Original Article

Garlic in Diabetes

# Antidiabetic Actions of Powdered Plant and Aqueous Extract of Allium Sativum (Garlic) Bulbs in Type-II Diabetic Patients

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## ABSTRACT

**Objectives**: To study hypoglycemic properties ofpowdered plant and aqueous extract of Allium sativum (Garlic) bulbs in type-II diabetics.

**Study Design:** Experimental human study.

**Place and Duration of Study:** This study was conducted at the Hamdard Institute of Pharmaceutical Sciences Islamabad and Army Medical College Rawalpindi from ___.

**Material and Method:** The study was performed on 45 humans, which were divided into 3 groups i.e. Group A, B and C. Group A comprises of 15 patients of type-II diabetes, taking no drugs for diabetes. Group B comprises of 15 patients of Type-II diabetes taking oral hypoglycemic agents with inadequate control of blood sugar levels. Group C was control group, containing 15 healthy volunteers. The study was divided into 2 phases. Initially, after baseline sampling for blood glucose and urinary glucose, all the subjects were given powdered bulbs of Allium sativum orally, at low (20 mg/kg/d), intermediate (30 mg/kg/d) and high (45 mg/kg/d) doses, for 14 days. At day 15, blood and urine sampling was done. After 1 week, all the subjects were administered aqueous extract of Allium sativumbulbs orally, at low (20 mg/kg/d), intermediate (30 mg/kg/d) and high (45 mg/kg/d) doses, for 14 days. At the end, sampling was done again.

**Results:** Both dry powdered plant and aqueous extract of bulbs of Allium sativum (Garlic) decrease blood and urine glucose levels in type-II diabetics, especially in the groups who were taking oral hypoglycemics and had inadequate control of blood glucose previously.

**Conclusion:** Allium sativum has significant hypoglycemic activity, particularly in high dose, and can be combined with oral hypoglycemic agents in type-II diabetics.



## INTRODUCTION

Plants are an exemplary source of drugs, infact many of the currently available drugs were derived either directly or indirectly from plants. According to world ethnobotanical information report, 800 plants may possess antidabetic properties.[1] For e.g. Galega officinalis is a source plant for metformin, an oral antidabetic drug.[2] Also there is established antidiabetic activity of Eugenia jambolana, Momordica charantiaand Tefairia occidentalis.[3-5]

Allium sativum (Garlic), is a member of the Liliaceae family of plants and it is a common food for flavor and spice.[6] This plant has been used for many years for different medical illnesses. The bulbs and oil are used traditionally. Pharmacological actions of Allium sativum are widespread and it has been demonstrated to have antihyperlipidemic,[6]antihypertensive,[7] wound healing,[8] antidiabetic,[9] anticancer,[10] immunomo-dulator,[11] antihelmintic,[12] and hepatoprotective[13] properties. The present study was designed to study the antidabetic effects of powdered plant and aqueous extract of Allium sativum (Garlic) bulbs in type-II diabetic patients.

## MATERIALS AND METHODS

This Experimental study period was 5 weeks. The study was conducted in Hamdard Institute of Pharmaceutical Sciences, Islamabad and Army Medical College, National University of Sciences & Technology, Rawalpindi, Pakistan. This study was approved by ethical committee of Army Medical College.

**Plant Material & Preparation of Extract:** Allium sativum Linn bulbs were obtained from the local market. Dr. Mir Ajab Khan, department of biological sciences, Quaid-i-Azam University, Islamabad, identified the plant. The bulbs were shade dried, pulverized by a mechanical grinder and passed through 40-mesh sieve. Half of the powdered plant was stored in labelled glass bottles. Other half of the powdered plant was soaked in water, in labelled beakers (100g in 500ml) and kept at room temperature. The slurry was stirred 2 hourly and left overnight. The mixture was then filtered and the filtrate was freed from solvent under partial vacuum (71 mmHg) at 35-45°C to yield pulp. The final residue collected was a thick paste. This was dried at reduced temperature. This dried mass served as aqueous extract for experimentation.[14,15]

**Grouping of Subjects:** 45 subjects (patients and controls) were medically examined and divided into 3 Groups i.e. Group A, B and C, each containing 15 subjects. Each Group was further subdivided into 3 subgroups.

