Original article

Preventive role of Zingiber officinale (ginger) juice against hyperlipidemia in alloxan induced diabetic rats

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Abstract

Objectives : This experimental animal study was undertaken to investigate the preventive role of ginger juice against hyperlipidemia in alloxan induced diabetic rats.

Methods : Male wistar rats, (130-150) gm wt. fed on standard diet and water ad libitum, were divided into 3 groups (n=6) in each group: Group-I, non-diabetic control, Group-II diabetic control & Group-III, normal rats pretreated with ginger before they were made diabetics. Diabetes was induced by inj. Alloxan 150mg/kg body wt. i.p (Group-II , on 2nd day & Group-III, on the 9th day).

Results : Rats having blood glucose level of more than 7mmol/L on day 5 (72 hrs after alloxaninj) were considered diabetic & selected for experiment. Rats of Group-III received Zingiber officinale (ginger) juice (4ml/kg. body wt, orally) for 7 days (day 2-day 8) through ryles tube before alloxan induction & 3 days after the induction. On day 12 animals were sacrificed under light ether anaesthesia, blood was collected by cardiac puncture and serum separated for estimation of lipids. Pretreatment with Zingiber officinale (ginger) juice significantly ($p< 0.01$) reduced alloxan induced hyperglycemia & hyperlipidemia.

Conclusion : Hyperlipidemia, a metabolic derangement, contributing to atherosclerosis in diabetes mellitus. Zingiber officinale (Ginger) is one of the most widely used spices and is reputed to have medicinal properties against diabetes mellitus & it has also hypocholesterolemic effects. This study suggest that pretreatment with Zingiber officinale (ginger) prevents the development of hyperlipidemia in alloxan induced diabetic rats.

Key words : Hyperlipidemia, Zingiber officinale (ginger), diabetic rats.

Introduction

Hyperlipidemia is a major risk factor for atherosclerosis in diabetes mellitus. Diabetic individuals have 2-4 folds increased risk of clinical atherosclerotic disease[1]. Atherosclerosis increases the risk of heart disease, stroke and other vascular diseases. The use of herbal remedies has increased many folds from 1990 onwards.

These herbal remedies are apparently effective, produce minimal or no side effects and are of relative low costs as compared to oral synthetic hypoglycemic agents. In recent years, ginger has become a subject of interest because of its beneficial effects on human health.

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Zingiber officinale commonly known as ginger is consumed worldwide as spice and is known to have wide variety of medicinal properties. It was reported that ginger has medicinal properties against digestive disorders, rheumatism & diabetes.[2] Akhani et al. reported that ginger pretreatment inhibited streptozotocin hyperglycemia & hypoinsulinaemia.[3] Sharma et al, 1996, have showed the hypolipidemic effect of ginger. In diabetic rats, the impaired utilization of carbohydrate leads to accelerated lipolysis resulted in hyperlipidemia.[4] Another study has reported that an ethanolic extract of ginger prevent hypercholesterolemia and development of atherosclerosis in cholesterol fed rabbits.[5] It was concluded that the hypo-cholesteromic effect of ginger could have possibly resulted from the inhibition of cellular cholesterol biosynthesis after the consumption of the extract.[6] Furthermore, Neess et al. reported that the reduction of cellular cholesterol biosynthesis is associated with increased activity of the LDL receptor, which in turn leads to enhanced removal of LDL from plasma, resulting in reduced plasma cholesterol concentration.[7]

The present study was undertaken to investigate the

preventive role of fresh ginger juice against hyperlipidemia in pretreated rats followed by the induction of diabetes.

MATERIALS AND METHODS

The experimental animal study was done in the department of Pharmacology & Therapeutics, Dhaka Medical College and Hospital in collaboration with the Department of Pathology of Ibrahim Medical College, Dhaka, during January 2009 to December 2009.

Plant materials and preparation of juice

The fresh juice of Zingiber officinale (ginger) was obtained from local market. 1 kg of fresh rhizome were crushed, and then squeezed in muslin cloth to obtain the juice using the method of Akhani et al.[3] Sodium benzoate (0.5%) was added as preservative. The juice was stored in the refrigerator at 2-8°c in a well-closed glass container.

