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An Overview of Cinnamon Properties Effects on Blood Glucose and Hemoglobin A1C in Diabetic People

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Abstract

Diabetes mellitus (DM) is a group of metabolic diseases characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. In 2017, it was expected that 425 million people (20–79 years of age) suffered from DM and the number is expected to rise to 629 million by 2045. For centuries cinnamon has been a culinary spice and folk remedy for various maladies. In traditional medicines, its uses include for relief of gastrointestinal distress, arthritis, high blood pressure, dermatitis, toothache, and colds; for improving menstrual irregularities; and for wound healing. In the current literature, the key words including cinnamon, diabetes, insulin, blood glucose, and hemoglobin A1C from the list of MeSH and other credible scientific websites such as Science Direct, PubMed and Google Scholar were used to compile the effects of cinnamon on blood glucose level and hemoglobin A1C in diabetes. Studies show cinnamon can reduce serum levels of glucose, hemoglobin A1C, improving glucose transport, improving anthropometric (Body Mass Index, body fat, and visceral fat), and improving glycemic parameters (FPG, 2hpp, HbA1C, Fasting Insulin, and Insulin Resistance). From the findings of various studies, it can be concluded that the oral administration of cinnamon extracts has a valuable effect on blood glucose levels and hemoglobin A1C.

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Introduction

Diabetes mellitus (DM) is a group of metabolic diseases characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Metabolic abnormalities in carbohydrates, lipids, and proteins result from the importance of insulin as an anabolic hormone. Low levels of insulin to achieve adequate response and/or insulin resistance of target tissues, mainly skeletal muscles, adipose tissue, and to a lesser extent, liver, at the level of insulin receptors, signal transduction system, and/or effector enzymes or genes are responsible for these metabolic abnormalities. The severity of symptoms is due to the type and duration of diabetes. Some of the diabetes patients are asymptomatic especially those with type 2 diabetes during the early years of the disease, others with marked hyperglycemia and especially in children with absolute insulin deficiency may suffer from polyuria, polydipsia, polyphagia, weight loss, and blurred vision. Uncontrolled diabetes may lead to stupor, coma and if not treated death, due to ketoacidosis or rare from nonketotic hyperosmolar syndrome [1-3]. Although classification of diabetes is important and has implications for the treatment strategies, this is not an easy task and many patients do not easily fit into a single class especially younger adults [1, 4, 5] and 10% of those initially classified may require revision [6]. In 2017, it was expected that 425 million people (20–79 years of age) suffered from DM and the number is expected to rise to 629 million by 2045 [7]. DM with its effect on health, the healthcare system expenses of individuals represents a severe international health burden [8]. Cinnamon is one of the well-known and oldest spices, which has been used

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for centuries in several cultures [9]. For centuries cinnamon has been a culinary spice and folk remedy for various maladies. In traditional medicines, its uses include for relief of gastrointestinal distress, arthritis, high blood pressure, dermatitis, toothache, and colds; for improving menstrual irregularities; and for wound healing. Depending on the cultural culinary context, cinnamon is added to beverages, desserts, liqueurs, teas, chicken and lamb dishes, breads and pastries, and fruit preparations [10-12]. Four species of the genus Cinnamomum are main contributors to its commercial applications. These are Cinnamomum Verum (also known as Cinnamomum Zeylanicum, Sri Lankan/Ceylon Cinnamon), Cinnamomum Cassia (also called Cinnamomum Aromaticum, Chinese Cinnamon), Cinnamomum Burmannii (Indonesian/Java Cinnamon), and Cinnamomum Loureiroi (Saigon/ Vietnamese Cinnamon). The chemical profiles of the oils and other extracts derived from the dried inner bark of these different species exhibit varying levels of main constituents, which include cinnamaldehyde, cinnamic acid, coumarin, linalool, eugenol, caryophyllene, and polyphenolpolymers [13-17]. Recently, cinnamon supplements received increased attention for their use as adjuncts in treating high blood glucose and lipid levels and other symptoms of the metabolic syndrome [18-20].

Methods

In the current literature review, the key words including cinnamon, diabetes, insulin, blood glucose, and hemoglobin A1C from the list of MeSH and other credible scientific websites such as Science Direct, PubMed and Google Scholar were used to compile the effects of cinnamon on blood glucose level and also hemoglobin A1C in diabetes.

