Int J Pharm Bio Sci 2015 Oct; 6(4): (P) 772 - 776

Research Article **Pharmaceutics**

International Journal of Pharma and Bio Sciences **ISSN 0975-6299**

EFFECT OF CINNAMON (*CINNAMOMUM CASSIA*) INTERVENTION ON METABOLIC FEATURES OF ADULT MALE WITH TYPE 2 DIABETES

RICHA SONI* AND VIBHA BHATNAGAR

Department of Foods and Nutrition, College of Home Science, Maharana Pratap University of Agriculture and Technology, Udaipur, India

ABSTRACT

The present study was conducted to determine the effect of oral administration of cinnamon (*Cinnamomum cassi*a) on type 2 diabetic males. Thirty subjects were randomly divided into two groups (15 in each) experimental and control. Experimental group was supplemented with 2 g cinnamon powder filled in capsules (four capsules/day/person) for six weeks. Another group served as control. Body mass index (BMI), blood pressure and lipid profile were estimated at the initial level (0 day), after three weeks and finally after six weeks. After intervention the mean systolic blood pressure (SBP), serum cholesterol (SC) and Low density lipoprotein (LDL) levels were reduced significantly ($P<0.001$) in experimental group (SBP: 126.13 to 121.40 mmHg, SC: 183.66 to 164.93 mg/dl, LDL: 104.73 to 89.93 mg/dl) compared with control group (SBP: 134.06 to 133.2 mmHg, SC: 173.93 to 179.33 mg/dl, LDL: 98.06 to 92.26 mg/dl). A reduction in BMI, diastolic blood pressure (DBP), serum triglycerides (TG), and very low density lipoprotein (VLDL) was observed at six weeks compared to baseline in the experimental group however the changes were not statistically significant. There was slight improvement in high density lipoprotein (HDL) of experimental group but not significant. Whereas, no significant change in any parameter of control group was observed.

KEY WORDS:

- Diastolic blood pressure
- Lipid profile
- Systolic blood pressure
- Type 2 diabetes
- Body mass index (BMI)

RICHA SONI
Department of Foods and Nutrition, College of Home Science,
Maharana Pratap University of Agriculture and Technology, Udaipur, India

INTRODUCTION

India, the world's second most populous country, now has more people with type 2 diabetes (more than 50million) than any other nation. With the spread of fast-food outlets and more sedentary lifestyle, the prevalence of diabetes in India is rising alarmingly. In India, a wide range of outcomes for different groups is buried within the average diabetes prevalence of 8%. Prevalence is only 0.7% for non-obese, physically active, rural Indians. It reaches 11% for obese, sedentary, urban Indians.[1] Diabetes leads to several serious short- term and long-term complications like diabetes coma, strokes, kidney failure, neuropathy, angina, heart attacks, cataract, gangrene, ketoacidosis and hypertension. The incidence of cardiovascular diseases is increased two- to fourfold in people with type 2 diabetes. [2] Proper medical care and regular monitoring of diabetes is essential not only to keep the disease under control but also to prevent an assortment of other diabetes related problems. Because no cure has been identified, hence management of diabetes with diet, exercise and drugs has been emphasized. Botanical products can improve glucose metabolism and the overall condition of individuals with diabetes not only by hypoglycemic effects but also by improving lipid metabolism, antioxidant status, and capillary function.[3]. It has been reported that Cinnamon (*Cinnamon cassia*) contains an active ingredient water soluble polephenol compound MHCP (methyl hydroxy chalcon polymer) that not only work synergistically with insulin cells but it also reduces cholesterol levels and improve lipid metabolism.[4] Cinnamon also brings biochemical changes to the body that keep triglycerdies level low. Cinnamon bark has also shown strong lipolytic activity.[5] Diabetes constitutes more than 50 million people of India and the modern allopathic system of medicine has not been able to reach the remote rural areas for various reasons. A large number of people cannot afford the expanses of elaborate methods of treatment and in recent years, there is more inclination towards alternative therapies of treatment. Therefore, it was considered worthwhile to investigate the effect of Cinnamon intervention on BMI, blood pressure and lipid profile of middle aged adult male with Type 2 Diabetes.

