

REVIEW ARTICLE

# The Effect of Garlic (*Allium Sativum*) Supplementation in Patients with Type 2 Diabetes Mellitus: A Systematic Review

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ABSTRACT

Garlic plays a very important role in diabetic patients. Therefore, this study determined the effect of garlic supplement in capsule on blood glucose and lipid profile of patients with type 2 diabetes under a systematic review. Using the keywords: *Allium sativum*, diabetic, garlic, metabolic syndrome and lipid profile, we performed MeSH with specified condition, then RCT, which was published up to date by November 12<sup>th</sup> and obtained in English, in electronic databases: Science Direct, Pub Med, ProQuest and Scopus was collected and studied. Finally, the screening performed by choosing a study on type 2 diabetes was used to select 3 studies as our survey. The efficacy of garlic supplement in the form of capsules, pills, and extracts or in raw form in controlling and treating type 2 diabetes symptoms and improving lipid factors were shown. Garlic supplement could reduce the level of fasting blood sugar (FBS), two-hour blood glucose (2 hpp), low density lipoprotein (LDL), total cholesterol (TC), and triglyceride (TG), increase the level of high density lipoprotein (HDL), and improved insulin resistance and Body Mass Index (BMI). Although in some studies; no significant changes were made or seen regarding these factors. So garlic supplement can be considered as complementary to control blood glucose levels and improve lipid profile in people with type 2 diabetes. However, it cannot definitely state that garlic supplement is useful in the treatment of type 2 diabetic patients and need more studies.

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Introduction

Diabetes is the most common metabolic disease of the gland and is one of the most common non-communicable diseases in the world and now it has the fastest outbreak in the whole world (1). In 1993, World Health Organization (WHO) declared diabetes as a hidden epidemic, and called on all

countries of the world to confront this epidemic (2). In 2008, about 190 million people in the whole world have diabetes and it is predicting that these statistics reach to 366 million people by the year 2030 (3). In a report the amount of type 2 diabetes outbreak, which included 95 percent of cases of diabetes, is declare between 1 to 4 percent in the

general population, and between 5 to 10 percent in people over the age of 40. In 1384, the outbreak of diabetes in Iran between 30 to 69 years old was estimated to 13.4 percent (4).

Statistics shows that diabetic patients are 2 to 4 times more likely to suffer from heart attacks than the others (5). Based on patient reporting system in USA, 75 percent of diabetic patients had a blood pressure equal to or greater than 130/90 in 2003 until 2004 (5). Diabetes was also the main reason of the new cases of blindness in people between the ages of 20 to 74 and the factor for 44 percent of new kidney failure cases and in 2005 in the United States. Almost 60 to 70 percent of patients with diabetes showed mild to severe neurological injuries (6). Weight control, physical activity, healthy diet and the use of blood glucose control drugs such as metformin, glibenclamide and insulin, pancreas transplant and diet are the current ways to treat diabetes (7). A lot of research has shown that more than 400 herbal species have hypoglycemic activity, given that the medicinal plants are easily accessible and cheap and maybe useful for the prevention and treatment of diabetes. Therefore, the attention of the researchers has increased to them (7, 8).

Garlic is another edible plants that many studies have shown to be effective in treating diabetes, blood pressure and cardiovascular disease (9). Garlic contains 65 percent water and contains substances such as lectin, fiber, adenosine sulfur, pectin, fructanov, carbohydrates, phospholipid, fatty acids, essential amino acids, prostaglandins, nicotinic acid, vitamins C, E, B1, B2, B6 (10).

Garlic also contains phosphorus, zinc, selenium, potassium, iron, manganese, calcium and sodium (11). The researchers found that specific compounds in garlic such as allicin, allyl propyl disulfide, S-allyl cysteine sulfoxide, by preventing liver function in deactivate insulin increase the amount of insulin in the blood (12). The purpose of this systematic

review study was to evaluate the effects of reducing blood glucose and improve the lipid profile of garlic supplement in patients with type 2 diabetes.

## Materials and Methods

### Search Strategy

In this study, articles until November 2017 were searched in Pub Med, Science Direct, Scopus and ProQuest in electronic databases. This search was repeated in all electronic listed databases by using the words *Allium sativum*, diabetic, garlic, metabolic syndrome, and lipid profile.

### Entry and Exit Criteria

Inclusion criteria were subjects with a fasting blood glucose greater than 126 mg/dL, age above 18 years, duration of study longer than 1 week, those with type 2 diabetes, body mass index (BMI) above 23 kg per square meter and studies without time limit. The exclusion criteria were: all people with a disease or genetic problem besides type 2 diabetes, those with renal and liver failure, cancer, pregnancy, lactation; also, studies that lasted less than 4 weeks.

