ORIGINAL ARTICLE

EFFECT OF CINNAMON EXTRACT ON BLOOD GLUCOSE LEVEL AND LIPID PROFILE IN ALLOXAN INDUCED DIABETIC RATS

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Background: Cinnamon has been shown to potentiate the hypoglycaemic effect of insulin through up regulation of the glucose uptake in cultured adipocytes of rats. This study tried to find out the effect of Cinnamon alone or in combination with Insulin in diabetic albino rats. **Methods:** Thirty rats were divided into three groups, A and B. Group A were given cinnamon extract 200 mg/Kg body weight daily orally and group B rats were given cinnamon extract 400 mg/Kg body weight daily. After six weeks blood glucose and lipid profile levels were evaluated in all the groups. **Results:** Group of rats given 200 mg cinnamon extract showed significant decrease of blood glucose concentration but there was slight or no change in the level of lipid parameters including serum cholesterol, triglyceride and lipoproteins (HDL, LDL-chol). On the other hand group of rats given 400 mg extract of cinnamon showed a better but non significant change in level of lipid related parameter while blood glucose level was significantly decreased. **Conclusion:** The cinnamon at a dose of 400 mg showed same effects on blood glucose level but better effects on lipid profiles especially of serum cholesterol level of group of rats compared to 200 mg of cinnamon extract. Cinnamon may be recommended as hypoglycaemic herb but not as hypolipidemic herb.

Keywords: Cinnamon, lipid profile, Diabetes, LDL, HDL

INTRODUCTION

The prevalence of diabetes for all age groups world wide was estimated to be 2.8% in 2000 and will be 4.4% in 2030. The total number of people with diabetes is expected to rise from 171 million in 2000 to 366 million in 2030.[1] In diabetic patients, the body loses insulin producing capacity as a result of pancreatic β-cell apoptosis or insulin insensitivity. The cytokines, lipo-toxicity and gluco-toxicity are three major stimuli for β-cell apoptosis.[2] Evidence is increasing that control of hyperglycaemia, hypertension and dyslipedemia may postpone the development of diabetic complications in type 2 diabetes mellitus.[3]

Currently there is growing interest in herbal remedies due to side effects associated with therapeutic agents (oral hypoglycaemic agents and insulin) for the treatment of diabetes mellitus. Cinnamon has a long history as an anti-diabetic spice, but trials involving cinnamon supplementation have produced contrasting results.[4] Cinnamon extracts are reported to have beneficial effects on people with normal and impaired glucose tolerance, the metabolic syndrome, type 2 diabetes, insulin, insulin sensitivity and insulin resistance.[5] All show beneficial effects of whole cinnamon and/or aqueous extracts of cinnamon on glucose, lipids, antioxidant status, blood pressure, lean body mass, and gastric emptying. However, not all studies have shown positive effects of cinnamon, and type and amount of cinnamon, as well as the type of subjects are likely to affect the response to cinnamon.[6]

Cinnamon supplementation facilitates glucose disposal in healthy humans, which may be achieved by enhancing (1) insulin sensitivity via increased phosphorylation of signalling proteins and (2) insulin-sensitive glucose transporter 4-mediated glucose uptake into muscle cells. Because peripheral insulin resistance is primarily a consequence of reduced muscle insulin sensitivity, Cinnamon extracts may attenuate insulin resistance and glucose intolerance.[7]

Naturally-occurring compounds that have been shown to improve insulin sensitivity include Cr and polyphenols found in cinnamon (*Cinnamon cassia*). These compounds also have similar effects on insulin signalling and glucose control. Studies utilising an aqueous extract of cinnamon, high in type A polyphenols, have also demonstrated improvements in fasting glucose, glucose tolerance and insulin sensitivity in women with insulin resistance.[8] A constituent of cinnamon known as methyl hydroxyl chalone polymers (MHCP) was proposed to be effective insulin mimetic which activates the path ways leading to glucose utilisation in cells. It is proposed that MHCP act as insulin mimetic most likely by trigging the same cascade as the insulin signalling path way.[9] On the other hand cinnamon extract administration to high fructose diet fed rats prevented the development of insulin resistance possibly by enhancing insulin signalling path way in skeletal muscle.[10]

The cinnamon extract seems to have a moderate effect in reducing fasting plasma glucose concentrations in diabetic patients with poor glycaemic control.[11] Patients with type 2 diabetes found that cinnamon intake was associated with favourable effects on fasting plasma glucose but does not improve the

level of HbA1C. It is thought that cinnamon should not be recommended for improvement of glycaemic control.[12]

We tried in this study to find out the possible effect of cinnamon extract as anti-hyperglycaemic and anti-hyperlipidemic herb.