Animals

Male wistar rats weighing between 130-150gm were housed in polycarbonate cage sat a regulated temperature (22±2°c) & humidity (55%) controlled room with a 12h light/12h dark cycle for 12 days and were fed on standard rat pellet diet and allowed to drink water and libitum.

Induction of diabetes in rats

After 24 hours fasting, rats of (group II & III) were injected alloxan 150 mg/ kg b.w. i.p on Day 2 and Day 9 of the study respectively.

Fasting blood glucose levels were estimated on day1(before inj. alloxan), on day 5 (72 hrs after inj. alloxan) and day 12 of the experimental study. Blood glucose was estimated by placing a test strip in the glucometer (ACCU-CHEK, Roche diagnostic GmbH). A drop of blood was collected by aseptically cutting the tail at the tip (0.1cm) with sharp sterile blade and then applying the drop of blood to the test area of the strip. Rats with blood glucose of more than 7mmol/L on day 5 (i.e. 72 hrs after inj. alloxan) were considered diabetic & selected for experiment.

Experimental design

Rats were divided into 3 groups (n=6, in each group). Group 1 : Normal (non diabetic) control, Group II : Diabetic control & Group III : Normal rats pretreated with ginger before they were made diabetics, rats of this group received Z. officinale (ginger) at a dose of 4ml/kg body weight (as per Akhani et al[3]) for 10 days (day 2- day 11) orally through ryles tube. On the 12th day of the study, animals were sacrificed under light ether anaesthesia, whole blood was collected by cardiac puncture and then serum was separated for estimation of lipids.

Statistical Analysis

The results are presented as mean ± SD. Unpaired 't' test was performed and p value <0.05 was considered as statistically significant.

RESULTS

Diabetic control is compared with normal. Treated group is compared with diabetic control.

A. Effects of Z. officinale (ginger) juice on blood glucose level in normal, diabetic & pretreated rats.

i. The mean ± SD of blood glucose (mmol/L), in normal non- diabetic rats (Group-I) on day 1 and day 12 of the study were 5.40±0.76 and 5.45±0.76 respectively, while in diabetic control rats (Group-II) were 5.57±0.12 and 8.52±0.68 respectively. The difference between two groups (Group-I vs. Group-II) were statistically significant ($p<0.001$) suggesting that inj. alloxan significantly increased the blood glucose level. The mean ± SD of blood glucose (mmol/L), of diabetic control rats (Group-II) and of pretreated rats (Group III, normal rats pretreated with ginger for 7 days before inj. alloxan and 3 days after induction) on day 12 of the study were 8.52±0.68 and 7.50±0.42 respectively. The difference between two groups (II & III) were statistically significant ($p<0.011$), suggesting that pretreatment with ginger juice before inj. alloxan produced significant decrease in blood glucose level when compared with diabetic control. The results are shown in Table-1.

Table - 1 : Effects of Zingiber officinale (ginger) on blood glucose in non-diabetic normal control (Group-I), & diabetic control rats (Group-II)

Fasting blood glucose (mmol/L)	Group-I (n=6)	Group-II (n=6)	p value
At 1st day	5.40±0.76	5.57±0.12	0.619ns
At 12th day	5.45±0.76	8.52±0.68	.001***
Fasting blood glucose (mmol/L)	Group-II (n=6)	Group-III (n=6)	p value
At 12th day	8.52±0.68	7.50±0.42	.011**

Data were expressed as Mean ± SD

**= significant at 0.01

***=significant at .001

ns= not significant

B. Effects of Zingiber officinale (ginger) juice on lipid profile in normal, diabetic & pretreated rats.

i. Effects of Zingiber officinale (ginger) juice on lipid profile in normal (non-diabetic) & diabetic control rats

