Effect of cinnamon supplementation on fasting blood glucose and insulin resistance in patients with type 2 diabetes

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Abstract

Introduction: *Cinnamon has become an interesting natural product because of its health benefits and its ability to reduce serum lipids, blood glucose, and improve insulin efficacy.*

Objective: *The purpose of this study was to evaluate the effect of cinnamon on blood glucose and insulin resistance in type 2 diabetes patients.*

Method: *Two hundred with type 2 diabetic patients were enrolled in the randomized control trial. Of 200 patients, 100 patients were the study group was given 500 mg of cinnamon powder in capsule form daily along with antidiabetic drug medication (Metformin) for 3 months period and 100 patients were continued with antidiabetic drug medication(Metformin); selected as control group. Blood glucose and serum insulin were measured at the baseline and after 3 months intervention period. Insulin resistance was measured by homeostatic model assessment of insulin resistance (HOMA-IR).*

Results: *The result showed a 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 HOMA-IR.*

Conclusion: *Based on this study, the supplementation of cinnamon could be useful and recommended as an effective therapy for reducing blood glucose and improving serum insulin in type 2 diabetes patients.*

Keywords: *Blood Glucose, Cinnamon, Insulin Resistance, Type 2 Diabetes*

Introduction

Diabetes mellitus is one of the most common metabolic disorders associated with increased blood sugar, carbohydrates, proteins, lipids metabolism and relative or absolute insulin depletion [1]. The prevalence and incidence of this disease are rising continuously, which implies a global epidemic [2]. Increase in the prevalence of diabetes appears to be more pronounced in developing countries. World Health Organization (WHO) has estimated that in 1995, 19.4 million individuals were affected by diabetes in India. These numbers are expected to increase to 57.2 million by the year 2025. The revised figures are 80.9 million by the year of 2030[3]. Studies on native Indian population have confirmed that, during last 30 years, the patient with diabetes have risen markedly. The disease is affecting at an alarming rate to both rural and urban populations in India [4-7]. The recent increase is attributed to some extent, industrialization, urbanization and their associated life style changes, physical inactivity, obesity and possibly a genetic predisposition [8, 9].

Type 2 diabetes involves 90-95% of subjects. It affects people of all races, ethnicities, ages and genders and can significantly alter quality of life. Conditions such as metabolic syndrome prediabetes often result in diabetes within few years. Controlling these syndromes and diabetes becomes a dilemma when it is coupled with the cost of medications. Individuals suffering from diabetes are often started on medication such as metformin and are seen frequently by their providers; therefore, have increasing medical expenses as well [10]. Hence to reduce the long term cost of medication in managing diabetes, a new cost effective alternative supplementation help to reduce long term side effects and expenses for diabetes.

Spices are the common dietary adjuncts which add the taste and flavor to foods. They are pungent or aromatic substances obtained from dried parts of plants usually seeds, fruits, leaves, roots, bark and other plant parts originating in the tropics. They are sources of many compounds that can persuade digestion

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and metabolism processes. Many research studies that exhibit several valuable physiological effects of cinnamon including their insulin-potentiating activity in normal as well as experimentally induced diabetic animal models and also in humans [11-13]. One spice that is emerging as a potential therapeutic agent for the management of diabetes is cinnamon.

The word "cinnamon" is derived from Greek that means sweet wood, which comes from the inner bark of tropical evergreen cinnamon trees [14]. It is one of the most widely used seasoning agents used in the food and beverage industries worldwide and well documented for its medicinal properties since ancient times [15, 16].

Cinnamon has become a natural product of interest because it has been assumed to provide health benefits, such as the ability to reduce serum lipids and blood glucose. It has been suggested that, the modality in which cinnamon expresses its effect on blood glucose can be accredited to its active component cinnamaldehyde [17].

There are only few studies that have been done on effects of cinnamon in treatment of type 2 diabetes. Some studies showed positive results, some showed negative. There is a need for more comprehensive study to assess the effects of cinnamon in type 2 diabetes. Therefore, the purpose of this study is to evaluate the effects of cinnamon on fasting blood glucose (FBG) and insulin resistance (IR) in patients with type 2 diabetes.

Material and Methods

The study was carried out in the Department of Biochemistry, Krishna Institute of Medical Sciences, Karad (Western Maharashtra). The study was approved by Institutional Ethics Committee. This study was carried out in the form of randomized control trial which includes all type 2 diabetic patients referred to Krishna Hospital and Medical Research Centre, Karad. The total of 200 subjects with type 2 diabetes were enrolled into two groups with 100 subjects in each group, including one study group and one control group. The objectives of the study and risk factors were explained to volunteers after that their written informed consents were obtained.

Inclusion criteria: Non insulin dependent type 2 diabetics aged between 35-65 years, having single drug schedule for this treatment.