METHODS AND MATERIALS

The study was approved by the institutional advisory committee of Maharana Pratap University of Agriculture and Technology, Udaipur, India and supported by grants from research fund of the same university. A total of 30 subjects with type 2 diabetes since last 3 to 4 years and not on insulin therapy were selected for the study. The inclusion criteria were non insulin dependent type 2 diabetic, male in the age group of 40 to 60 years, fasting blood glucose between 126-160 mg/dl. Exclusion criteria were allergy to cinnamon, peptic and gastric ulcer, any other liver or renal disease. Subjects were selected from Outpatient department (OPD) of Government Hospital of Udaipur (India) and randomly assigned to experimental (n=15) and control (n=15) group. Subjects in the experimental group were provided 2 g of cinnamon in the powdered form filled in empty gelatin capsules (4 capsules/day/person) for a period of six weeks. Subjects were instructed to take one capsule after each of the four meals i.e. breakfast, lunch, evening tea and dinner for six weeks. The subjects were advised to take capsules immediately after meals. Group II served as control group receiving no supplementation. All the subjects were asked to follow their normal routine and take their normal diet and usual diabetic medicine. In order to supervise the supplementation protocol researcher was contacting all the subjects once in a week. Each subject was required to return the original bottle of their supplement for capsule count. BMI, blood pressure and lipid profile was estimated three times at initial (0 day), after three weeks and finally after six weeks. All subjects reported to the laboratory after a 12-hour fast and at least 48-hours after participating in intense physical activity. Height was measured with the help of anthropometric rod and weight was measured with electronic weighing machine. BMI was calculated for each of the patient as weight (kg) divided by height (m^2). Following ten minutes of seated rest, subjects' blood pressure was determined by sphygmomanometer. For the estimation of lipid profile, venous blood samples of all the selected subjects were taken after an overnight fasting. All blood samples were taken in the morning at approximately the same time of day to minimize diurnal variation. Lipid profile estimation consisted of following parameters.

- Serum cholesterol
- Serum triglycerides
- HDL cholesterol
- LDL cholesterol
- VLDL cholesterol

Serum cholesterol was estimated with ERBA cholesterol estimation kit by CHOD- PAP method and end point with a lipid clearing agent. Serum triglyceride was measured with ERBA triglyceride estimation kit by GOD trinder method and end point with lipid clearing agent. HDL was estimated with ERBA HDL estimation kit by phosphotungstic acid method. LDL and VLDL were calculated with the following formulas.

$$\underset{\text{(mg/dl)}}{\text{LDL cholesterol}} = \underset{\text{(mg/dl)}}{\text{Total cholesterol}} - \underset{\text{(mg/dl)}}{\text{HDL}} + \underset{\text{(mg/dl)}}{\text{VLDL}}$$

$$\underset{\text{(mg/dl)}}{\text{VLDL – Cholesterol}} = \frac{\text{Triglycerides (mg/dl).}}{5}$$

The data gathered were statistically analyzed as per the objectives of the study.[6] General information about subjects was expressed as Mean ±SE values or percentage. Paired 't'-test was used to assess the effect of intervention on anthropometric, biophysical and biochemical parameters of the subjects.[6]

RESULTS

The sample was consisted of 30 type 2 diabetic male patients divided into two groups (Experimental n=15 and Control n=15). The mean age of the patients was 52 years. Majority of the subjects were vegetarians (73.3%), non-smokers (83.3%), non-drinkers (86%) had no family history of diabetes (60%) and were involved in some kind of physical exercise (63%). Half of the subjects were obese, 40% were hypertensive and 13% were having cardio vascular diseases.

Effect of cinnamon intervention on body weight and BMI

BMI- The mean body mass index (BMI) of the experimental and control group was 26.03 kg/m^2 and 25.43 kg/m^2 respectively (Table I). Results showed that though there was a slight reduction in the body weight and BMI but the difference was not significant in both the groups after the intervention.

