

Effect of Cinnamon Bark on Glucose and Lipids Levels of Male Egyptian Type II Diabetes Mellitus Patients

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ABSTRACT

The present study aimed to determine the effect of cinnamon bark on blood glucose, triacylglycerol, total cholesterol, HDL cholesterol, and LDL cholesterol levels in patients with type 2 diabetes. A total of 30 patients (male) with type 2 diabetes, aged 30-50 years, were divided into two groups. Groups 1 and 2 consumed 1.5 or 3 g of cinnamon daily, respectively for 45 days. **Results:** After 45 days, cinnamon reduced the mean fasting serum glucose (17.63; 24.65%), total cholesterol (17.61, 24.25%), LDL cholesterol (21.73, 31.86%), triacylglycerol (19.62, 22.1%), and phospholipids (15.35, 26.02%) levels. Changes in HDL cholesterol were not significant. It, also, reduced body weight, thus decreasing its body mass index (BMI). **Conclusions:** The results of the present study demonstrated that intake of 1.5 & 3.0 g of cinnamon per day reduces serum glucose, triacylglycerol, LDL cholesterol, and total cholesterol in patients with type 2 diabetes and suggest that the inclusion of cinnamon in the diet of patients with type 2 diabetes may reduce risk factors associated with diabetes and cardiovascular diseases, it, also, improves their body mass index (BMI).

Key words: NIDDM, Lipid profile, Cinnamon

INTRODUCTION

Diabetes is a predominant public health concern affecting a lot of people allover the world. The disease causes substantial morbidity, mortality, and long-term complications and remains an important risk factor for cardiovascular disease ⁽¹⁾. With increasing rates of childhood and adult obesity, diabetes is likely to become even more prevalent over the coming decade. There is an increasing trend allover the world to use complementary and alternative medicine (CAM) among the general public ⁽²⁾. Studies have examined so many ways as mind-body techniques,

biofeedback and others^(3,4), but most of the literature, however, has focused on herbs or other dietary supplements. Herbal remedies or other dietary supplements taken by mouth are to be consistently among the top CAM therapies used⁽⁵⁻⁷⁾. Plant derivatives with purported hypoglycemic properties have been used in folk medicine and traditional healing systems around the world. Many plants as spices, bitter melon, onions, garlic, fenugreek or its extract have anti diabetic (hypoglycemic) and/or hypocholesterolemic effect with different degrees. Spices such as cinnamon and turmeric display insulin-enhancing activity in vitro⁽⁸⁻¹⁰⁾ through improving glucose

metabolism, lipid metabolism, antioxidant status, and capillary function⁽¹¹⁾. In general, the scientific literature on the efficacy of CAM especially spices in the treatment of diabetes is relatively sparse and heterogeneous. Based on WHO recommendation on diabetes mellitus⁽¹²⁾, investigations of hypoglycemic agents of plant origin used in traditional medicine are important. Cinnamon bark (*Cinnamomum zeylanicum*; *Cinnamomum cassia*) is one of the world's oldest spices. In folk (remedy) medicine it is used for its carminative, stimulant and antiseptic properties. Khan et al., 1990⁽⁸⁾ suggested that cinnamon has insulin potentiating activity.

AIM OF THE WORK

The purpose of current study was to determine the effect of cinnamon bark powder on blood glucose, triacylglycerol, total cholesterol, HDL cholesterol, and LDL cholesterol levels in people with type 2 diabetes.

SUBJECTS & METHODS

Analysis of Cinnamon

Cinnamon (*Cinnamomum cassia*) bark powder was purchased from local markets in Cairo. It was analyzed to determine chemical⁽¹³⁾ and mineral composition. Minerals were measured in the ash using atomic absorption, Unicam 929⁽¹⁴⁾.

