Original Article

ANTI-HYPERLIPIDEMIC ACTION OF *ZINGIBER OFFICINALE* (GINGER) JUICE IN ALLOXAN INDUCED DIABETIC RATS

Selima Sultana[1], Shakil Akter[2] and Md. Ismail Khan[3]

Department of Pharmacology & Therapeutics
[1]Ad-din Women's Medical College, [2]Bangladesh Medical College, [3]Dhaka Medical College, Dhaka

Abstract

Hyperlipidemia is an important modifiable risk factor contributing to atterosclerosis in diabetes mellitus. *Zingiber officinale* (ginger) widely consumed as spice is known for its hypoglycemic and hypochlosteremic actions. The present study was undertaken to investigate anti-hyperlipidemic action of ginger juice in alloxan-induced diabetic rats. Male Wister rats, 130-150 g wt, fed on standard diet and water ad libitum were divided into 4 groups (n=6 in each group): group I non-diabetic control, group II non-diabetic treated; group III diabetic control and group IV diabetic treated. Diabetes was induced by Inj. alloxan 150 mg Kg^{-1} b.w., i.p. (group III & IV) on Day 2. Rats having blood glucose level of >7 mmol/l on day 5 (72 hrs after alloxan Inj.) were considered diabetic and selected for experimentation. Both non-diabetic and diabetic treated groups (Gr II & IV) received *Zingiber officinale* (ginger) juice (4 ml Kg^{-1} b.w., p.o.) for 10 days (day 2-day 11) through Ryles tube. On Day 12, animals were sacrificed under light ether anaesthesia, blood was collected by cardiac puncture and serum separated for estimation of lipids.

Zingiber officinale (ginger) juice significantly ($p < 0.01$) decreased alloxan induced hyperglycemia (group IV), but had no effect on blood glucose level in normal rats (group II); significantly ($p < 0.001$) reduced alloxan induced hyperlipidemia, but produced no significant lipid lowering effects in normal rats (group II).

The results suggest a significant anti-hyperlipidemic action of *Zingiber officinale* (ginger) juice in alloxan induced diabetic rats. The findings may be clinically significant and exploited.

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Key words: Anti-hyperlipidemia, *Zingiber officinale* (ginger), diabetic rats

Introduction

Cardiovascular diseases (coronary artery diseases, strokes and peripheral vascular diseases) constitute the major causes of morbidity and mortality in diabetes mellitus. Diabetic individuals have 2-4 times increased risk of clinical atherosclerotic diseases.[1] Hyperlipidemia is one of the most important modifiable risk factors contributing to atherosclerosis in diabetes and may be the result of unbalanced metabolic status of diabetes namely hyperlipidemia and insulin resistance.[2]

Search for medicinal plants and/or their extracts for the treatment of diabetes mellitus continues despite their limited success as substitutes for insulin or its analogues and other synthetic anti-diabetic drugs. *Zingiber officinal Roscoe* commonly known as ginger is consumed worldwide as spice and is known to have wide variety of medicinal properties. Pharmacologically, the plant (fresh rhizome) or its extracts have been investigated for its hypoglycemic,[3,4] hypocholesteromic,[2,5,6] anti-inflammatory,[7-8] anti-microbial[8] and anticancer activities.[9]

Address for Correspondence:
Dr. Selima Sultana, Assistant Professor, Department of Pharmacology & Therapeutics, Ad-din Women's Medical College, 2 Bara Magbazar, Dhaka-1217, e-mail: ark_udd@yahoo.com

The present study was undertaken to investigate the effect of fresh ginger juice on lipid profile (hyperlipidemia) in alloxan induced diabetic rats compared to non-diabetic controls.

Materials and Methods

This experimental animal study was done in the Department of Pharmacology & Therapeutics, Dhaka Medical College during period January-December 2009.