MATERIAL AND METHODS

Thirty adult male albino rats weighing (150–200 gm) were obtained from National Institute of Health (NIH), Islamabad and kept under observation for a week in the animal house of Post Graduate Medical Institute, Lahore, prior to experimentation. Rats were divided into 2 groups comprising of group A and B.

Albino rats were fed with normal rat diet *ad libitum*. Fresh and wholesome water was also provided *ad libitum*. Alloxan monohydrate was dissolved in saline solution and was administered in a dose of 100 mg/Kg body weight intera-peritonially.[13]

The dose of the cinnamon was determined for animals on bodyweight basis. A dose of 200 mg/Kg body weight was given to group A and a dose 400 mg/kg body weight to group B.

Data was analysed using SPSS-14.

RESULTS

The blood glucose concentrations presented as Mean±SD in Group A at 0, 2 and 4 weeks were 138.90±17.12, 127.60±12.61, 119.80±11.97 and 116.80±12.35 mg/dl respectively. The difference of blood glucose level between 0 vs 2, 0 vs 4, and 0 vs 6 weeks showed statistically highly significant decrease.

Levels of serum triglyceride were 81.90±5.54, 83.20±2.39, 86.80±22.23 and 82.60±17.06 mg/dl respectively. Levels of VLDL were 16.38±1.11, 16.64±0.48, 17.36±4.45 and 16.52±3.41 mg/dl. It was observed that there is a variation in the level of VLDL and its carrier protein. (Table-1)

Effect of cinnamon extract 400 mg/Kg (Group A) on Blood Glucose and serum lipid profile is presented in Table-2. The levels of blood glucose were 143.00±16.35, 136.30±16.12, 129.30±6.23 and 124.10±32.80 mg/dl at 0, 2, 4 and 6 weeks respectively. Significant difference was observed only after 4 and 6 weeks. Levels of triglyceride were 83.10±15.74, 91.70±15.31, 84.30±3.65 and 73.51±14.33 mg/dl respectively. Levels of VLDL carrier protein were 16.62±3.15, 18.34±3.06, 16.86±0.73 and 14.70±2.87 mg/dl. Although, the levels of triglyceride and VLDL carrier protein were decreased but this showed no significant difference.

Table-1: Effect of cinnamon extract 200 mg/Kg (Group A) on blood glucose and serum lipid profile

Parameters	Week of sampling/level of blood glucose (mg/dl)				Significance		
	0 Week	2 Week	4 Week	6 Week	0 vs 2 Week	0 vs 4 Week	0 vs 6 week
Glucose (mg/dl)	138.90±17.12	127.60±12.61	119.80±11.97	116.80±12.35	NS	S	HS
Triglyceride (mg/dl)	81.90±5.54	83.20±2.39	86.80±22.23	82.60±17.06	S	NS	NS
VLDL	16.38±1.11	16.64±0.48	17.36±4.45	16.52±3.41			

HS= <0.01, S= <0.05, NS= >0.05

Table-2: Effect of cinnamon extract 400 mg/Kg (Group B) on blood glucose and serum triglyceride

Parameters	Week of sampling/level of blood glucose (mg/dl)				Significance		
	0 Week	2 Week	4 Week	6 Week	0 vs 2 Week	0 vs 4 Week	0 vs 6 week
Glucose (mg/dl)	143.00±16.35	136.30±16.12	129.30±6.23	124.10±32.80	NS	S	S
Triglyceride (mg/dl)	83.10±15.74	91.70±15.31	84.30±3.65	73.51±14.33	S	NS	NS
VLDL	16.62±3.15	18.34±3.06	16.86±0.73	14.70±2.87			

HS= <0.01, S= <0.05, NS= >0.05

DISCUSSION

Hypoglycaemic herbs are widely used as non-prescription treatment for diabetes. However, few herbal medicines have been well characterised and demonstrated the efficacy in systematic clinical trials as those of Western drugs. These herbs may lower blood glucose however; their test results are subject to several factors. Firstly, each herb contains thousands of components, only a few of which may be therapeutically effective. Secondly extraction of active component is not easy.[14,15]

Present study observed that 200 mg/Kg cinnamon showed significant glucose lowering effect from the period of 0–6 weeks. The hypoglycaemic effect of cinnamon oil (CO) in a type 2 diabetic animal model was studied by Ping *et al*[16] and according to their study CO was administrated at doses of 25, 50 and 100 mg/Kg for 35 days. They found that fasting blood glucose concentration was significantly decreased (p<0.05) with the 100 mg/Kg group (p<0.01) compared to diabetic control group. They observed that CO had a regulative role in blood glucose level and lipids, and improved the function of pancreatic islets. Another study[17] was carried out on group of mice. They gave cinnamon extract for a period of 12 weeks (200 mg/Kg). Their study found that both fasting blood glucose and postprandial 2 h blood glucose levels in the cinnamon treated group were significantly lower than those in the control group (p<0.01). On the other hand a study reported that cinnamon may improve glycaemic control and insulin sensitivity, but the effects are quickly reversed.[18]

