Original Article

Effects of Garlic (*Allium sativum*) on Blood Glucose Level in Type 2 Diabetes Mellitus Patients Treated with Metformin

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Abstract

**Background:** Diabetes mellitus is a heterogeneous group of metabolic disorders with microvascular and macrovascular complications which are the major causes of morbidity and mortality in diabetic patients. Anti-diabetic drugs are available in modern medicine, but prolonged use of these drugs may produce some side effects. Garlic due to some of its active components can improve glycemic status. **Objective:** To observe the effect of garlic (*Allium sativum*) in patients with type 2 diabetes mellitus with obesity. **Materials and Methods:** This prospective interventional study was carried out in the Department of Pharmacology & Therapeutics, Sir Salimullah Medical College (SSMC), Dhaka from July 2014 to June 2015. Total 60 type 2 diabetes mellitus with obesity subjects of both sexes in the age range 40 to 60 years were included in this study. They were selected on the basis of inclusion and exclusion criteria from Outpatient Department of Bangladesh Institute of Rehabilitation of Diabetes, Endocrine and Metabolic Disorder (BIRDEM) Hospital, Dhaka. The subjects were divided into two groups by simple random sampling. One was Group A and another was Group B. The subjects (30) of Group A were supplemented only metformin at a dose of 1000 mg per day. The subjects (30) of Group B were supplemented metformin at a dose of 1000 mg and garlic in capsule form at a dose of 500 mg per day. They were studied two times, on day-1 (1st day of metformin treatment, Group A.), on 12 weeks (after 12 weeks of metformin treatment, Group A.). Subjects of Group B were also studied two times on day-1 (before supplementation of garlic, Group B.) and on 12 weeks (after 12 weeks supplementation of garlic and metformin, Group B.). Fasting blood glucose level and postprandial blood glucose level of all subjects were measured by glucose oxidase method. Blood HbA1c level of all participants was measured by immunoassay method. The statistical analysis was done by using paired and unpaired sample ‘t’ test. **Results:** In this study, the mean FBG and PPBG levels decreased nonsignificantly (p>0.05) after 12 weeks treatment of metformin in comparison to 1st day of metformin treatment. Again, the mean FBG and PPBG levels decreased significantly after 12 weeks supplementation of metformin and garlic compared to before supplementation of garlic (p<0.001) and after 12 weeks supplementation of metformin (p<0.05). Again, blood HbA1c level decreased nonsignificantly (p>0.05) after 12 weeks treatment of metformin and metformin and garlic supplementation compared to 1st day of metformin treatment and before supplementation of garlic. **Conclusion:** The present study reveals that garlic (*Allium sativum*) has significant effect on improvement of glycemic status.

**Key words:** Diabetes Mellitus; Garlic; FBG; PPBG; HbA1c

Introduction

Diabetes mellitus is defined as chronic or persistent hyperglycemia due to deficiency of insulin secretion or of insulin action, or both.¹ It is the most growing metabolic disease which is characterized by altered carbohydrate, lipid and protein metabolism.² According to World Health Organization (WHO) the prevalence of diabetes mellitus in the global population is approximately 9%, of which 90% is type 2 diabetes mellitus. However, the prevalence

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of diabetes mellitus in Bangladesh is approximately 10%. The incidence of diabetes mellitus is increasing day by day, which can be increased from 150 million to 300 million by the year 2025. Characteristic symptoms of diabetes mellitus are thirst, dry mouth, polydipsia, polyuria, tiredness, fatigue, blurring of vision, and weight loss; in its most severe form, symptoms are ketoacidosis, nonketotic hyperosmolar coma and death. The principal laboratory findings of type 2 diabetes mellitus is hyperglycemia, either fasting blood glucose (FBG) level 126 mg/dL or glycosylated hemoglobin (HbA1c) 6.5%.

Type 2 diabetes mellitus is a chronic disorder characterized by chronic hyperglycemia with long term macrovascular and microvascular complications. According to World Health Organization type 2 diabetes constitutes about 85–95% of all diabetes. This increasing trend of type 2 diabetes mellitus is associated with rapidly changing lifestyle such as increasing urbanization, dietary habits, reduced physical activity along with population aging. Type 2 diabetes mellitus most commonly occurs after 40 years.