Results

Established on the study of Zare et al. (2019) found, that cinnamon supplementation (500 mg capsules twice daily) can develop anthropometric considerations, glycemic indices, and lipid profile of patients with type 2diabetes. These benefits are considerably more prominent in patients with higher Body mass index (BMI≥27) [21]. Also, Kim et al. (2006) studied the anti-diabetic activity of cinnamomum cassia extract in type 2 diabetic animal models. Cinnamon extract was administered at many dosages for 6 weeks. It was found that blood glucose level is significantly diminished in a dose-dependent manner (P< 0.001) with the most compared with the control [22]. Kumar et al. (2013) considered the effect of oral administration of cinnamon extract to hyperglycemia induced rats. The Study showed that oral administration of cinnamon extract produced a significant decrease in the blood glucose level in the model of induced diabetes rats [23]. Anderson et al. (2016) demonstrated the effects of cinnamon cassia 250 mg given twice a day to patients with type 2 diabetes. After, two months it was found that fasting blood glucose decreased significantly (P< 0.001) [24]. In addition, Al-Yasiry et al. (2014) proved the hypoglycemic activity of cinnamon in poorly controlled patients with type 2 diabetics. The participants were given 0.5 g of crude cinnamon 15 minutes after each meal for a total of 1.5 g daily for three months. They found that HbA1c decreased from 9.54+0.96 pre-treatment to 8.22 + 0.65 post treatment (P< 0.01) [25]. Cinnamon cassia usage in type 2 diabetes was studied by Akilen. (2010) Participants were given a total of 2g daily ingestion of 2 g of cinnamon each day was found to significantly reduce the HbA1c level, $p < 0.05$ [26]. Governa et al. (2018) found that the consumption of supplementation with cinnamon, usually in combination with standard hypoglycemic therapies, has been related to modest effects on fasting plasma glucose and hemoglobin A1c [27]. In some studies, the improvements to serum insulin response or sensitivity to cinnamon were inconsistent while, in other studies showing a benefit effect of cinnamon on insulin response [28-30]. In a study on healthy individuals, 3 different oral glucose tests were administered to 7 healthy individuals. Accordingly, the individuals have consumed 5 g of placebo, 5 g of cinnamon, and 5 g of cinnamon 12 hours after the oral glucose test. In the group that consumed cinnamon, there was a significant decline in the total plasma glucose response, and insulin sensitivity developed [28]. In another study of the same researchers on healthy individuals, they have found that cinnamon has made improvements in glucose and insulin sensitivity during 14-day periods [30]. In the study of Tang et al. (2008) it was found that there was no change in preprandial blood glucose and blood lipids at the end of 4 weeks in healthy individuals who were given cinnamon [31]. In the study of Kim et al. (2006) hydroxyl cinnamic acid was obtained by refining from cinnamon. They investigated this acid as an antidiabetic derivative.

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They found that it had the highest glucose transport activity. They determined that it reduced the plasma glucose by improving glucose transport [32]. In a study of obese and normal weight individuals, in the measurements made 120 minutes after cinnamon consumption, cinnamon was found to reduce the postprandial blood glucose in both groups [33]. It has been reported in a study that 500 mg of cinnamon capsule per day provides positive improvement in the preprandial plasma glucose level of individuals diagnosed with metabolic syndrome [34]. In the study of Stoecker et al. (2010) 137 type 2 diabetes mellitus patients were evaluated for 2 months. The use of 500 mg cinnamon capsules was found to cause a decrease in preprandial and postprandial blood glucose levels [35]. In the study of Akilen et al. (2010) 2 g/day Cinnamomum cassia type cinnamon consumption for 12 weeks was observed to cause a significant decline in HbA1c level [26]. In the study of Lu et al. (2012) a group that consumed ground cinnamon was compared with a placebo group. The study included 66 Chinese people with type 2 diabetes mellitus. At the end of 90 days, a significant decline was observed in HbA1c. No significant decline was observed in the placebo group. Preprandial blood glucose was found to decline significantly in both groups [36]. A meta-analysis of 6 clinical trials involving cinnamon has included 435 people. It was found that cinnamon reduced preprandial blood glucose, and HbA1c decreased in short-term studies [37]. In one study Cinnamon supplementation led to improvement of all anthropometric (Body Mass Index, body fat, and visceral fat), glycemic (FPG, 2hpp, HbA1C, Fasting Insulin, and Insulin Resistance), and lipids (Cholesterol Total, LDL-c and HDL-c) outcomes (except for triglycerides level). All observed changes (except for Cholesterol Total and LDL-c) were significantly more prominent in patients with higher baseline Body Mass Index [19]. Costello et al. (2016) in one study concluded that cinnamon supplements added to standard hypoglycemic medications and other lifestyle therapies had modest effects on FPG and HbA1c [20]. Sali et al. (2018) in one study examined the effect of different molecules derived from different parts of cinnamon on diabetes type 2 enzyme (Dipeptidyl peptidase-4) and carried out primary studies concerning cinnamon anti-diabetic effect [38]. Mirmiranpour H et al. (2019) in one study concluded the use of probiotic supplements (individually or in combination with cinnamon) leads to a reduction in blood glucose and an increase in antioxidant enzymes in people with type 2 diabetes [39]. Namazi et al. (2019) in one study concluded Supplementation with cinnamon can reduce serum levels of glucose with no changes in other glycemic parameters and anthropometric indices [40]. Deyno S et al. (2019) in one study observed Cinnamon significantly reduced fasting blood glucose (FBG) and homeostatic model assessment for insulin resistance (HOMA-IR) level compared to placebo [41]. Hendre AS et al. (2019) in one study concluded highly significant reduction in fasting as well as in post prandial blood glucose and significant difference in serum insulin by the end of 3 months period. Similarly, significant changes were observed in homeostatic model assessment of insulin resistance [42].

Conclusion

Cinnamon has been used as a natural traditional medicine in numerous cultures throughout the world. From the findings of various studies, it can be concluded that the oral administration of cinnamon extracts has a valuable effect on blood glucose levels and hemoglobin A1C. Additional studies are required to determine the effectiveness of the active principles of cinnamon and their therapeutic properties in the management of diabetes.

Authors' contribution

All authors contributed equally to the manuscript.

Conflicts of interest

The authors declared no competing interests.

Ethical considerations

Ethical issues (including plagiarism, data fabrica¬tion, double publication and etc.) have been completely ob¬served by author.

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