Present study observed that there is no remarkable change in the levels of triglyceride and carrier protein VLDL after taking 200 mg cinnamon for a period of 0–6 weeks. A study reported that oral administration of cinnamaldehyde (20 mg/Kg body weight) significantly decreased glycosylated haemoglobin (HbA1C), serum total cholesterol, triglyceride levels and at the same time markedly increased plasma insulin, hepatic glycogen and high-density lipoprotein-cholesterol levels. The results of an experimental study indicate that cinnamaldehyde possesses hypoglycaemic and hypolipidemic effects in STZ-induced diabetic rats.[19]

Some studies have reported that cinnamon does not appear to improve HbA1C, fasting blood glucose or lipid parameters in patients with type 1 or type 2 diabetes.[20] Some experts advise against treatment of diabetes with cinnamon.[21] A study proposed the mechanism that cinnamon extract may improve the postprandial overproduction of intestinal apoB48-containing lipoproteins by ameliorating intestinal insulin resistance and may be beneficial in the control of lipid metabolism.[22] Another study experimented and proved that purified hydroxychalcone from cinnamon is fully capable of mimicing insulin and recommended further studies.[23,24]

Present study observed that 400 mg cinnamon showed significant glucose lowering effect from the period of 0–6 weeks. Present study also observed that there is a decrease in the levels of triglyceride and its carrier VLDL after taking 400 mg cinnamon for a period of 0–6 weeks. Our study is in accord to a study who observed that CO was administrated at doses of 25, 50 and 100 mg/Kg for 35 days. It was found that fasting blood glucose concentration was significantly decreased ($p<0.05$) with the 100 mg/Kg group ($p<0.01$) the most efficient compared with the diabetic control group. In addition, there was significant decrease in plasma C-peptide, serum triglyceride, total cholesterol and blood urea nitrogen levels after 35 days. Meanwhile, glucose tolerance was improved, and the immunoreactive of pancreatic islets β-cells was promoted. Results suggest that CO had a regulative role in blood glucose level and lipids, and improved the function of pancreatic islets.[16] Another study observed that cinnamon extract was administered at different dosages (50, 100, 150 and 200 mg/Kg) for 6 weeks.

It was found that blood glucose concentration is significantly decreased in a dose-dependent manner ($p<0.001$) with the most in the 200 mg/Kg group compared with the control. The concentration of triglyceride, total cholesterol and intestinal α-glycosidase activity were significantly lower after 6 weeks of the administration. These results suggest that cinnamon extract has a regulatory role in blood glucose level and lipids and it may also exert a blood glucose-suppressing effect by improving insulin sensitivity or slowing absorption of carbohydrates in the small intestine.[3]

According to a study 3 groups of experimented animal consumed 1, 3, or 6 g of cinnamon daily for 40 days followed by a 20-day washout period. The study observed that after 40 days, all three levels of cinnamon reduced the mean fasting serum glucose (18–29%), triglyceride (23–30%). The study suggested that the inclusion of cinnamon in the diet of people with type 2 diabetes will reduce risk factors associated with diabetes and cardiovascular diseases.[25] The study investigated the effect of cinnamate, a phenolic compound found in cinnamon bark, on lipid metabolism and antioxidant enzyme activities in rats fed a high cholesterol diet. Three groups of rats were given a diet containing 1 g of cholesterol/Kg for 6 weeks. These results suggest that dietary cinnamate inhibits hepatic HMG-CoA reductase activity, resulting in lower hepatic cholesterol content, and suppresses lipid peroxidation via enhancement of hepatic antioxidant enzyme activities.[26]

A study experimented hypolipidemic effect of cinnamon and reported that accumulation of diacylglycerol plays an important role in development of hepatoma in LEC rats by mediating proto-oncogene c-fos induction.[27,28]

During the entire study, the albino rats which were given either cinnamon extract alone or in combination with insulin, showed 100% survival rate as compared to increasing high mortality and ill health of albino rats that were on insulin alone. This revealed that cinnamon also functions as potent anti-oxidant agent, which could lead to additional health benefits. However, if patients are chronic diabetic then cinnamon alone may not be very beneficial. It is only useful in patients who have mild to moderate hyperglycaemia.

CONCLUSION

Cinnamon may have anti-hyperglycaemic antilipidemic properties and have potential to reduce serum triglyceride and postprandial blood glucose levels. Further research is required to confirm a possible correlation between baseline fasting blood glucose, blood glucose reduction, and triglyceride level, and to assess the potential to reduce pathogenic diabetic complications with cinnamon supplementation. It is also necessary to look for side effects of herb if any.

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