The general consensus is that the main treatment of type 2 diabetes is lifestyle management, like exercise and weight reduction. Pharmacological agents, including sulfonylureas, biguanides, alpha-glucosidase inhibitors, thiazolidinediones and meglitinide, are also used; however, long-term complications of type 2 diabetes mellitus are unaltered with these agents. Metformin is currently being used in type 2 diabetes as the first choice oral agent, along with appropriate diet control and modification of lifestyle. Metformin acts primarily by reducing the hepatic glucose output and improving insulin sensitivity in the liver and muscle. Metformin has pleiotropic vascular effects that act on endothelial imbalance, probably increasing nitric oxide bioavailability, decreasing atheroma plaque growth, improving the atherogenic lipid profile, and inhibiting lipid incorporation into vessel walls, thereby inhibiting vascular smooth muscle cell proliferation. 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. Metformin is useful in the prevention of type 2 diabetes; the landmark Diabetes Prevention Program concluded that metformin is effective preventing the new onset of type 2 diabetes in middle-aged obese persons with impaired glucose tolerance and fasting hyperglycemia. It is interesting that metformin did not prevent diabetes mellitus in older, leaner prediabetic subjects. However, long-term complications are not altered with metformin therapy. Previous studies have shown mixed results of metformin therapy on C-reactive protein (CRP), but the studies on non-diabetic patients have reported greater inhibitory effects on CRP than the studies on diabetics. Thus, the effect of metformin therapy on CRP needs to be established in type 2 diabetic patients. Epidemiologic studies suggest that metformin use may dramatically reduce the risk of some cancers. The World Health Organization Expert Committee on diabetes has recommended that traditional medicinal herbs can be further investigated for the treatment of diabetes mellitus. The most commonly used medicinal herbs are *Allium sativum* (garlic), *Ginseng* species, *Momordica charantia* (bitter melon), *Trigonella foenum-graecum* (fenugreek) and *A. cepa* (onion).

*Allium sativum*, commonly known as garlic, is widely used around the world with a history of human use of over 7,000 years for culinary and medicinal purpose. Recently, garlic has been used in the form of garlic oil, garlic powder and pills for certain therapeutic purposes. Garlic has a reputation in particular because of its widespread health use around the world as a dietary as well as therapeutic supplement. Garlic contains a variety of effective compounds, such as allicin, a sulfur-containing compound that exhibits hypcholesterolemic, antioxidant, hypotensive, anticoagulant and antithrombotic effects. Garlic exhibits a wide range of properties including immunomodulatory and hepatoprotective effect. Garlic extracts are believed to possess beneficial effects for the prevention of cardiovascular diseases. Garlic helps to maintain electrolyte balance, especially sodium and potassium. It has been observed that consuming 10 gm of raw garlic per day in two meals for six weeks can reduce blood glucose and HbA1c level in patients with diabetes mellitus. Some other researchers showed that daily 40 mg garlic consumption may improve blood HDL-cholesterol levels. In this perspective, we designed this study to observe the effect of garlic in obese type 2 diabetic patients.
Materials and Methods

This prospective interventional study was carried out in the Department of Pharmacology & Therapeutics, Sir Salimullah Medical College (SSMC), Dhaka between 1st July 2014 and 30th June 2015. According to inclusion criteria all the study subjects were selected from Outpatient Department of Bangladesh Institute of Rehabilitation of Diabetes, Endocrine and Metabolic Disorder (BIRDEM) Hospital, Dhaka. After proper counseling, the aim, objectives, risk and the procedure of the study were explained in details to the subjects. Respondents who gave consent were recruited as research participants and were allowed to withdraw themselves from the study even after participation whenever they like. Ethical permission was taken from the Institutional Ethics Committee (IEC) of Sir Salimullah Medical College. Subjects having type 1 diabetes mellitus, hypertension, heart disease, kidney disease, liver disease, thyroid disease, infectious disease etc were excluded from the study.

The subjects were divided into two groups by simple random sampling. One was Group A and another was Group B. The subjects (30) of Group A were supplemented only metformin at a dose of 1000 mg per day. The subjects (30) of Group B were supplemented metformin at a dose of 1000 mg and garlic in capsule form at a dose of 500 mg per day. They were studied two times — on day-1 (1st day of metformin treatment, Group A1) and on 12 weeks (after 12 weeks of metformin treatment, Group A2). Similarly Group B subjects were also studied two times — on day-1 (before supplementation of garlic, Group B1) and on 12 weeks (after 12 weeks supplementation of garlic and metformin, Group B2). Their general information and data were collected and all the information was recorded in a prefixed questionnaire.