**Inclusion Criteria:** The following criteria were used to include the patients in the study:

- Type-II diabetics with fasting plasma glucose level equal to or greater than 140 mg/dl
- Type-II diabetic patients taking oral hypoglycemics, having inadequate control of blood glucose
- Normal healthy subjects
- The patients and control subjects were of either sex between the ages of 35-60 years.

**Exclusion Criteria:** The following criteria were used to exclude the patients:

- Patients suffering from type-I diabetes.
- Patients with any complication of diabetes.
- Patients with GIT, hepatic, cardiovascular or renal diseases that can interfere with the absorption, metabolism and excretion of the study plant.
- Pregnant or nursing females.
- Smokers.

**General Plan of Study:** The study was divided into 2 phases i.e. Phase 1 and 2. All the patients and control subjects were monitored for any adverse effects of the plant.

**Table No.1: Grouping of Subjects**

| Groups | Category | Dose of Drug |
|---|---|---|
| **Group A (n=15)**<br>Subgroup A1 (n=5)<br>Subgroup A2 (n=5)<br>Subgroup A3 (n=5) | Patients of Type-II diabetes, taking no drugs for diabetes | A1 = Low Dose (20 mg/kg/d)<br>A2 = Intermediate Dose (30 mg/kg/d)<br>A3 = High Dose (45 mg/kg/d) |
| **Group B (n=15)**<br>Subgroup B1 (n=5)<br>Subgroup B2 (n=5)<br>Subgroup B3 (n=5) | Patients of Type-II diabetes taking oral hypoglycemic agents with history of inadequate control of blood glucose | B1 = Low Dose (20 mg/kg/d)<br>B2 = Intermediate Dose (30 mg/kg/d)<br>B3 = High Dose (45 mg/kg/d) |
| **Group C (n=15)**<br>Subgroup C1 (n=5)<br>Subgroup C2 (n=5)<br>Subgroup C3 (n=5) | Control group, containing healthy volunteer subjects | C1 = Low Dose (20 mg/kg/d)<br>C2 = Intermediate Dose (30 mg/kg/d)<br>C3 = High Dose (45 mg/kg/d) |

**Phase 1 (Dry Powder Phase):** After baseline sampling, all the subjects were administered dry powdered bulbs of Allium sativum, orally for 14 days. Subgroups A1, B1 & C1 received the drug at low dose (20 mg/kg/d), Subgroups A2, B2 & C2 received the drug at intermediate dose (30 mg/kg/d), while Subgroups A3, B3 & C3 received the drug at high dose (45 mg/kg/d). On day 15, blood and urinary samples of all the subjects were taken.

**Phase 2(Aqueous Extract Phase):** After an interval of 1 week, fasting blood and urine samples were again taken. Then all the subjects were administered aqueous extract of Allium sativum bulbs, orally for 14 days. Subgroups A1, B1 & C1 received the drug at low dose (20 mg/kg/d), Subgroups A2, B2 & C2 received the drug at intermediate dose (30 mg/kg/d), while Subgroups A3, B3 & C3 received the drug at high dose (45 mg/kg/d). On day 15, blood and urinary samples of all the subjects were taken.

**Sampling:** All the subjects were requested to come fasting (no food for 12 hours) for blood sampling, and to drink 250ml water before sampling.[16] Patients already taking oral hypoglycemic agents were requested to take their usual medicine and food after sampling.

**Blood Sampling:** Blood sampling (3-5 ml) was done from each subject by venipuncture, using aseptic technique. The blood samples were collected in clean oven dried test tubes, which were previously rinsed with 1% sodium fluoride and 3% potassium oxalate solution to prevent coagulation and glycolysis. The plasma was separated by centrifugation. Any sample showing hemolysis was discarded. After separation of plasma, it was transferred to glass bottles with plastic caps. The plasma glucose estimation was done on the same day.

**Urine Sampling:** All the subjects were instructed to void their morning urine in specific bottles, provided to them. The bottles were then sent for urine glucose estimation.