Subjects (Selection Criteria)

The study was conducted on 30 patients of non insulin dependent diabetes mellitus (NIDDM, type II) patients, who were attending

governmental and Non-Governmental Organization (NGO's) as hospitals and clinics during the years 2001-2004. Their age range was 30-50; with a mean of 41.72 ± 1.59 years. Their BMI range was 26.26-31.42, with a mean of 29.21 ± 0.46 kg/m². The duration of diabetes was 8.0 ± 0.7 ; with a mean of 4.5-17 years. Their fasting blood (serum) glucose levels range between 254.65 and 327.05 mg/dl. The selected subjects were non-smokers, not taking any medicines other than oral anti-diabetic pills for the past four years (at least). The diagnosis of type II diabetes mellitus was based on the criteria of⁽¹⁵⁾.

Anthropometrics Measurements

Weight (wt) and height (ht) were measured in indoor clothing without shoes and body mass index (BMI) was calculated where $BMI = wt \text{ (kg)} / ht \text{ (m}^2\text{)}$.

Research Design

Cinnamon was put into capsules. Each capsule contained 500 mg of cinnamon. The patients were given [1.5 g (1x3 capsules/day) or 3 g (2x3 capsules/day) for 45 days]. The patients take their capsule supply ($\pm 10\%$ extra) every two weeks and they were asked to bring the remaining. Compliance was monitored by capsule count and personnel contact with the subjects and, also, through their physician. The study was conducted for 45 days with 30 individuals with male, type 2, obese and/or overweight diabetics divided into two groups. Group 1 consumed three 500 mg (1x3) capsules of cinnamon/day; group 2 consumed six capsules (2x3) of cinnamon/day. Subjects consumed their normal diets and continued their

medications throughout the study. The patients were instructed to take the capsules immediately after meals (breakfast, lunch, dinner, sometimes they skip dinner and take double after lunch).

Blood Sampling

Fasting blood samples were drawn after overnight fasting and collected. Blood was centrifuged to separate serum. They were kept at -80°C if not analyzed immediately. Glucose, cholesterol (ch or C), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL-C), Ch/HDL-C, HDL-C/LDL-C, triacylglycerol (TG) was determined. Repeated freezing and thawing was avoided.

The Analytical Methods of Blood Serum:

Total cholesterol, TC, (Bio Mérieux kits^(16,17)), total triacylglycerol, TG, (Bicon kits⁽¹⁸⁾), total phospholipids⁽¹⁹⁾, serum HDL (Bio Mérieux kits^(20,21)), serum LDL (Bio Mérieux kits⁽²²⁻²⁴⁾) contents were determined using suitable kits reagents. VLDL-C was determined by using the following equation: VLDL-C=total cholesterol - (HDL-C + LDL-C).

Statistical Analysis

Data are expressed as Mean \pm SE. Data were assessed by paired t-test^(25,26).

RESULTS

Data of table (1) shows anthropometric measurements of both group 1 and 2 (G 1 & 2). The data revealed that there was no

significant difference between the two groups concerning age, weight and BMI. Taking 1.5 or 3 g of cinnamon led to significant decreases in weight and improves BMI after 45 days (6 weeks). Mean decrease was 7.34, 6.51% for G1 & 2 respectively. In group 1, 33.33% were obese (BMI ≥ 30.0) and 66.67% were overweight (BMI ≥ 25.0); the obese ones turned into overweight after taking cinnamon, while overweight ones 50% of them turned into normal and the remaining 50% remained overweight with lower BMI. In group 2, 46.67% were obese and 53.33% are overweight; the obese ones turned into overweight after taking cinnamon, while overweight ones 42.86% of them turned into normal and the remaining 57.14% remained overweight with lower BMI (table 2). The duration of diabetes in diabetic type 2 patients, NIDDM, was: G 1: 8.2 ± 0.72 ; G 2: 8.73 ± 0.76 y.

Data of table (3) reveal the chemical and mineral composition of cinnamon. Analysis shows that cinnamon contains (g/100 g): 4.2 Protein, 5.5 fats, 3.14 ash (mineral), 10.5 crude fibers, and 76.16 carbohydrates with total calorie of 376.94 Kj/100 g. The mineral contents of cinnamon (mg/100 g) were 55.14, 527, 82, 40, 0.51, 2.12, 6.05 and 0.29 for Na, K, Mg, Fe, Cu, Zn, Mn and Cr respectively.

