Comparative study of antihyperglycemic and antihypercholesteromic effect of aquous extract of *Allium sativum* (Garlic) *and* *Zingiber officinale* (Ginger) in alloxan induced rats

MM Hossain[1*], M Islam[2] and MS Islam[1]

[1]Department of Anatomy, Histology & Physiology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh
[2]Department of Microbiology and Parasitology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh

*Correspondence: mmhossaindvmbau@gmail.com

ABSTRACT

The aim of this study was to compare the single and combined effect of *Allium sativum* (Garlic) *and Zingiber officinale* (Ginger) against hyperglycemia and hypercholsteremia in alloxan induced rats. A total of 300 rats were used for 5 trials. Among them 60 rats (12 normal rats and 48 alloxan induced diabetic rats) were used for each trail. In each trial rats were divided into 5 groups each containing 12 individuals as follows: Group A (Normal Control); Group B (Diabetic control); Group C (Alloxan + Garlic treated); Group D (Alloxan + Ginger treated) and Group E (Alloxan + Garlic + Ginger treated). After 18 hours of starvation, body weights, blood glucose level and blood cholesterol level were measured. Then alloxan were injected @ 100 mg/kg body weight intraperitonially to induce hyperglycemia as well as hypercholsteremia in groups B, C, D, and E. All groups were reared under normal condition from Day 1-10. To ensure the induction of hyperglycemia as well as hypercholsteremia on the day of 10 body weights, blood glucose and cholesterol level were measured. After that all groups were kept for more 21 days. During that period on Day 0, 7, 14, and 21 body weights, blood glucose as well as cholesterol level were measured by using commercially available biochemical kits. Aqueous extract of garlic and ginger were fed @ 500mg and 300mg/kg body weight daily for 21 days in groups C and D respectively and a combined dose (800mg/kg) were used for group E. The blood sugar level and blood cholesterol level were reduced in Group C from 154.5±3.98 to 120.35±4.21 and 209.11±5.24 to 126.66±6.58, respectively. In Group D the blood sugar level and blood cholesterol level were reduced from 155.5±2.99 to 123.12±4.23 and 213.43±6.21 to 128.76±6.98, respectively. But the reduction of blood sugar level and blood cholesterol level were more prominent in Group E from 156±4.11 to 110.21±3.98 and 218.12±6.34 to113.81±6.13, respectively. From the above observations it can be concluded that combined use of garlic and ginger is more effective to control hyperglycemia as well as hypercholsteremia compare to single dose.

Key words: rats, alloxan, garlic, ginger, glucose, cholesterole

INTRODUCTION

Diabetes mellitus, a metabolic disease with manifestation of hyperglycemia, is a fast growing health problem throughout the world. It has been estimated that the number of adults affected by diabetes in the world will grow from 135 million in 1995 to 300 million in the year 2025 (Mutalik et al., 2003, King et al., 1998). Generally, diabetes is classified into two main types: type-1 diabetes, a state of insulin deficiency because of defect in islet β-cell function and type-2 diabetes which mainly characterized by resistance to the actions of insulin. The overall prevalence of type-1 diabetes (diabetes mellitus) in the global population is approximately

6% where as 90% comprising type 2 diabetes. The American Diabetic Association has recommended metformin as a first-line agent for the treatment of type 2 diabetes, as metformin helps in weight loss and lowers fasting plasma insulin concentrations, total and low-density lipoprotein cholesterol, and free fatty acids (Anonymous, 2011) however; long-term complications are not altered with metformin therapy. Moreover, the hypoglycemic drugs lead to some unpleasant side effects such as lactic acidosis, peripheral edema, severe hypoglycemia, and abdominal discomfort (Lorenzati et al., 2010).

The therapy of diabetes has changed markedly in the past 20 - 25 years. By using synthetic hypoglycemic agents usually produces many side effects and also they are too much expensive. Therefore, the search for more effective and safer hypoglycemic agents has continued to be an important area of active research. These facts show that proposing an immediate strategy for diabetes prevention and treatment is a global subject. For a long time, diabetics have been treated with several medicinal plants or their extracts based on the folklore medicine (Akhtar and Ali., 1984). A number of investigations of oral antihyperglycemic agents from plants used in traditional medicine have been conducted and many of the plants have been found with good activity (Rind et al., 2010, Khushk et al., 2010, Kesari et al., 2007). Presently, there is growing interest in herbal remedies due to the side effects associated with the oral hypoglycemic agents (therapeutic agent) for the treatment of diabetes mellitus (Kim et al., 2006).