With all aseptic precautions, five mL of venous blood was drawn from median cubital vein by sterile disposable syringe. To assess their glycaemic status FBG and PPBG level were measured by glucose oxidase method and blood HbA1c level measured by immunoassay method in the laboratory of Department of Biochemistry of BSMMU, Dhaka. Data were analyzed by Paired sample ‘t’ test. p value <0.05 was taken as level of significance.

Garlic supplementation

All the subjects of Group B of this study were supplemented with garlic capsule containing 250 mg garlic two times daily for 12 weeks.13

Results

Table I shows age, fasting blood glucose (FBG), postprandial blood glucose (PPBG) and HbA1c in different groups of subjects and Table II shows the comparison of FBG, PPBG and HbA1c level in different groups of subjects.

In this study, FBG, postprandial blood glucose (PPBG) and HbA1c levels did not show significant change after 12 weeks of treatment of metformin in comparison to 1st day of metformin treatment. Mean FBG and PPBG levels decreased significantly but HbA1c level decreased nonsignificantly after 12 weeks supplementation of metformin and garlic compared to before supplementation levels.

Table I: Age, fasting blood glucose (FBG), PPBG and HbA1c% in different groups (n=60)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group A1 (n=30)</th>
<th>Group B1 (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>48.23 ± 4.59</td>
<td>47.83 ± 4.71</td>
</tr>
<tr>
<td>FBG (mmol/L)</td>
<td>8.52 ± 0.29</td>
<td>8.49 ± 0.24</td>
</tr>
<tr>
<td>PPBG (mmol/L)</td>
<td>10.69 ± 0.28</td>
<td>10.46 ± 0.24</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>7.49 ± 0.23</td>
<td>7.44 ± 0.12</td>
</tr>
</tbody>
</table>

Independent sample ‘t’ test was done for comparison between the groups. Figures in parentheses indicate ranges. Group A1: Metformin treated (on day-1); Group B1: Before supplementation of garlic (on day-1)
Discussion
Antidiabetic medications have significant side effects that are not familiar with patients, have limited effectiveness or lack evidence of having impact on the course of the disease. An increasing interest in herbal and complementary medicine has led to a search for effective natural therapies that have significant effects on blood glucose level.

The present study was done to observe the effect of garlic (*Allium sativum*) on type 2 diabetes mellitus subjects with obesity. For this, the levels of fasting blood glucose (FBG), postprandial blood glucose (PPBG) and HbA1c were measured to assess their glycemic status.

**Fasting blood glucose (FBG) level**
In this study, FBG level did not decrease significantly (p>0.05) after 12 weeks’ treatment with metformin in comparison to that of before metformin treatment (on day-1) in Group A. FBG level decreased significantly (p<0.001) after 12 weeks’ treatment with metformin plus supplementation of garlic compared to that of before supplementation of garlic (on day-1). Moreover, FBG level decreased significantly (p<0.05) after 12 weeks treatment of metformin plus supplementation of garlic compared to that of after 12 weeks treatment with metformin only. This finding is consistent with that of some other investigators.

**Postprandial blood glucose (PPBG) level**
In this study, PPBG level did not decrease significantly (p>0.05) after 12 weeks treatment with metformin in comparison to that of before metformin treatment (on day-1) in Group A. PPBG level decreased significantly (p<0.001) after 12 weeks treatment with metformin plus supplementation of garlic compared to that of before treatment with metformin plus supplementation of garlic (on day-1). Moreover, PPBG level decreased significantly (p<0.01) after 12 weeks of treatment with metformin plus supplementation of garlic compared to that of after 12 weeks treatment with metformin only. This finding is similar with that of some other investigators.

**Blood HbA1c level**
In this study blood HbA1c level did not decrease significantly (p>0.05) after 12 weeks treatment with metformin in comparison to that of before metformin treatment (on day-1) in Group A. Blood HbA1c level was decreased nonsignificantly (p>0.05) after 12 weeks treatment with metformin plus supplementation of garlic compared to that of before supplementation of garlic (on day-1). Moreover, blood HbA1c level was decreased significantly (p<0.01) after 12 weeks treatment with metformin plus supplementation of garlic compared to that of after 12 weeks treatment of metformin. This finding is consistent with that of Kumar et al.5
From this study, it can be concluded that garlic (*Allium sativum*) has got significant effect on improvement of glycemic status with lowering fasting blood glucose level and postprandial blood glucose level.

**References**