Data of table (4) shows the mean level of serum glucose and lipoproteins profiles of NIDDM (type 2). Data of table (4) shows that taking 1.5 g (group 1) or 3 g (group 2) of cinnamon led to significant decreases in serum glucose levels after 45 days (6 weeks) for both groups. Decreases

ranged from: 13 to 25 % (mean 17.63; G 1), 17.41 to 28.94 % (mean 24.65; G 2). There were, also, significant decreases in serum cholesterol levels in all groups consuming cinnamon. These decreases in serum cholesterol level ranged from: 15.02 to 23.07 % (mean 17.61; G 1), 20.81 to 28.94 % (mean 24.25; G 2). There were non-significant changes in HDL-C in the subjects consuming 1.5 or 3 g of cinnamon for 45 days (6 weeks), only slight increase (3.15% & 3.35% for G 1 & 2 respectively). Decreases in LDL-C and VLDL-C were significant in both groups. The decrease in LDL-C reaches 21.73% & 31.86% for G1 & 2 respectively, while the decrease in VLDL-C in both groups was almost

the same (\approx 17.58%). Decreases in triacylglycerol levels after 6 weeks of cinnamon consumption ranged from 11.63% to 25.83% & 18.71% to 25.71% in G 1 & 2 respectively. Decreases in phospholipids levels after 45 days (6 weeks) of cinnamon consumption ranged from 6.25% to 28.06% & 17.08% to 31.64% in G 1 & 2 respectively.

Data of table (4) reveals that atherogenic indices of diabetic patients as cholesterol/HDL-C showed a significant decrease after taking the cinnamon capsule while HDL-C/LDL-C showed a significant increase after taking the cinnamon capsule for both groups 1 & 2.

Table (1): Anthropometrics measurements of the diabetic patients

			Age	Duration	G 1	Age	Duration	G 2		
					Weight			Weight		
			Year	Year	Kg	Kg/m ²	Year	Kg	Kg/m ²	
Initial	Mean		40.40	8.2	76.69	28.49	41.72	8.73	74.20	29.21
	±SE		1.51	0.72	2.01	0.41	1.59	0.76	1.66	0.46
Final	Mean				71.01	26.39			69.37	27.32
	±SE				1.73	0.34			1.54	0.45
	P<	I vs F			0.041	0.0005			0.042	0.006
% change					-7.34	-7.34			-6.51	-6.51

Table (2): Distribution of BMI of diabetic patients

	BMI	G 1		G 2		Initial	Final	No	%
		Initial	Final	Initial	Final				
		No	%	No	%				
Normal	<25							4	26.67
Overweight	≥25-<30	10	66.67	15	100	7	46.67	11	73.33
Obese	≥30	5	33.33			8	53.33		
Total		15		15		15		15	

Table (3): Analysis of Cinnamon/100 g.

		Chemical														
		Carbo-hydrate	Protein	Moisture	Fat	Fiber	Ash	Calorie	Na	K	Mg	Fe	Cu	Zn	Mn	Cr
			g.						mg	mg	mg	mg	mg	mg	mg	μg
		67.16	4.2	9.5	5.5	10.5	3.14	376.94	55.14	527	82	40	0.51	2.12	6.05	290
RDA											420	8	900	11	2.3	35
%RDA	1.5 g										0.3	7.5	0.001	0.33	3.95	12.43
	3.0 g										0.59	15.0	0.002	0.65	7.89	24.9

Table (4): Clinical characteristics of male NIDDM (type 2)