**Biochemical & Statistical Analysis:** Plasma assay of glucose was done by kit method and urinary glucose was estimated by strip method.[17] The data was analyzed using Microsoft Excel and SPSS-20. P-value of <0.05 was considered statistically significant.[18]

# RESULTS

Results of this study showed that there was significant decrease in plasma glucose two weeks after administration of powdered plant and aqueous extract of Allium sativum bulbs. The greatest decrease was with high dose (45 mg/kg/d) of the plant used, and the mean value comes closer to mean value of control group. With low and intermediate doses (20 mg/kg/d and 30 mg/kg/d respectively), the glucose levels were though reduced, but there was no significant difference. Glycosuria disappeared two weeks after administration of high dose of bulbs of Allium sativum while low and intermediate doses did not have any significant effect on glycosuria. The results are summarized in the following tables and graphs:

**Table 02: Results of dry powdered bulbs of Allium sativum on glucose levels ± S.D.**

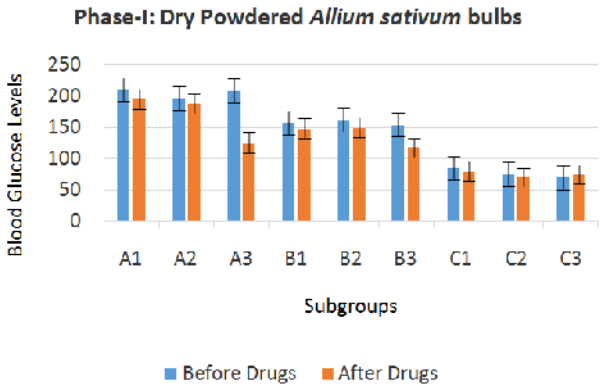
| Phase 1: Dry Powdered bulbs of Allium sativum | | | | |
|---|---|---|---|---|
| | Blood Glucose (mg/dl) | | Urinary Glucose | |
| | Before Drugs | After Drugs | Before Drugs | After Drugs |
| **Group A: (DM-II patients with no previous medication)** | | | | |
| Subgroup A1: Low dose | 210 ±13.2 | 195 ± 9.0** | +ve | +ve |
| Subgroup A2: Int. Dose | 196 ±12.9 | 187 ± 8.4** | +ve | +ve |
| Subgroup A3: High Dose | 208 ± 16.0 | 125 ± 9.8* | +ve | -ve |
| **Group B: (DM-II patients on oral hypoglycemic agents)** | | | | |
| Subgroup B1: Low dose | 157 ± 12.1 | 148 ± 8.8** | -ve | -ve |
| Subgroup B2: Int. Dose | 162 ± 10.3 | 150 ± 7.9** | -ve | -ve |
| Subgroup B3: High Dose | 154 ± 7.5 | 117 ± 8.9* | -ve | -ve |
| **Group C: (Control Group)** | | | | |
| Subgroup C1: Low dose | 85 | 80** | -ve | -ve |
| Subgroup C2: Int. Dose | 75 | 70** | -ve | -ve |
| Subgroup C3: High Dose | 70 | 75** | -ve | -ve |

***Significant, **Not-significant, +ve = Glycosuria, -ve = No Glycosuria, Low dose: 20 mg/kg/d, Intermediate dose: 30 mg/kg/d, High dose: 45 mg/kg/d**

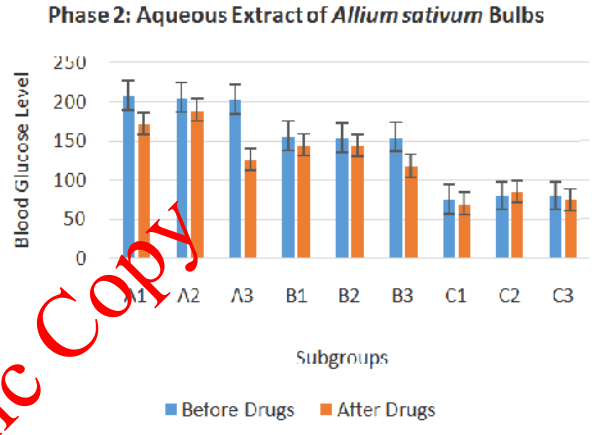
**Table No.3: Results of aqueous extract of Allium sativum bulbs on glucose levels ± S.D.**