Garlic (*Allium sativum*) is a member of the Liliaceae family, which is one of the most popular herbs used worldwide to reduce various risk factors associated with several diseases (Thomson et al., 2007, Jamison, 2003). Garlic has been found to be effective in lowering serum glucose levels in STZ-induced as well as alloxan induced diabetic rats and mice. Most of the studies showed that garlic can reduce blood glucose levels in diabetic mice, rats and rabbits. In addition, Liu and co-workers (2005) reported that both garlic oil and diallyltrisulphide improved glycaemic control in STZ-induced diabetic rats. Ingestion of garlic juice resulted in better utilization of glucose in glucose tolerance tests performed in rabbits, while allicin at a dose of 250 mg/kg was 60% as effective as tolbutamide in alloxan induced diabetic rabbits (Mathew and Augusti, 1973). A few isolated studies about the hypoglycaemic properties of ginger in animals have been reported (Sharma and Shukla, 1977). It is reported that a small but significant blood glucose lowering effect of ginger juice in diabetic and non-diabetic animals was observed (Akhani et al., 2004). Some hypoglycemic activity was found in both garlic and ginger as compared to diabetic controls groups.

Therefore, the search for new anti-diabetic agents preferably herbal medicinal product are to be the main challenge in the modern world to protect this silent killer type of metabolic disease without creating health hazard. Considering the above facts the present study was designed to compare the single and combined effect of *Allium sativum* (Garlic) *and Zingiber officinale* (Ginger) on blood glucose and blood cholesterol level in diabetic rats with minimum health hazard.

MATERIALS AND METHODS

This research work was conducted in the Laboratory of Physiology, Department of Anatomy, Histology and Physiology, Faculty of Animal Science and Veterinary Medicine, Sher-e-Bangla Agricultural University (SAU), Dhaka during the period from July 2014 to June 2015.

Collection and acclimatization of rats

Total 60 mixed albino rats, long Evan's strain (*Ratus norvegicus*) aged between 2 to 3 months and weighting between 70 to 100g were collected from the Faculty of Pharmacy, Jahangir Nagar University, Savar, Bangladesh. For five experimental trials, all the rats were grouped into five experimental groups each containing 12 rats. Each group was housed at serene bottomed wire cages arranged in rows and kept in the animal house of this department. The animals were fed with pellet at a recommended dose of 100 g/kg as advised by the authority from where the mice were purchased. Drinking water was supplied *ad libitum*. The rats were reared in that condition throughout the experimental period.

Collection of herbs

Garlic (*Allium sativum)* and Ginger *(Zingiber officinale)* were purchased from the local market.

Experimental design

A total of 300 rats were used for 5 trials. Among them 60 rats (12 normal rats and 48 alloxan induced diabetic rats) were used for each trail. In each trial rats were divided into 5 groups each containing 12 individuals as follows:

Group A: Normal Control
Group B: Diabetic control
Group C: Alloxan + Garlic treated
Group D: Alloxan + Ginger treated
Group E: Alloxan + Garlic + Ginger treated

After 18 hours of starvation, body weights, blood glucose and cholesterol level were measured. Then alloxan were injected @100 mg/kg body weight intraperitonially to induce hyperglycemia as well as hypercholesterolemia in groups B, C, D, and E. All the groups of rats were reared under normal diet and water *ad libitum* from Day 1-10. At day 10, body weights, blood glucose and cholesterol level were measured to ensure the induction of hyperglycemia as well as hypercholsteremia. After that all groups were kept for more 21 days. During that period on Day 0, 7, 14, and 21 body weights, blood glucose as well as

cholesterol level were measured. Aqueous extract of garlic and ginger were fed @ 500mg and 300mg/kg body weight daily for 21 days in groups C and D respectively and a combined dose (800mg/kg) were used for group E. The body weight, blood glucose and blood cholesterol level were measured by using commercially available biochemical kits.

Induction of hyperglycemia and hypercholesterolemia

Hyperglycemia and hypercholesterolemia were induced by injecting single dose of alloxan intraperitonially @ 100 mg/kg b.wt. (Junod et al., 1996). In this experiment, polyuria, polydipsia and polyphogia after 24 hours of alloxan injection were observed. Rats with serum glucose level ranging between 150mg/dl or above considered as hyperglycemic. At the same time the rats with cholesterol level above 200mg/dl were considered as hypercholesterolemic (Reeves et al., 1993).

Statistical Analysis

The data obtained from this study were expressed as mean ± standard deviation.

RESULT AND DISCUSSION

The effect of garlic and ginger extracts on blood glucose and cholesterol level in alloxan-induced rats in different treatment conditions were measured. Changes in blood glucose and cholesterol level of rats were summarized in the Table 1 and Table 2 respectively during the experimental period.