		Blood Sugar	Cholesterol	HDL-C	LDL-C	VLDL-C	Triacyl-glycerol	Phospho-lipids	<u>Chol</u> HDL-C	<u>HDL</u> LDL-C
G 1										
Initial	Mean	289.06	257.69	41.66	170.75	45.28	193.75	512.69	6.26	0.24
	±SE	8.27	6.86	1.76	2.18	3.73	3.15	9.84	0.17	0.01
Final	Mean	237.17	212.34	42.85	127.56	41.91	155.53	433.26	5.00	0.32
	±SE	5.22	5.96	1.65	1.31	4.52	2.54	8.80	0.10	0.01
	P<	0.00001	0.00003	NS	0.000001	0.044	0.000003	0.000002	0.0003	0.000004
	% Change	-17.63	-17.61	3.15	-21.73	-17.58	-19.62	-15.35	-20.18	31.71
G 2										
Initial	Mean	279.62	262.16	42.65	180.13	39.37	185.20	530.94	6.22	0.24
	±SE	5.22	7.26	1.83	3.22	2.81	2.43	6.39	0.12	0.01
Final	Mean	210.60	198.25	44.04	122.54	31.67	144.18	392.71	4.56	0.36
	±SE	4.23	4.95	1.85	1.68	1.88	1.57	6.57	0.10	0.01
	P<	0.000005	0.00006	NS	0.000002	0.03	0.000003	0.00005	0.0000026	0.000001
	% Change	-24.65	-24.25	3.35	-31.86	-17.81	-22.10	-26.02	-26.66	51.96

NS = Non significant

P< 0.05 is significant

DISCUSSION

Treatment of diabetic patient with cinnamon capsule for 45 days leads to significant reduction of their body weight, which improve their BMI.

Uncontrolled, untreated diabetes mellitus is characterized by elevated blood glucose level. In this study blood glucose level was reduced significantly after taking cinnamon. Cinnamon may reduce blood glucose level through many mechanisms as increasing insulin sensitivity⁽²⁷⁾ or incorporation of its content of Mg and Cr^(28,29).

Type II diabetics suffer from insulin resistance, which include decreased stimulation of muscle glycogen synthesis probably due to defects in glycogen synthase activity and glucose uptake⁽²⁷⁾. They, also, suffer from altered enzymatic activities, such as an increased phosphatase activity and/or seryl phosphorylation of the insulin receptor substrate by glycogen synthase kinase-3^(30,31). Dephosphorylation of the receptor β -subunit is associated with the deactivation of its kinase activity and, therefore, is associated with insulin signal downregulation⁽³²⁾. Maximal phosphorylation of the insulin receptor is associated with increased insulin sensitivity, which is associated with improved glucose and lipid levels. Extracts of cinnamon was shown to activate glycogen synthase, increase glucose uptake, and inhibited glycogen synthase kinase-3 β ^(33,34). Extracts of cinnamon, also, was shown to activate insulin receptor kinase and inhibite dephosphorylation of the insulin receptor, leading to

maximal phosphorylation of the insulin receptor^(33,34). All of these effects would lead to increased insulin sensitivity. It, also, may aid in triggering the insulin cascade system. Since insulin plays a key role in lipid metabolism, and cinnamon can affect insulin then cinnamon may improve glucose and lipids in vivo^(33,34). Dhuley 1999⁽³⁵⁾ showed that cinnamon displays antioxidant activity in rats fed a high-fat diet. Cinnamon enhance activity of antioxidant enzymes through counteracted increase in lipid conjugated dienes and hydroperoxides, the primary products of lipid peroxidation.

Magnesium (Mg) has many important functions in the body. There are controversies in the studies. Some studies have suggested that low Mg level may worsen glucose control in type II diabetes through interrupting insulin secretion from the pancreas and increasing insulin resistance. Mg deficiency is common in diabetics⁽²⁸⁾. Magnesium is a cofactor in various enzyme pathways involved in glucose oxidation, and it modulates glucose transport across cell membranes. It may increase insulin secretion and/or improve insulin sensitivity and peripheral glucose uptake. In another study (Ghada)¹ found that magnesium concentration of Egyptian, diabetic, type II patient were significantly lower than normal non-diabetic patient i.e. they have lower concentration of Mg. Cinnamon contain 60 mg Mg/100 g. (table 3), thus 1.5 and 3.0 g. provide 0.26 and 0.51 of the recommended dietary

¹ Under publication

allowance (RDA⁽³⁶⁾) of Mg respectively.

