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Study on the Effect of Cinnamon in the Treatment or Auxiliary Treatment of Type 2 Diabetes

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Abstract. Type 2 Diabetes Mellitus(T2DM) is one of the fastest-growing global health emergencies of the 21st century. Currently, more than 500 million people worldwide are living with diabetes. According to the International Diabetes Federation, it is expected to affect 592 million people by 2035 and 784 million by 2045. Therefore, the purpose of this paper is to explore the feasibility of natural medicine in the treatment of type 2 diabetes. Cinnamon, as a natural product, has been used as a spice or traditional Chinese medicine for thousands of years. The present clinical trials on the treatment of type 2 diabetes with cinnamon as an adjuvant were analyzed. By comparing the data of Fasting blood glucose(FBL), Glycosylated Hemoglobin(HbA1c), Total cholesterol(TC) and Triglyceride(TG) in different clinical trials, it can be concluded that cinnamon can be used to help treat patients with type 2 diabetes.

Keywords: Cinnamon, T2DM, Clinical test, meta-analysis.

1. Introduction

Diabetes is a major health problem that has reached alarming proportions. According to the International Diabetes Federation, 592 million people are expected to have diabetes by 2035 and 784 million by 2045. Therefore, the search for popular drugs to treat type 2 diabetes has become a major direction of international research. In recent years, studies have shown that some natural drugs are also effective in the treatment of diabetes. This article mainly reviews the existing clinical research results of cinnamon hypoglycemia, and reviews the effects of cinnamon on blood glucose and dyslipidemia in type 2 diabetes patients.

By searching the literature on PubMed, Google scholar, and Web of Science from 2000 to July 2024, the following keywords are adopted: "cinnamon," "blood sugar," "clinical trials," "diabetes," and "Type 2 diabetes". Fasting blood glucose, hemoglobin glycated hemoglobin (HbA1c) and lipid parameters above were used as the main indicators to measure whether cinnamon is effective in patients with type 2 diabetes. At present, there are few clinical studies on cinnamon capsules for patients with type 2 diabetes, and its related pharmacological effects are still unclear. By summarizing the clinical trials on the effects of cinnamon capsules on patients with type 2 diabetes in recent years, this paper can promote the research on the pharmacological effects of cinnamon and contribute to the development and research of natural hypoglycemic drugs. It provides a new direction for the future exploration of bulk drugs for the treatment of type 2 diabetes.

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2. Analysis of the therapeutic effect of cinnamon

Cinnamon, a natural product, has been used as a spice or in traditional Chinese medicine for thousands of years. It is widely distributed in southern China and tropical Southeast Asia, and has the characteristics of large yields and easy access to products. The Chinese medical work Compendium of Materia Medica has recorded the use of cinnamon, which points out that cinnamon has the effect of warming the middle and tonifying the kidney, dispelling cold and relieving pain. Recent studies have shown that cinnamon has significant regulatory effects on glycolipid metabolism.

2.1. Citing the literature and data sources

Table 1. The experimental conditions of each literature include: subjects, cassia bark grams, experimental days, number of experiments

Article	Subject Type	Daily Dose	Length of Study	n(cinnamon)	n(control)
Mang et al. (2006)	T2DM	3 g	16 weeks	33	32
Vanschoonbeek et al. (2006)	T2DM	1.5 g	6 weeks	12	13
Sengsuk et al. (2016)	T2DM	1.5g	60 days	49	49
Blevins et al. (2007)	T2DM	0.5g(x2)	12 weeks	29	28
Crawford et al.(2009)	T2DM	1g	90 days	55	54
Akilen et al. (2010)	T2DM	2g	12 weeks	30	28
Talaei et al. (2017)	T2DM	3g	8 weeks	20	19
Lu et al. (2012)	T2DM	120mg	3 months	22	22
Zare et al. (2018)	T2DM	1.5g	3 months	69	69
Vafa et al. (2012)	T2DM	3g	8 weeks	19	18
Neto et al(2023)	T2DM	3g	90 days	71	69
Khan et al. (2003)	T2DM	1g	5.5 weeks	10	10

Table 1 summarizes key information about the retrieved articles, including authors, patients (t2DM), drug doses used in different trials, duration of action, and the number of people in the experimental and placebo groups to facilitate the following data analysis and discussion.

2.2. HbA1c and related data analysis

According to the data in the literature in Table1, it can be found that the HbA1c (%) measured by Lu's team decreased from the original 8.90 to 8.23, and the data from Sengsuk's team showed that after taking cinnamon capsules for 60 days, the data decreased from 8.48 to 7.73 with a percentage change rate of -8.84%. Among the above experiments, the largest percentage change came from the Zare team, where the HbA1c value dropped from 7.36 to 6.35 and the change rate reached -13.72%. Of the 10 data sets, only Vanschoonbeek measured an increase of 1.35%. There was no significant change in the data of the placebo group compared with the experimental group, and it can be considered that cinnamon has a significant effect on reducing HbA1c.