Table I

Impact of Cinnamon intervention on (Mean± SE) BMI of the subjects

S. No.	Parameters	Initial (a)	After 20 day (b)	After 40th day(c)	't' value a v/s b	t' value a v/s c
A	**Experimental group (n=15)**					
1.	• Weight(kg)	69.93 ± 2.97	68.16±2 .60	67.93±2.70	0.95 NS	1.34 NS
2.	• Height(cm)	167.33± 0.9	167.33±0.9	167.33±0.9	-	-
3.	• BMI (kg/m²)	26.03 ± 0.67	25.58 ±0 .72	25.43 ±0 .75	0.59NS	0.35NS
B	**Control group (n=15)**					
1.	• Weight(kg)	70.86± 3.03	70.66± 3.01	70.89± 3.04	0.36 NS	0.18 NS
2.	• Height(cm)	167.92±0.94	167.92±0.94	167.92±0.94	-	-
3.	• BMI (kg/m²)	25.43±0.88	25.42± 0.88	25.40± 0.91	0.2 NS	0.31NS

NS- Non Significant

Effect of cinnamon intervention on blood pressure

After six weeks subjects in the experimental group decreased their SBP by 3.45% (from 126.13 ± 2.46mm Hg [pre] to 121.4±1.58 mmHg [post], P<0.01) compared to the subjects in the control group (from 134.06 ± 3.26 mmHg [pre] to 133.2±3.18 mmHg [post]). No significant changes in diastolic blood pressure (experimental: from 84.0 ± 1.34 mmHg [pre] to 83.33 ± 1.27mmHg [post], control: from 88.26±1.74 mmHg [pre] to 87.13±1.70 [post]) were noted.

Table II

Effect of Cinnamon intervention on (Mean± SE) Blood Pressure

S. No.	Parameters (mmHg)	Initial (a)	After 20 day(b)	After 40th day (final) (c)	't' value a v/s b	't' value a v/s c
A	**Experimental group (n = 15)**					
1.	Systolic B.P.	126.13±2.46	124.66±2.77	121.4±1.58	0.98 NS	3.24**
2.	Diastolic B.P.	84.0±1.34	84.4±1.04	83.33±1.27	0.58 NS	0.78 NS
B	**Control group (n = 15)**					
1.	Systolic B.P.	134.06±3.26	132.73±2.93	133.2±3.18	0.65 NS	0.04 NS
2.	Diastolic B.P.	88.26±1.74	87.13±1.44	87.13±1.70	0.86 NS	0.38 NS

***** Significant at both 5% & 1% level***

NS - Non Significant

Effect of cinnamon intervention on lipid profile

Serum Cholesterol

Cinnamon intervention had a definite positive effect on the cholesterol levels of the subjects. The intake helped to reduce the mean serum cholesterol of experimental group (from 183.66 ± 8.19 mg/dl [pre] to 164.93 ± 9.96 mg/dl [post], P>0.01) significantly. The reduction was 10.19 % (Table III). No significant change in serum cholesterol (from 173.93 ± 9.89 mg/dl [pre] to179.33±9.51 mg/dl [post]) was noted in the control group.

Serum Triglycerides

2 g cinnamon did not alter the serum triglyceride values significantly in both the groups. (experimental: 150.6 ± 10.99 mg/dl [per] to143.53 ± 9.64 mg/dl [post] and control: 160.06±15.74 mg/dl [pre] to 170.93±11.87 mg/dl [post], P>0.01).

High Density Lipoprotein (HDL-C)

The mean values for HDL - C for experimental group was 44.33 ± 3.06 mg/dl at initial level and 46 ± 3.0 mg/dl at the end of the study (Table III). Although there was 3.6 % improvement in HDL-C levels of experimental group but

these results were not statistically significant. (P>0.01) While in case of control group mean values at the initiation of the study was 43.26 ± 3.79 mg/dl at and 42.6 ± 3.94 mg/dl at the completion of the study. This indicates that there was no significant alteration in HDL - C level in control group.

Low-Density Lipoprotein (LDL-C)

Mean LDL - C values at the time of inception of study in the experimental group was 104.73 ± 5.98 mg/dl which reduced to 89.93 ± 10.25 mg/dl after the completion of study. The supplementation effect found to be significant in experimental group (P>0.05), which was 14.1%. The mean ± SE values for LDL - C before the intervention in control group was 98.06± 7.53mg/dl which remains almost static after the completion of study.

Very Low Density Lipoprotein (VLDL –C)

Being a carrier of the triglycerides its level in blood goes parallel to the triglycerides. The mean value of VLDL- C before, during and after intervention is presented in Table-III. In the mean values of VLDL-C ranged from (experimental: 30.13 ± 5.63 mg/dl[pre] to 29.0 ± 1.91 mg/dl [post] and control: 31.93±3.11mg/dl [pre] to 34.46±2.36 [post]) indicates no significant change in both the groups.