Exclusion criteria: Patients with pregnancy, breastfeeding, using tobacco, alcohol, consuming thyroid, hypolipidemic, antihypertensive and anticoagulant drug medications were excluded.

The study group was given one capsule of 500 mg cinnamon powder daily post-lunch for 3 months period. During study period, antidiabetic drug medication (Metformin) was continued as usual and subjects were advised to maintain their normal diet and physical activity.

Overnight fasting blood sample was collected from each subject at baseline and after 3 months period. The collected samples were immediately centrifuged at 3000 rpm for 10 minutes and were analyzed for FBG and insulin. Similarly postprandial blood samples were collected and analyzed for glucose.

Data were analyzed using paired and unpaired't' test and values were expressed as Mean ± Standard Deviation.

Results:

There was no significant difference found in the baseline FBG of control and study groups (p=0.1351). It indicated that the daily intake of 500 mg of cinnamon for 3 months period lowered FBG (p<0.0001) extremely in the study group. Also, it was significant decrease (p<0.0013) in FBG in control group after 3 months period when compared with baseline FBG. Further, a significant decrease was found in the FBG of study group after 3 months period as compared to control group (p= 0.0407). A significant difference in postprandial blood glucose (PBG) of control and study subjects before (baseline) (p=0.0573) and after (p=0.0205) 3 months period was found. In control group, extremely significant decrease (p<0.0001) of PBG was observed in baseline and after 3 months period. Similar results were found in study group before (baseline) and after 3 months period (p<0.0001). (Table 1)

Table 1.Comparison of mean blood glucose (baseline and after 3 months) in control and study groups

Variable	Parameter	Baseline Mean±SD	After 3 months periodMean±SD	Difference Mean±SD	Paired t-value	Paired P-value
Control group	FBG	149 ±19.69	146±19.46	3±8.27	3.311	<0.0013
Study group	FBG	154±29.33	143±17.40	11.3±27.97	4.044	<0.0001
Unpaired p and t value		p= 0.1351t = 1.500	p= 0.0407t = 2.060			
Control group	PBG	186±33.01	179±15.12	7±14.79	5.014	<0.0001
Study group	PBG	190±21.83	174±14.23	16±26.86	3.629	<0.0001
Unpaired p and t value		p= 0.0573t = 2.315	p= 0.0205t = 2.336			

FBG:- Fasting blood glucose, PBG: Postprandial blood glucose

Table 2. Comparison of mean serum insulin and HOMA-IR (baseline and after 3 months) in control and study groups

Variable	Parameter	Baseline Mean±SD	After 3 months periodMean±SD	Difference Mean±SD	Paired t-value	Paired P-value
Control group	Serum insulin	11.57±4.14	11.32±4.06	0.25±0.60	4.217	<0.0001
Study group		9.96±4.19	9.15±1.63	0.80±4.06	1.990	0.0493
Unpaired p and t value		p= 0.0065t = 2.748	p = <0.0001t = 4.968			
Control group	HOMA-IR	4.24±1.53	4.07±1.45	0.17±0.36	4.975	<0.0001
Study group		3.83±1.87	3.22±0.69	0.61±1.81	3.369	0.0011
Unpaired p and t value		p= 0.0936t = 1685	p = <0.0001t = 5.524			

HOMA-IR: homeostatic model assessment of insulin resistance

It was found significant decrease in serum insulin in control and study groups before (baseline) (p<0.0065) and after (p<0.0001) 3 months period. In our study, it was observed that the cinnamon supplementation showed significance in serum insulin after 3 months period (p=0.0493) as compared to baseline serum insulin in same group. Also, similar results were found in control group in baseline and after 3 months period (p<0.0001).

The study showed that, significant difference of HOMA-IR was found in study group and control group after 3 months period (p<0.0001). However, no significant difference found in HOMA-IR of baseline control group and study group (p=0.0936). Further, in the study group, significant difference of HOMA-IR found after 3 months period (p=0.0011) as compared to baseline HOMA-IR of same group. Similar result was found in HOMA-IR of control group (p<0.0001) during baseline and after 3 months period. (Table 2)

Discussion

Our findings of this study showed that a significant difference of fasting and post prandial blood glucose found in control and study groups between the baseline and after 3 months of intervention period. Also it was found a significant difference in serum insulin and HOMA-IR when compared between baseline and after 3 months period in control and study groups.

The results of the present study is in agreement with several studies reported by Khan *et al*. (2003) [18], Mang *et al*. (2006) [19], Wang *et al.* (2007) [20], Solomon *et al.* (2007) [21], Crawford (2009) [22], Akilen *et al.* (2010) [23], Sharma *et al.* (2012) [24], Vafa *et al.* (2012) [25], and Al-Yasiry *et al*. (2014) [26] indicating that cinnamon could have significantly hypoglycemic effect on FBG.