| Phase 2: Aqueous Extract of Allium sativum | | | | |
|---|---|---|---|---|
| | Blood glucose (mg/dl) | | Urinary Glucose | |
| | Before Drugs | After Drugs | Before Drugs | After Drugs |
| **Group A: (DM-II patients with no previous medication)** | | | | |
| Subgroup A1: Low dose | 209 ± 22.4 | 172 ± 4.1** | +ve | +ve |
| Subgroup A2: Int. Dose | 206 ± 9.61 | 190 ± 7.9** | +ve | +ve |
| Subgroup A3: High Dose | 203 ± 20.1 | 127 ± 12.4* | +ve | -ve |
| **Group B: (DM-II patients on oral hypoglycemic agents)** | | | | |
| Subgroup B1: Low dose | 157 ± 7.2 | 145 ± 4.7** | -ve | -ve |
| Subgroup B2: Int. Dose | 154 ± 10.9 | 144 ± 7.1** | -ve | -ve |
| Subgroup B3: High Dose | 155 ± 11.5 | 118 ± 12.8* | -ve | -ve |
| **Group C: (Control Group)** | | | | |
| Subgroup C1: Low dose | 75 | 70** | -ve | -ve |
| Subgroup C2: Int. Dose | 80 | 85** | -ve | -ve |
| Subgroup C3: High Dose | 80 | 75** | -ve | -ve |






**Graph No.1: Effect of dry powdered plant on glucose levels**




**Graph No.2: Effect of aqueous extract of plant on glucose levels**

**Untoward Effects:** GIT upsets e.g. nausea, vomiting and abdominal discomfort was reported with the administration of high dose of Allium sativum in 2 patients. Mild headache was reported by some patients.

# DISCUSSION

This study has demonstrated the hypoglycemic properties of dry powdered and aqueous extract of Allium sativum (Garlic) bulbs. Previously such studies were mostly performed in animals but this study was performed in human model of type-II diabetes mellitus patients. When these drugs were administered to diabetic patients, especially the patients on oral hypoglycemic agents with inadequate control of blood sugar, they showed remarkable decrease in blood & urine glucose levels in comparison to control group.

The results of this study correlates with a study done at University of Karachi, by Ashraf et al. (2011), which has depicted that administration of garlic tablets, along with standard oral hypoglycemic agent i.e. Metformin, to type-II diabetic patients, reduces their blood glucose and lipids levels over the period of 24 weeks.[19] Sher et al. (2012) in another study reveals that garlic extract produced hypoglycemia as well as hypolipidemia in

alloxan induced diabetic rabbits. The hypoglycemic effect was more pronounced with metformin, whereas hypolipidemic effect was more pronounced with garlic.[20]

A review article by Patel et al.(2012) reveals that plants like Allium sativum, Citrullus colocynthis, Trigonella foenum greacum, Gymnema sylvestre, etc. contains active compounds i.e. pedunculagin, strictinin, leucopelargonidin-3-O-alpha-L rhamnoside, epigallo-catechin gallate, roseoside, dehydrotrametenolic acid, beta-pyrazol-1-ylalanine, glycyrrhetinic acid cinchonain Ib, leucocyandin 3-O-beta-d-galactosyl cellobioside, isostrictinin, epicatechin and christinin-A, which show significant insulinomimetic and antidiabetic activity. The antidiabetic activity of medicinal plants is attributed to the presence of terpenoids, flavonoids, polyphenols, coumarins and other constituents which show reduction in blood glucose levels.[21]

Another proposed hypoglycemic mechanism of action of Allium sativum is that, it contains disulfides such as allicin (siallyldisulphide oxide) and allyiprpyldis allylpropyldisulhide, which by virtue of their thiol groups act as sparing agents for insulin. [22]

## CONCLUSION

Dried powdered plant and aqueous extract of Allium sativum bulbs can be combined with oral hypoglycemic agents to bring the blood glucose to normal levels in patients whose blood glucose levels are not controlled with these agents or in those patients in whom these drugs produce adverse effects on dose increment.

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