Lipid profile (mean ± SD) of total cholesterol,

HDL-cholesterol, LDL-cholesterol and triglyceride G, all in mg/dl, (estimated on day 12 of the study) of normal (non diabetic) control rats (Group-I) were 85.67±977, 43.67±5.61, 22.83±4.83 and 51.67±4.67 respectively. While those of diabetic control rats (Group-II) were 111.00±5.87, 37.17±6.01, 55.50±3.94 and 75.00±3.58 respectively. The difference in lipid profile (increase in total cholesterol, LDL- cholesterol & triglyceride) in two groups (Group-I vs. Group-II) were statistically significant (p<.001 for Total cholesterol, LDL-cholesterol & Triglyceride), but HDL-cholesterol level statistically without change when compared to normal group.

ii. Effects of Zingiber officinale (ginger) on lipid profile in diabetic control (Group-II) & Pretreated rats before they made diabetics (Group-III).

Lipid profile (mean ± SD) of total cholesterol, HDL-cholesterol, LDL- cholesterol and TG, all in mg/dl (estimated on day 12 of the study) were 111.00±5.87, 37.17±6.01, 55.50±3.94 and 75.00±3.58 respectively, while those of pretreated rats, Group-III, (ginger juice 4ml/kg body weight for 7 days from 2nd day & 3 days after induction& inj. alloxan 150 mg/kg body weight given on the 9th day), were102.33±6.09, 55.17±6.27, 12.33±3.27 and 70.67±4.50 respectively. The differences in lipid profile (decrease in total cholesterol, LDL-cholesterol, and increased in HDL- cholesterol) in two groups (Gr.-II & III) were statistically significant (p<0.031 for total cholesterol, and for LDL- cholesterol p<.001, for HDL- cholesterol p<.001 &) when compared with diabetic control rats, while plasma TG statistically (p<0.095) did not change. The results are shown in table-2.

Table 2 : Effects of Zingiber officinale (ginger) juice on lipid profile in normal control (Group-I), diabetic control (Group-II) & pretreated rats (Group-III).

Lipid profile	Group- I	Group- II (n=6)	p value (n=6)
Total cholesterol (mg/dl)	85.67±9.77	111.00±5.87	0.001***
HDL (mg/dl)	43.67±5.61	37.17±6.01	081 ns
LDL (mg/dl)	22.83±4.83	55.50±3.94	0.001***
TG (mg/dl)	51.67±4.76	75.00±3.58	0.001***
Lipid profile	Group- II (n=6)	Group III (n=6)	p value
Total chol(mg/dl)	111..00±5.87	102.33±6.09	0.031*
HDL (mg/dl)	37.17±6.01	55.17±6.27	0.001***
LDL (mg/dl)	55.50±3.94	12.33±3.27	0.001***
TG (mg/dl)	75.00±3.58	70.67±4.50	0.095ns

All estimation were done on day 12 of the study
Data were expressed as Mean ± SD
*= significant at 0.05
***= significant at 0.001
ns= not significant

Discussion

The present study was undertaken to investigate the preventive role of Zingiber officinale (ginger) juice against hyperlipidemia in alloxan induced diabetic rats. Injection of alloxan (150 mg/kg body weight, intravenous) produced marked hyperglycemia and hyperlipidemia (increased total cholesterol, LDL-cholesterol & TG and decreased HDL- cholesterol). Treatment with Zingiber officinale (ginger) juice (4ml/kg body weight, per oral) for 7 days from 2nd day to normal rats before they were made diabetics & 3 days after the induction, produced significant blood glucose and lipid lowering (decreased total cholesterol, LDL- cholesterol & TG & increased HDL-cholesterol) effects. Thus, suggesting preventive role of Zingiber officinale (ginger juice) against hyperlipidemia in alloxan induced diabetic rats. The results are in agreement with those of previous studies 3-5, who showed similar lipid lowering effects in pretreatment with Zingiber officinale (ginger) in different experimental animal models.

Conclusion

The present study demonstrated the preventive role of Zingiber officinale against hyperlipidemia in alloxan induced diabetic rats. Further studies are suggested for investigating possible mechanism(s) of action. However further investigations may be required to find out the specific role of different lipid profile in large number of experimental animals in different settings.

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