Table III

Effect of cinnamon intervention on (Mean± SE) lipid profile

S. No.	Parameters Lipid Profile (mg/dl)	Initial (a)	After 20 day(b)	After 40th day (c)	t value a v/s b	't' value a v/s c
A	**Experimental group (n=15)**					
1.	S. Cholesterol	183.66±8.19	175.26±8.92	164.93±9.96	2.97**	4.40**
2.	S. triglycerides	150.66±10.99	143.20±9.93	143.53±9.64	2.04 NS	1.13 NS
3.	HDL - C	44.33±3.06	45.0±3.15	46.0±3.0	0.37 NS	2.13 NS
4.	LDL - C	104.73±5.98	101.13±9.11	89.93±10.25	0.70 NS	2.30*
5.	VLDL - C	30.13±5.63	29.13±1.99	29.0±1.91	1.51 NS	0.36 NS
B	**Control group (n=15)**					
1.	S. Cholesterol	173.93±9.89	178.4±8.68	179.33±9.51	1.97 NS	1.99 NS
2.	S. triglycerides	160.06±15.74	170.66±11.7	170.93±11.87	1.23 NS	1.26 NS
3.	HDL - C	43.26±3.79	40.33±3.66	42.6±3.94	1.50 NS	1.98 NS
4.	LDL - C	98.06±7.53	105.53±7.64	92.26±4.88	1.64 NS	0.18 NS
5.	VLDL - C	31.93±3.11	34.66±2.32	34.46±2.36	1.59 NS	1.92 NS

***** Significant at both 1% & 5% level***

**** Significant at 5% level but NS at 1% level. NS - Non Significant.***

DISCUSSION

The findings of the present investigation indicate that consuming 2g cinnamon per day for six weeks is beneficial in reducing several components (SBP, serum cholesterol and LDL-C) of metabolic syndrome in diabetes. While no significant difference was observed in DBP, serum triglycerides, HDL-C and VLDL-C before and after the intervention between the two groups. Khan et al.[7] were the first to report that cinnamon enhances glucose uptake in a rat epididymal fat cell assay. Thereafter, others confirmed the insulin-potentiating properties of cinnamon on glucose uptake.[4] Khan et al [8] were also first to present data on the effects of cinnamon supplementation in vivo in humans. Sixty type 2 diabetics randomly assigned to three groups receiving 1,3, 6 g of cinnamon /day for 40 days. Cinnamon supplementation significantly reduced the fasting blood glucose (18-29%), serum cholesterol (12-26%) and LDL-C level (7-27%) and triglyceride (23-30%). Afterward other researchers proved hypoglycemic effects of cinnamon.[9] These results are similar to the present study but no significant reduction in triglyceride was observed. The observed reduction in lipid profile in the present study is less than that of Khan *et al*. Differences between the 2 studies could be attributed to the inclusion of only men in the present study and the type of medication that was used by the patients. Although Khan et al.[8] selected subjects using only sulfonylurea derivatives, but in this study we selected a group of patients using commonly prescribed combinations of oral blood glucose–lowering agents (sulfonylureas derivatives, metformin, and/or thiazolidinediones). Also our subjects' lipid levels were not abnormal, while Pakistani subjects in Khan *et al*. study have abnormal lipid levels.[8] Insulin resistance leads to the overproduction of very low density lipoproteins (VLDLs) and to reduce lipoprotein lipase activity, thereby resulting in dyslipidemia. Therefore, attainment of better glycemic control may improve the lipid profile.[10] Anuradha and Devi [11] also reported significant reduction in both serum cholesterol and LDL levels after 4 g cinnamon supplementation for 90 days. Similar outcomes were also notices by Ziegenfuss et al [12] in a study involving 22 subjects with metabolic syndrome, subjects were divided into two groups and given either 500 mg/day of an aqueous extract of cinnamon (Cinnulin PF, Integrity Nutraceuticals, Spring Hill, TN) or a placebo for 12 weeks. Subjects in the group receiving capsules containing the aqueous extract of cinnamon displayed decreased fasting blood glucose, decreased systolic blood pressure(133 to 129 mm Hg) , and increased lean mass (+1.1%) compared with the placebo group. Additionally, within-group

analyses uncovered small, but statistically significant decreases in body fat (–0.7%) in the cinnamon group. Akilen et al [13] also reported that Intake of 2g of cinnamon for 12 weeks significantly reduces the HbA1c (8.22 to 7.86%), SBP (132.6 to 129.2 mm Hg) and DBP (85.2 to 80.2 mm Hg) among poorly controlled type 2 diabetes patients. Many other researches[14,15,16,17] also reported beneficial role of cinnamon consumption on some features of metabolic syndrome in type 2 diabetic patients.

