose, A1C, or insulin levels, nor on blood lipids	12

from 6 weeks to 4 months. More evidence from well-designed clinical trials is needed, especially those that examine cinnamon doses relevant to typical intakes. Particularly important will be a better characterization of the possible contributors to variation in cinnamon's effects, such as those due to diet, sex, ethnicity, body mass index, fasting blood glucose levels, and use of other medications.[12,19,20]

There is little research on cinnamon's antioxidant action in humans. There is suggestive evidence that cinnamon can provide such benefits in animals. Cinnamon antioxidant activity has been demonstrated in multiple cell culture studies. However, it is not known whether these constituents are bioavailable in humans once ingested. This question needs to be further explored.

An animal study indicates that cinnamon may lower sugar-induced blood pressure. Furthermore, research suggests that cinnamon contains constituents that have anti-inflammatory and antimicrobial properties. Additional investigations of these potential health benefits in animals and in human trials are needed.

Keith Singletary, PhD, is professor emeritus of nutrition in the Department of Food Science and Human Nutrition at the University of Illinois. From 2001 to 2004, he was the director of the Functional Foods for Health Program, an interdisciplinary program between the Chicago and Urbana-Champaign campuses of the University of Illinois. He also has served as associate head for graduate programs and associate head for undergraduate programs of the Department of Food Science and Human Nutrition. Dr Singletary received bachelor's and master's degrees in microbiology from Michigan State University and the PhD in Nutritional Sciences from the University of Illinois. He joined the University of Illinois faculty in 1986. Dr Singletary's primary research interests focus on molecular carcinogenesis and cancer chemoprevention, specifically identifying and determining the mechanism of action of phytochemicals in fruits, vegetables, and spices as cancer protective agents. He also is recognized for his investigations into the biological basis behind the enhancing effect of alcohol intake on breast carcinogenesis.

Over the years, Dr Singletary has been awarded research grants from federal, private institute, and corporate sources and authored numerous journal publications on diet and cancer. In 2003, he was recognized with the Senior Faculty Award for Excellence in Research by the College of Agricultural, Consumer and Environmental Sciences at the University of Illinois. In 2006, he was recognized with the Outstanding Graduate Mentor/Advisor award from the Department of Food Science and Human Nutrition. Dr Singletary has served as a member of the Board of Directors of the Illinois Division of the American Cancer Society and has chaired the Division's Cancer Prevention Committee. He currently serves on various committees

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