The dose of cinnamon (500 mg) was lesser in our intervention study compared to other studies reported by Crawford (2009) [22], Akilen *et al.* (2010) [23], Sharma *et al.* (2012) [24], and Vafa *et al.* (2012) [25]. It has indicated for the effectiveness of cinnamon in 500 mg dose for hypoglycemic activity and also suggested from our results that cinnamon treatment in even lower dose could be effective to reduce FBG and may be helpful to minimize side effects such as stomachache, gastric irritation due to larger dose. (Table 3) Dose of cinnamon was 120 and 360 mg reported by Ting *et al*. (2012) [27] which is lesser than dose of our study.

Comparison in dose wise in the effects of cinnamon on blood glucose and insulin resistance in our present study and other studies is depicted table 3. HOMA-IR in our results of the present study is lower remarkably than studies reported by Wang *et al.* (2007) [20] and recently by Hajimonfarednejad *et al*. (2018) [11].

Table 3: Comparison of our study with other studies

Study	Dose (g)	FBG (%)	Insulin (%)	HOMA-IR (%)	Duration (week)
Present study	0.5	-9	-9	-20	12
Khan *et al*. (2003) [18]	1-6	-15	—	—	5.5
Mang *et al*. (2006) [19]	6	-10.3	—	—	16
Wang *et al*. (2007) [20]	1	-8	NS	NS	8
Soloman *et al.* (2007) [21]	5	-13	—	—	—
Vafa *et al.* (2012) [25]	3	-9.2	-6.2	-3.5	8
Ting et al (2012) [27]	0.350	-15	—	—	12
Al-Yasiry *et al*. (2014) [26]	0.5	-27.5	—	—	12
Hajimonfarednejad *et al*. (2018) [11]	1.5	—	—	—	12

(—): Not available full text and based on abstract only

In different randomized, double blind, placebo-controlled study, Mang *et al*. (2006) [19] investigated the effects of daily intake of an aqueous cinnamon extract in patients with well-controlled type 2 diabetes. It was observed that, cinnamon had a moderate effect in reducing fasting plasma glucose by 10.3 % in cinnamon group as compared to 3.4 % in the placebo group [19]. Significant reduction in plasma glucose and improved insulin resistance was reported after ingestion of cinnamon in the study reported by Solomon *et al*. (2007) [21]. Crawford *et al*. (2009) have reported the significant reduction in FBG patients receiving 1 gm of cinnamon for 90 days. [22]

Akilen *et al*. (2010) in a randomized placebo controlled double blind clinical trial studied the effect of cinnamon on 58 type 2 diabetic patients on oral hypoglycemics. Administration of either 2 g of cinnamon or placebo daily over a period of 12 weeks demonstrated a significant reduction in fasting blood glucose after 12 weeks of treatment [23].

The effect of cinnamon in newly diagnosed type 2 diabetics was studied by Sharma *et al.* (2012). One hundred fifty participants were divided into three groups and given a placebo, 3 g cinnamon and 6 g cinnamon daily spread out over three meals. FBG levels were drastically reduced in both cinnamon groups ($p<0.001$) [24].

The effectiveness of *Cinnamon zeylanicum* in the reduction of FBG was assessed by Vafa *et al*. (2012) [25]. Two of 500 mg tablets were given to 37 subjects three times daily for eight weeks. Cinnamon zeylanicum, also known as true cinnamon, significantly reduced the FBG in the cinnamon group ($p<0.05$). Al-Yasiry Kathuman, Al-Ganimi (2014) [26] determined the hypoglycemic effects of cinnamon on 40 poorly controlled male type 2 diabetics. Participants were given 1.5 gm cinnamon daily for 3 months period. Cinnamon produced 27.5 % decline in FBG of participants ($p<0.01$).

According to several studies including our present study, it has been postulated that naturally occurring substances such as chromium and polyphenols have been shown to improve the insulin sensitivity [27]. These compounds could exert similar effects on insulin signaling and glucose control. Cinnamon consists of insulin-potentiating water soluble polyphenol compound that might be beneficial [20]. It causes activation of insulin receptors by increasing their tyrosine phosphorylation activity and by decreasing phosphatase activity which inactivates the insulin receptors [28, 29]. Based on these facts, it has suggested that some of the beneficial effects brought about by cinnamon in relation to blood glucose lowering in humans are due to polyphenols present in cinnamon [28, 29, 30].

Thus the results of present study and previous scientific evidences have been suggested that cinnamon may have beneficial effects in reducing blood glucose and improving IR in patients with type 2 diabetes.

Conclusion

The study demonstrates that, cinnamon improves metabolism of glucose in patients with type 2 diabetes and may be useful as an efficient and cost effective agent in management of type 2 diabetes mellitus. However, more detailed, extended study is required to further elucidate use of cinnamon as a beneficial antidiabetic food adjunct.

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Conflict of interest

The authors declare that they have no conflict of interest

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