### Extracting the Data

All eligible studies were listed in a table including: 1) Name of the first author, 2) Year of publication, 3) Sample size, 4) Control group, and 5) Duration of the study.

## Results

In a systematic review, a total of 5739 studies were identified for early searches, the number of 5450 studies at the start of the search were omitted due to lack of necessary conditions by examining their title. Out of the 289 remaining articles during review the abstract and their full text contained only 3 studies to do systematic review was selected which were summarized in Table 1. The findings of the studies are as follows.

**Table 1:** List of studies on the effects of garlic supplement blood glucose factors and lipid profiles.

Author	Participants	Duration	Interventions a) garlic supplement b) Placebo group c) control group
Kumar, 2013	60 patients with type 2 diabetes and obesity	12 weeks	a) Group 2 was given metformin tablets, 500 mg BD/TDS, after meals, along with garlic ( <i>Allium sativum</i> ) capsules, 250 mg BD. c) Group 1 was given metformin tablets, 500 mg twice a day (BD)/three times a day (TDS).
Afkhami-Ardekani, 2006	40 patients with type 2 diabetes	4 weeks	a) Garlic extract from Goldarou Company, Iran) three times a day for 4 weeks. Each tablet contains 300 mg of effective extract of garlic.
Sobenin et al., 2008	20 patients with type 2 diabetes	4 weeks	a) Garlic powder tablet Allicor. b) Placebo.

### Blood Glucose Factors

Fasting blood glucose has been reported in all studies. In one of the studies (12), the results showed that the mean fasting blood glucose level was  $121.34 \pm 6.90$  mg/dl for metformin ( $P < 0.01$ ). In another study (13), the fasting blood glucose level decreased significantly (36%) and the mean fasting blood glucose level was about  $6.3 \pm 0.4$  mmol/l ( $P < 0.05$ ), compared to placebo. Unlike previous studies, in one study (14), the mean was  $32.25 \pm 154.59$  mg/dl ( $P < 0.001$ ) and did not show any significant difference compared to before the garlic supplement (Table 2).

Two-hour blood glucose level has been reported in two studies (12, 14). The average PPBG at the end of the study was  $140.9 \pm 10.20$  mg/dl, which was significant ( $P < 0.01$ ) in the other group). In another study (14), two-hourly glucose level did not show any significant difference compared to previous garlic supplement ( $246.5 \pm 58.3$  mg/dl) ( $P < 0.001$ ). Glycosylated glucose level (HbA1c) has been reported only in one study (12). According to the results, mean HbA1c at the end of study was  $7.05 \pm 0.50$  mg/dl, which showed a significant decrease ( $P < 0.001$ ).

### Lipid Profile

Low-density lipoprotein (LDL), total cholesterol (TC), triglyceride (TG), high-density lipoprotein (HDL) levels have been reported in all studies. In one study (12), lipid profile level was significantly

altered. Mean LDL ( $34.39 \pm 178.77$  mg/dl), mean TC ( $238.50 \pm 19.49$  mg/dl) and mean for TG ( $170.47 \pm 7.17$  mg/dl) decreased significantly ( $P < 0.05$ ). Also, the average for HDL ( $46.97 \pm 9.14$  mg/dl) significantly increased ( $P < 0.01$ ). In another study, LDL level with mean of  $4.12 \pm 0.44$  mmol/l, TC level with mean of  $6.23 \pm 0.47$  mmol/L and TG level with mean of  $1.90 \pm 0.25$  mmol/L and TG level were significantly less than other factors ( $P < 0.05$ ).

HDL level showed a relative increase with the mean of  $1.28 \pm 0.11$  mmol/L). Unlike previous studies, in one of the studies (14), the mean LDL ( $95.6 \pm 37.5$  mg/dl) ( $P = 0.001$ ), the mean TC ( $189.1 \pm 35.6$ ) ( $P = 0.004$ ), the mean TG at the end of the study ( $257.1 \pm 32.2$  mg/dl) ( $P = 0.672$ ), the mean for HDL ( $40.9 \pm 9.5$  mg/dl) ( $P = 0.284$ ) changed that were not statistically significant (Table 3).

### Body Mass Index

BMI was reported only in one of the studies (1), showing that the mean for BMI was  $25.97 \pm 10.70$ , which was not statistically significant ( $P > 0.05$ ) (Table 4).