Chromium (Cr) is an essential trace mineral. Low intake of Cr (< 20 µg/day) may decrease the cellular response to insulin and slow the utilization of stored fat⁽²⁹⁾. Cr potentiate insulin action^(29,37). Insulin increases Cr transport with transferrin by promoting the movement of transferrin receptors from vesicles to surface membranes and this facilitate Cr transport to insulin-sensitive cells where it combines with stored apochromodulin and enhances insulin action on glucose metabolism⁽³⁷⁾. Chromium works closely with diabetes, facilitate glucose uptake into cells, decreases fasting glucose, improves glucose tolerance, lowers insulin and decreases total cholesterol and triacylglycerol while increasing HDL-C. Chromium lowers body weight. All these effects are due to increased insulin sensitivity⁽²⁸⁾. Cinnamon contains 0.29 mg Cr/100 g. (table 3), thus 1.5 and 3.0 g provide 12.43 and 24.86 % of the recommended dietary allowance (RDA⁽³⁶⁾) of Cr respectively. RDA of Cr for human is 35 µg/day⁽³⁷⁾.

CONCLUSIONS

The current study demonstrates beneficial effects of different levels (1.5 & 3 g/day) of cinnamon on serum glucose, triacylglycerol, LDL cholesterol, and total cholesterol levels in patients with type 2 diabetes. Cinnamon reduced serum glucose, triglyceride, total cholesterol, and LDL cholesterol levels in patients with type 2 diabetes. Because cinnamon would not contribute to

caloric intake, diabetics may benefit from the regular inclusion of cinnamon in their daily diet.

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تأثير القرفة على مستوى السكر والدهون في مرض النوع الثاني من البوال

السكرى المصرىين

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قسم الكيمياء الحيوية - المعهد القومى للغذية - مصر

الملخص العربى

الغرض:

دراسة تأثير تناول لحاء القرفة على مستوى السكر، الجلسريدات الثلاثية، الكوليسترول الكلى، كوليسترول البروتينات الدهنية ذات الكثافة العالية، كوليسترول البروتينات الدهنية ذات الكثافة المنخفضة في مرض النوع الثاني من البوال السكري.

تصميم التجربة والطريق:

أجريت التجربة على ٣٠ مريضاً (ذكور) من النوع الثاني، تراوحت أعمارهم ما بين ٣٠ و ٥٠ سنة، كانوا يتناولون ١.٥ أو ٣.٠ جرام/يوم لمدة ٤٥ يوم.

النتائج:

لوحظ بعد ٤٥ يوم انخفاض مستوى السكر (١٧.٦٣٪، ١٧.٦٢٪، ١٧.٦١٪، ١٧.٦٠٪، ١٧.٥٩٪)، الكوليسترول المحمول على الليبيدات ذات الكثافة المنخفضة (٢١.٧٣٪، ٣٥.١٥٪)، الجلسريدات الثلاثية (١٩٦٢٪، ٢٢.١٪) الدهون الفوسفورية (٣١.٨٦٪)، لوحظ أيضاً عدم تغير نسبة كوليسترول البروتينات الدهنية ذات الكثافة العالية، لوحظ أيضاً أنها أدت إلى انخفاض معامل كتلة الجسم.

الاستنتاج:

توضّح نتائج هذه الدراسات أن تناول ١.٥ أو ٣.٠ جرام القرفة/يوم أدى إلى انخفاض مستوى السكر، الجلسريدات الثلاثية، كوليسترول البروتينات الدهنية ذات الكثافة المنخفضة والكوليسترول الكلى في مرضي البوال السكري ذي النوع الثاني، كما أنها تخفض عوامل الخطير المرتبطة بمرضى البوال السكري، القلب، كما أنها أيضاً تحسن معامل كتلة الجسم.