CONCLUSION

The results of the present study demonstrated that intake of 2 g of cinnamon/ day significantly reduces serum cholesterol, LDL and systolic blood pressure in people with type 2 diabetes. No adverse effect of cinnamon was observed on the health status of the subjects. Cinnamon supplementation could be considered as an additional dietary supplement option to regulate blood glucose and blood pressure levels along with conventional medications to treat type 2 diabetes mellitus.

REFERENCES

1. Diamond J. Diabetes in India. Nature,469 (7331): 478-479, (2011)
2. Raza A. J. and Movahed A. Current concepts of cardiovascular diseases in diabetes mellitus. International Journal of Cardiology, 89 (2-3): 123–134, (2003)
3. Bailey C.J. and Day C. Traditional plant medicines as treatments for diabetes. Diabetes Care, 12 (8):553–564, (1989)
4. Broadhurst C.L., Polansky M.M., Anderson R.A. Insulin-like biological activity of culinary and medicinal plant aqueous extracts in vitro. Journal of Agriculture Food Chemistry, 48(3):849–852,(2000)
5. Jarvill J. and Karjee T. A hydroxy chalcone derived from cinnamon, function *as* mimetric to insulin in 3T3 XT adipocytes. *http./. diabetesjournal. Org.(2003)*
6. Gupta S C. Ed.Fundamentals of Statistics, Himaliya Publishing House Print line :New Delhi,17-20 (1992)
7. Khan A., Bryden N. A., Polansky M.M., Anderson R.A., Insulin potentiating factor and chromium content of selected foods and spices. Biological Trace Element Research, 24 (2):183–188, (1990)
8. Khan A., Safdar M., Khan H.M.A., Khallak K.N. and Richard A., Cinnamon improves glucose and lipid of people with type 2 diabetes. *Pakistan Journal of Nutrition,* 2(12): 312 – 319, (2003)
9. Soni R. and Bhatnagar V. Effect of Cinnamon (Cinnamomum cassia) intervention on blood glucose of middle aged adult male with Non Insulin Dependent Diabetes Mellitus (NIDDM). Studies on Ethno- Medicine, 3(2): 141-144, (2009)
10. Vafa M., Mohammadi F., Shidfar F., Somaghi S., Heidari I., Golestan B. and Amiri F. Effect of cinnamon consumption on glycemic status, lipid profile and body composition in type 2 diabetic patients. International Journal of Preventive Medicine, 3 (8): 531-536, (2012)
11. Anuradha V. and Devi A. Hypoglycemic effect of cinnamon and cumin seed powder on type 2 Diabetes. Indian Journal of Nutrition Dietetics,41 (1):370-374, (2004)
12. Ziegenfuss T.N., Hofheins J.E., Mendel R.W., Landis J., and Anderson R.A. Effects of a water-soluble cinnamon extract on body composition and features of the metabolic syndrome in pre- diabetic men and women. Journal of International Society of Sports Nutrition, 28(3):45-53, (2006)
13. Akilen R., Tsiami A., Devendra D. and Robinson N. Glycated haemoglobin and blood pressure-lowering effect of cinnamon in multi-ethnic Type 2 diabetic patients in the UK: a randomized, placebo-controlled, double-blind clinical trial. Diabetic Medicine, 27(10):1159-1167, (2010)
14. Stoecker BJ., Zhan Z., Luo R., Mu X., Guo X., Liu Y., Guo Q., Zhou J., Kong J., Zhou Z., CUI B., Anderson RA. Cinnamon extract lowers blood glucose in hyperglycemic subjects. The journal of Federation of American Society for Experimental Biology, 1 (24): 722, (2010)
15. Crawford P. Effectiveness of cinnamon for lowering hemoglobin A1C in patients with type 2 diabetes: a randomized, controlled trial. Journal of American Board of Family Medicine,22(5):507-512, (2009)
16. Solomon T.P, Blannin A.K. Changes in glucose tolerance and insulin sensitivity following 2 weeks of daily cinnamon ingestion in healthy humans. European Journal of Applied Physiology, 105(6):969-976, (2009)