### Discussion

Garlic supplement may be effective as a therapeutic and controlling method for blood glucose and lipid profiles, as well as BMI. In this systematic study, some studies have shown that garlic supplement therapy reduced the blood glucose level, improved the lipid profile and decreased the BMI. But,

**Table 2:** Results of garlic supplement effects on blood glucose factors.

Study	Measure of clinical scores	Outcome
Kumar, 2013	*Glucose indicators	The mean fall in FBG and PPBG was highly significant ( $P = 0.001$ ) in both groups, ie, group 1 on metformin and group 2 on garlic plus metformin, at the end of study when compared with start of treatment. When group 2 was compared with group 1, there was a significant reduction ( $P = 0.01$ ) for group 2 in FBG and PPBG after starting of treatment until the end of study. The mean HbA1c at the beginning of the study in group 1 was $7.67 \pm 0.97\%$ , and at the end of the study this decreased to $7.45 \pm 0.77\%$ . Similarly, in group 2, the mean HbA1c level was $7.48 \pm 0.59\%$ in the beginning and decreased to $7.05 \pm 0.50\%$ at the end of 12 weeks. This mean fall in HbA1c was not significant ( $P = 0.05$ ) in both groups at the start and end of treatment.
Afkhami-Ardekani, 2006	Glucose indicator*	This study did not show any significant differences between fasting blood glucose and 2 h PP glucose levels before and after Garsin consumption.
Sobenin et al., 2008	Glucose indicators*	The significant difference in mean fasting blood glucose levels from placebo patients were observed after 2, 3 and 4 weeks of treatment. None of Allicor-treated patients were excluded from the study due to the impairments in fasting glucose levels.

\*The average blood glucose factors was included: fasting blood sugar (FBS), biracial glucose (PPBG) and HbA1c.

**Table 3: Results from the effects of garlic supplement on lipid profile.**

Study	Measure of endoscopic score	Outcome
Kumar, 2013	Lipid profile indicators *	when group 2 was compared with group 1 at the end of treatment, it was observed that there was significant fall (P=0.05) in S total CH, S TG, and S LDL-C, and a significant increase (P, 0.01) in S HDL-C in group 2 as compared with group 1.
Afkhami-Ardekani, 2006	Lipid profile indicators *	Total serum cholesterol level was 207.7±42.2 mg/dl and 189.1±35.6 mg/dl before and after Garsin intake respectively (P=0.004)]. Mean serum LDL cholesterol level also decreased by 15.7±2.7 mg/dl, which was significant.
Sobenin et al., 2008	Lipid profile indicators*	In Type 2 diabetic patients who received monotherapy with Allicor, a significant decrease in serum triglyceride levels was observed after 3 weeks of treatment, and by the end of the study, the difference from baseline levels accounted for 36% (P\0.05). At the same time, the levels of total cholesterol, HDL cholesterol and LDL cholesterol did not change significantly.

\*The average for lipid profiles included total cholesterol (TC), triglyceride (TG), high density lipoprotein (HDL), and low density lipoprotein (LDL).

**Table 4: Results of garlic supplement effect on body mass index (BMI) and weight.**

Study	Measure of histologic score	Outcome
Kumar, 2013	Anthropometric indicators*	At the end of treatment, when group 2 was compared with group 1, a significant reduction (P=0.05) fall in BMI was observed in group 2.

\*The average anthropometric indices was included: BMI

some studies did not reveal any significant effect for garlic supplement. Fasting blood glucose, two-hourly blood glucose and glycosylated hemoglobin levels were shown to decrease significantly; but in one study, no significant difference was observed between fasting blood glucose and two-hourly blood glucose levels (13, 14).

Lipid profiles including TG, TC, LDL, and HDL showed significant differences, as the levels of TG, TC and LDL decreased significantly and HDL level significantly increased too, but in one study, no significant change were observed in lipid profile. The status of BMI was not reported. According to the results of this systematic study, in two studies (13, 14), the levels of blood glucose and lipid profiles decreased significantly, but in another study (15), significant changes were observed regarding the lipid profile, fasting blood sugar and two hour blood glucose, also no BMI was found. In one study, triglyceride level showed a significant difference.

The other effect that garlic supplement has is improving the condition of patients with diabetes. Its antioxidant role eliminates free radicals and suppresses the inflammation and contributes in the treatment process. Garlic supplement inhibits the

alpha glucosidase enzyme that is involved in the metabolism of sugars and reduces the blood glucose in diabetic patients. Different effects of garlic supplement on blood glucose and lipid profile were shown to be dose-dependent and the duration of the study, as well as the complementary forms can also affect the results of these studies. The level of garlic supplement to have the highest bioavailability in the body is of great importance including high blood pressure, because it is a high potassium content that can act as a vasodilator to relax the vessel and lower the blood pressure level. Garlic is effective in reducing and controlling the pre-inflammatory factors, such as tumor necrosis factor, and interleukin-1 beta and interleukin 6, by having a phytochemical ingredient called quercetin. In some other garlic supplement studies, garlic has been combined with metformin and eventually resulted in a further reduction in the level of blood glucose. According to the results, it is not possible to definitely explain the effect of the garlic supplement treatment, and further studies are needed in this relation.

#### Conflict of Interest

None declared.

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