In the present study we found that, both garlic and ginger extract reduced the blood glucose, and cholesterol in diabetic rats. These results are in agreement with the study of Akhani et al., (2004), who found that post-treatment and pre-treatment of streptozotocin-induced diabetic rats with ginger extract significantly decreased the blood glucose level and increased the insulin level. Ozougwu and Eyo (2010) showed garlic extracts reduced blood glucose levels in a dose dependent manner producing its best effects at 300mg/kg. Researchers also showed that studies with raw garlic and onion have shown that they significantly reduce the total serum cholesterol (Ugwu and Omale, 2011; Effendy et al., 1997). Also some earlier reports supported our study (Banerjee and Maulik, 2002; Augusti and Sheela, 1992).

In conclusion, the present study reinforces the findings of previous studies that garlic and ginger had a significant effect in reducing blood glucose as well as blood cholesterol.

Table 1: Descriptive statistics of mean values of body weight (gm) and blood glucose level (mg/dl) with standard deviation in different rat groups

Groups	Day 0		Day 7		Day 14		Day 21	
	Avg. B. Wt (gm)	Avg BSL (mg/ dl)	Avg. B. Wt (gm)	Avg BSL (mg/ dl)	Avg. B. Wt (gm)	Avg BSL (mg/ dl)	Avg. B. Wt (gm)	Avg BSL (mg/ dl)
A	94.33 ±5.32	110.13 ±4.23	94.17 ±2.45	109.33 ±3.45	94.33 ±3.56	109.33 ±2.46	94.65 ±2.87	110.21 ±3.34
B	83.23 ±4.22	155.34 ±3.67	79.5 ±1.67	160.25 ±3.33	74.17 ±4.21	166.33 ±3.65	68.23 ±3.21	170.22 ±3.54
C	81.63 ±5.13	154.5 ±3.98	84.4 ±2.37	146.25 ±3.65	89.13 ±2.79	132.17 ±4.22	92.11 ±3.57	120.35 ±4.21
D	82.51 ±6.24	155.5 ±2.99	84.6 ±3.24	145.5 ±4.11	88.25 ±3.37	134.33 ±3.24	92.56 ±4.12	123.12 ±4.23
E	81.21 ±5.65	156 ±4.11	86.2 ±1.89	139.5 ±3.78	92.27 ±3.59	123.17 ±3.56	96.49 ±4.56	110.21 ±3.98

Legends:

Group A: Normal Control; Group B: Diabetic control; Group C: Alloxan + Garlic treated; Group D: Alloxan + Ginger treated; Group E: Alloxan + Garlic + Ginger treated; Avg.B.Wt: Average body weight; Avg. BSL: Average blood sugar level

Table 2: Descriptive statistics of mean values of body weight (gm) and blood cholesterol level (mg/dl) with standard deviation in different rat groups

Groups	Day 0		Day 7		Day 14		Day 21	
	Avg. B. Wt (gm)	Avg BCL (mg/ dl)	Avg. B. Wt (gm)	Avg BCL (mg/ dl)	Avg. B. Wt (gm)	Avg BCL (mg/ dl)	Avg. B. Wt (gm)	Avg BCL (mg/ dl)
A	94.33 ±5.32	120.33 ±5.67	94.17 ±2.45	118.31 ±6.45	94.33 ±3.56	109.33 ±6.77	94.65 ±2.87	116.65 ±6.55
B	83.23 ±4.22	205.12 ±5.34	79.5 ±1.67	224.34 ±6.33	74.17 ±4.21	232.13 ±6.57	68.23 ±3.21	240.76 ±5.78
C	81.63 ±5.13	209.11 ±5.24	84.4 ±2.37	180.51 ±5.78	89.13 ±2.79	155.44 ±6.34	92.11 ±3.57	126.66 ±6.58
D	82.51 ±6.24	213.43 ±6.21	84.6 ±3.24	183.12 ±5.89	88.25 ±3.37	158.32 ±5.99	92.56 ±4.12	128.76 ±6.98
E	81.21 ±5.65	218.12 ±6.34	86.2 ±1.89	176.23 ±6.21	92.27 ±3.59	147.34 ±6.54	96.49 ±4.56	113.81 ±6.13

Legends:

Group A: Normal Control; Group B: Diabetic control; Group C: Alloxan + Garlic treated; Group D: Alloxan + Ginger treated; Group E: Alloxan + Garlic + Ginger treated; Avg.B.Wt: Average body weight; Avg. BCL: Average blood Cholesterol level

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