Plant materials and preparation of juice

The fresh rhizome of *Z. officinale* (ginger) was obtained from local market. 1 Kg of fresh rhizome were crushed, then squeezed in muslin cloth to obtain the juice using the method of Akhain *et al*.[4] Sodium benzoate (0.5%) was added as preservative. The juice was stored in the refrigerator at 2-8^{0}C in a well-closed glass container.

Animals

Male Wister rats weighing between 130-150 g were housed in air-conditioned animal room at 22$\pm$2^{0}C for 12 days and were fed on standard rat pellet diet and allowed to drink water ad libitum.

Experimental induction of diabetes in rats

After 24 hrs fasting, rats (group III & IV) were injected alloxan 150 mg Kg^{-1} b.w.ip on Day 2 of the study. Fasting blood glucose levels were estimated on Day 1 (before Inj. alloxan), on Day 5 (72 hrs after Inj. alloxan) and on 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 asceptically cutting the tail at the tip (0.1 cm) with shrap sterile blade and then applying the drop of blood to the test area of the strip. Rats with blood glucose of $>$7 mmol/l on Day 5 (i.e 72 hrs after Inj. alloxan) were considered diabetic and selected for experimentation.

Experimental design

Rats were divided into 4 groups (n=6, in each group), group I: Normal (non-diabetic) control, group II: Normal (non-diabetic) treated, group III: Diabetic control, group IV: Diabetic treated. Rats of Gr II (non-diabetic treated) and Gr IV (diabetic treated) received *Z. officinale* (ginger) juice at a dose of 4 ml Kg^{-1} b.w (as per Akhain *et al*[4]) 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$\pm$SD. Unpaired 't' test was performed and p value $<$0.05 was considered as statistically significant.

Results

A. Effects of *Z. officinale* (ginger) juice on blood glucose level in normal and diabetic rats

i. The mean$\pm$SD of blood glucose (mmol/l), in normal (non-diabetic) rats (group I) on day 2 and day 12 of the study were 5.40$\pm$0.76 and 5.45$\pm$0.76 respectively, while in normal (non-diabetic) treated (ginger juice 4 ml Kg^{-1} b.w. for 10 days) rats (group II) were 5.45$\pm$0.76 and 5.47$\pm$0.59 respectively. The differences between two group (I vs II) were not statistically significant ($p < 0.05$) suggesting that ginger juice did not lower blood glucose level in normal (non-diabetic) rats.

ii. The mean$\pm$SD of blood glucose (mmol/l), of diabetic control rats (group III) on day 2 (before Inj. alloxan) and on day 5 (72 hrs after Inj. alloxan) were 5.73$\pm$0.49 and 9.20$\pm$0.76 respectively, suggesting that Inj. alloxan significantly ($p < 0.001$) increased the blood glucose level.

iii. The mean$\pm$SD of blood glucose (mmol/l), of diabetic control rats (group III) and of diabetic treated (ginger juice 4 ml Kg^{-1} b.w. for 10 days) rats (group IV) on day 12 of the study were 8.52$\pm$0.68 and 7.52$\pm$0.42 respectively. The differences between two groups (III vs IV) were statistically significant ($p < 0.01$) suggesting that treatment of diabetic rats with ginger juice produced significant decrease in blood glucose level.

B. ***Effect of Zingiber officinale (ginger) juice on lipid profile in normal and diabetic rats***

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

Table-1: *Effects of Zingiber officinale (ginger) juice on blood glucose and lipid profile in normal (non-diabetic) rats*

Group & Treatment	Blood glucose mmol/l±SD	Total chol mg/dl±SD	HDL-chol mg/dl±SD	LDL-chol mg/dl±SD	TG mg/dl±SD
Group I Normal control fed standard diet & water (n-6)	5.45±0.76	85.67±9.77	22.83±9.83	43.67±5.61	51.67±4.76
Group II Normal Treated Ginger Juice 4 ml Kg^{-1} b.w for 10 days, Day 2-11, (n-6)	n.s 5.47±0.57	n.s 80.33±10.13	n.s 19.17±3.43	n.s 47.83±4.83	n.s 44.33±3.83