According to studies, the water-soluble polyphenol polymer in cinnamon has the ability to dramatically boost the body's insulin-dependent glucose metabolism and raise antioxidant activity. Cinnamon water extract also improves insulin signaling through blocking the phosphatase known as protein-tyrosine phosphatase 1B, which has a negative regulatory function on insulin activity. Moreover, cinnamon extract soluble in water has the ability to function as a dual activator of receptors γ and α that are activated by peroxisome proliferator, perhaps adding to the anti-diabetic properties of cinnamon. It will be crucial in the future to pinpoint the exact active ingredients in cinnamon and clarify the molecular process by which it influences insulin sensitivity.

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2.3. FBG and related data analysis

This study extracted nine sets of useful data on FBG measurement from the above literature and integrated the nine sets of data for analysis. The average decrease of the test groups was 6.75%, and the decrease of the khan group was 16% at most, from 11.6 to 9.7. The data in the khan group showed that cinnamon could significantly reduce FBG in the short term. But because HbA1c was not measured in the study, it is difficult to assess the long-term effects of cinnamon on blood sugar control. It can also be found that the effect of cinnamon on low fasting blood glucose seemed to be less significant than that on high fasting blood glucose, with a 6% decrease from 8.4 to 7.9 in the Vanschoonbeek group, and a decrease of about 10% in the group with fasting blood glucose above 9. Overall, cinnamon had a significant impact on helping to lower fasting blood sugar.

At present, cinnamon contains a variety of effective substances such as cinnamaldehyde and cinnamon polyphenol, among which cinnamon polyphenol was found to reduce the expression of glucose transporter 2(GLUT2)mRNA, and significantly reduce the expression of phosphoenolpyruvate carboxykinase (PEPCK) and glucose-6-phosphatase (G-6-Pase)mRNA. These findings suggest that cinnamon polyphenols can significantly improve insulin resistance in HepG2 cells, and the mechanism may be related to the decreased expression of GLUT2, PEPCK and G-6-Pase mRNA.

Cinnamaldehyde, as an effective component of cinnamon extract, can increase the sensitivity of cells to insulin, and help the absorption and utilization of glucose, thereby reducing blood sugar levels. In addition, cinnamon inhibits glycogen synthesis in the liver and reduces glucose emissions in the liver by further controlling blood sugar levels.

2.4. TG/TC and related data analysis

Only 7 out of 13 literatures recorded data on TG and TC. It can be observed that the effect of cinnamon on TG reduction was much higher than that of TC. Taking Lu et al's data as an example, his team measured that after taking cinnamon capsules, TG decreased from 2.93 to 2.15 by 26.62%, while TC only decreased from 4.96 to 4.63 by 6.65%. So we could conclude that long-term administration of low levels of cinnamon significantly reduced Triglyceride levels. Due to the lack of relevant data on cinnamon, its pharmacological effects on TC TG are still to be studied. Therefore, this paper only describes some isolated suggestions on the lipid regulatory mechanism of cinnamon.

Data from in vitro and in vivo animal studies indicate that cinnamaldehyde consumption has a significant control mechanism for blood glucose levels in type 2 diabetes patients, and also has a helpful effect on reducing TC and TG levels. Numerous investigations into the function of cinnamon and its constituents have used intestinal epithelial cells to identify a number of pathways involved in lipid metabolism. Reduced absorption of free cholesterol (FC) and free fatty acid (FFA) from the intestinal lumen to the intestinal epithelial cells, respectively, is the result of cinnamon's inactivation of Niemann-PickC1-like 1 and Cd36 mRNA receptors on intestinal epithelial cells. Furthermore, cinnamon has the ability to suppress the synthesis of chylomicrons via lowering intestinal cells' MTTP levels and Apo B48 production, which are involved in the assembly of intestinal lipoproteins. Additionally, by boosting the expression of ABCA1, which in turn facilitates the outflow of cholesterol from intestinal cells into the intestinal lumen, cinnamon and its isolated components may modulate cholesterol homeostasis. Additionally, The chemicals found in cinnamon also inhibit ABCG5, a protein that facilitates the passage of cholesterol from the intestinal epithelium into the intestinal lumen. Lastly, via lowering Srebp 1c expression, cinnamon can suppress lipogenesis. To summarize, the many benefits of cinnamon and its distinct components lead to an enhanced lipid composition.

3. Conclusion

The analysis of clinical trial data combined with 12 works of literature showed that cinnamon did interfere with various indicators of type 2 diabetes patients to a certain extent, but because the efficacy of natural drugs varies greatly due to regional factors and the composition is complex, the effective composition cannot be determined in a short time, and the pharmacological and toxic effects of

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cinnamon as a drug are still unclear. There is also a lack of clinical research on its pharmacological effects, and it is difficult to be used as the first choice for the treatment of diabetes, but it is undeniable that its control effect on diabetes. In the future, the determination of the active components of cinnamon and the in-depth study of its pharmacological effects may become the main research direction of the scientific team.

Through data analysis, most studies have revealed that cinnamon can help people with type 2 diabetes control blood sugar, but the scientific literature has also produced controversial results. Considering that clinical research on cinnamon is still in its infancy, there is little data at present. Therefore, future studies should develop more standardized experiments to provide insight into the effects of cinnamon on people with diabetes. Overall, cinnamon is indeed a good natural medicine with potential to assist in the treatment of type 2 diabetes.

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