All estimations were done on day 12 of the study, $p > 0.05$

Lipid profile (mean±SD of Tol. chol, HDL-chol, LDL-chol and TG, all in mg/dl, (estimated on day 12 of the study) of normal (non-diabetic) control rats (group II) were 85.67±9.77, 43.67±5.61, 22.83±4.83 and 51.67±4.76 respectively, while those of normal (non-diabetic) treated (ginger juice 4 ml Kg^{-1} b.w. for 10 days) rats (group II) were 80.33±10.13, 47.83±4.83, 19.17±3.49 and 47.33±3.83 respectively. The differences in lipid profile (decrease in Tol. chol, LDL-chol, TG and increase in HDL-chol) in two groups (I vs II) were not statistically significant ($p > 0.05$). The results are shown in Table-1.

ii. Effect of *Zingiber officinale* (ginger) juice on lipid profile in diabetic rats

Lipid profile (mean±SD of Tol. chol, HDL-chol, LDL-chol and TG all in mg/dl, (estimated on day 12 of the study) of diabetic control rats (group III) were 111.00±5.87, 37.17±6.01, 55.50±3.94 and 75.00±3.58 respectively, while those of diabetic treated (ginger juice 4 ml Kg^{-1} b.w. for 10 days) were 73.83±4.31, 48.33±4.46, 13.83±3.60 and 66.83±5.78 respectively. The differences in lipid profile (decrease in Tol. chol, LDL-chol, TG and increased in HDL-chol) in two groups (III vs IV) were statistically significant ($p < 0.001$ for Tol. chol & LDL-chol, $p < 0.01$ for HDL; $p < 0.05$ for TG).

The results are shown in Table-2.

Table-2: *Effect of Zingiber officinale (ginger) juice on blood glucose and lipid profile in diabetic rats*

Group & Treatment	Blood glucose mmol/l±SD	Total chol mg/dl±SD	HDL-chol mg/dl±SD	LDL-chol mg/dl±SD	TG mg/dl±SD
Group III Diabetic Control Alloxan 150 mg Kg^{-1} b.w, i.p on Day 2 (n=6)	8.52±0.68	111.00±5.87	37.17±6.01	55.50±3.94	75.00±3.58
Group IV Diabetic Treated Alloxan 150 mg Kg^{-1} b.w, i.p on Day+Ginger Juice 4 ml Kg^{-1} b.w for 10 days Day 2-11, (n=6)	* 7.50±0.42	*** 73.83±4.31	** 48.33±4.46	*** 13.83±3.60	* 66.83±5.78

All estimation were done on Day 12 of the study.
$p < 0.05$ for blood glucose & TG, $p < 0.001$ for Tol. chol & LDL-chol; $p < 0.01$ for HDL-chol

Discussion

The present study was undertaken to investigate the effects of *Zingiber officinale* (ginger) juice on lipid profile in alloxan induced diabetic rats compared to normal non-diabetic controls. Injection of alloxan (150 mg Kg^{-1} b.w,i.p) produced marked hyperglycemia and hyperlipidemia (increased Tol. chol, LDL-chol & TG and decreased HDL-chol). Treatment with *Zingiber officinale* (ginger) juice (4 ml Kg^{-1} b.w, p.o) for 10 days to alloxan induced diabetic rats produced significant blood glucose and lipid lowering (decreased Tol. chol, LDL-chol & TG and increased HDL-chol) effects. However treatment of ginger juice for 10 days to normal non-diabetic rats did not produce significant lipid lowering effects; thus suggesting a significant anti-hyperlipidemic action for *Zingiber officinale* (ginger) juice in alloxan induced diabetic rats. The results are in agreement with those of previous studies[2,5,6,8] who showed similar lipid lowering effects of *Z. officinale* in different experimental animal models.

The present study demonstrated a significant anti-hyperlipidemic action of *Zingiber officinale* (ginger) juice in alloxan induced diabetic rats. Further studies are suggested for investigating possible mechanism(s) of action. However the findings itself are of great interest and significance; and can be clinically exploited.

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