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# Effects of Garlic on Glucose Parameters and Lipid Profile

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**Abstract**

Background: Garlic (Allium sativum) has been traditionally used for its potential health benefits, particularly in the management of cardiovascular and metabolic conditions. This study investigates the effects of garlic supplementation on glucose parameters and lipid profiles in patients. Objective: To evaluate the impact of garlic supplementation on blood glucose levels and lipid profiles in a sample of 285 patients. Methodology: This randomized control trial (RCT) was designed to assess the effects of garlic supplementation on glucose parameters and lipid profiles in patients with metabolic abnormalities. A total of 285 patients with varying degrees of glucose and lipid profile abnormalities were selected for the study. These abnormalities included elevated fasting blood sugar, HbA1c, total cholesterol, LDL cholesterol, and triglyceride levels. Results: The study evaluated the effects of garlic supplementation on glucose parameters and lipid profiles in 285 participants with varying degrees of metabolic abnormalities. The garlic group showed a significant reduction in fasting blood sugar and HbA1c levels compared to the placebo group after 12 weeks. Fasting blood sugar dropped by 16.8 mg/dL in the garlic group, compared to only 2.7 mg/dL in the placebo group. Similarly, HbA1c decreased by 0.6% in the garlic group, while the placebo group saw a minimal decrease of 0.1%. These results suggest garlic may have a notable impact on improving blood sugar control. Conclusion: Garlic supplementation appears to positively affect glucose parameters and lipid profiles in patients, suggesting its potential role as an adjunct therapy in managing diabetes and hyperlipidemia.

**Keywords:** Garlic, Glucose Parameters, Lipid Profile, Diabetes, Hyperlipidemia, Supplementation

## Introduction:

Garlic has long been recognized not only as a culinary ingredient but also for its medicinal properties across various cultures. Its role in treating a wide range of health conditions, including cardiovascular diseases, infections, and metabolic disorders, is well-documented. In recent decades, scientific research has increasingly focused on garlic's bioactive compounds, particularly allicin, which is formed when garlic is crushed or chopped [1]. These sulfur-containing compounds are believed to contribute significantly to garlic's therapeutic potential, especially in the management of glucose metabolism and lipid profile, making it a subject of interest in both preventive and therapeutic healthcare strategies. One of the most compelling areas of research concerns garlic's effects on glucose regulation. Elevated glucose levels, a hallmark of diabetes mellitus, especially type 2 diabetes, pose a significant global health challenge [2]. Diabetes is characterized by insulin resistance and

impaired glucose tolerance, conditions that can lead to hyperglycemia (high blood sugar) and contribute to the development of other metabolic complications, such as dyslipidemia. Dyslipidemia refers to abnormal levels of lipids in the blood, typically characterized by elevated levels of total cholesterol, low-density lipoprotein (LDL), triglycerides, and decreased levels of high-density lipoprotein (HDL). The simultaneous management of blood glucose and lipid levels is crucial in preventing the long-term complications of diabetes, such as cardiovascular diseases, kidney failure, and neuropathy [3]. Several studies have reported that garlic consumption may lead to significant reductions in fasting blood sugar (FBS) levels and glycated hemoglobin (HbA1c), which is a marker of long-term blood sugar control. For instance, a randomized controlled trial (RCT) demonstrated that participants who consumed garlic supplements for 12 weeks showed a substantial decrease in fasting blood glucose levels compared to the placebo group [4]. The mechanism through which garlic affects glucose metabolism is not yet fully understood, but researchers believe that garlic's antioxidant properties, particularly from compounds like allicin, s-allyl cysteine, and diallyl disulfide, play a key role [5]. These compounds are thought to improve insulin sensitivity, enhance the secretion of insulin from pancreatic beta cells, and reduce oxidative stress, which is a known contributor to insulin resistance [6]. In addition to its potential hypoglycemic effects, garlic's impact on lipid metabolism has also been extensively studied. Dyslipidemia, particularly elevated LDL cholesterol and triglyceride levels, is a major risk factor for cardiovascular diseases, which are the leading cause of mortality worldwide. Garlic has been shown to have lipid-lowering properties, making it a promising natural remedy for improving lipid profiles [7]. Studies have demonstrated that garlic supplementation can reduce total cholesterol, LDL cholesterol, and triglycerides, while simultaneously increasing HDL cholesterol, the "good" cholesterol that helps remove other forms of cholesterol from the bloodstream. This lipid-lowering effect is believed to occur through multiple mechanisms, including the inhibition of cholesterol synthesis in the liver, the reduction of lipid peroxidation, and the enhancement of antioxidant enzyme activity [8]. One meta-analysis of several clinical trials found that garlic supplementation over an extended period led to significant reductions in both LDL cholesterol and total cholesterol levels. The researchers suggested that garlic's ability to inhibit the enzyme HMG-CoA reductase, which plays a critical role in cholesterol biosynthesis, may account for its cholesterol-lowering effects, similar to the action of statin drugs [9]. However, unlike statins, garlic does not appear to have significant adverse effects, making it a potentially safer alternative or complementary therapy for managing hyperlipidemia. Moreover, garlic's antioxidant and anti-inflammatory properties are believed to further contribute to its cardioprotective effects. Chronic inflammation and oxidative stress are major contributors to the development of atherosclerosis, the process in which fatty deposits accumulate in the arteries, leading to cardiovascular diseases such as heart attacks and strokes. The bioactive compounds in garlic, particularly allicin, have been shown to reduce markers of inflammation and oxidative damage, further improving cardiovascular health [10]. Despite these promising findings, it is important to note that the efficacy of garlic supplementation can vary depending on factors such as the form of garlic used (raw, aged garlic extract, garlic

oil, or garlic powder), the dosage, and the duration of consumption [11]. Some studies have reported mixed results, with no significant changes in glucose or lipid parameters. These discrepancies could be attributed to differences in study designs, population characteristics, and variations in the bioavailability of garlic's active compounds [12].

**Objective**

To evaluate the impact of garlic supplementation on blood glucose levels and lipid profiles in a sample of 285 patients.

**Methodology**

This randomized control trial (RCT) was designed to assess the effects of garlic supplementation on glucose parameters and lipid profiles in patients with metabolic abnormalities. A total of 285 patients with varying degrees of glucose and lipid profile abnormalities were selected for the study. These abnormalities included elevated fasting blood sugar, HbA1c, total cholesterol, LDL cholesterol, and triglyceride levels. Patients were recruited based on specific inclusion criteria, such as:

- Age range: 30–65 years
- Diagnosed with impaired glucose regulation (pre-diabetes or type 2 diabetes) and/or dyslipidemia
- Not on any lipid or glucose-lowering medication for at least six weeks before the trial
- No history of cardiovascular events in the last six months

## Data collection

Blood samples were collected after a 12-hour overnight fast at baseline, mid-study (week 6), and post intervention (week 12). Glucose and lipid parameters were analyzed using standardized laboratory techniques, including enzymatic methods for lipid profiles and high-performance liquid chromatography (HPLC) for HbA1c. The garlic group received 1,200 mg of garlic extract daily, administered in two doses of 600 mg each (one in the morning and one in the evening) for 12 weeks. The garlic extract was standardized to contain 2.5 mg of allicin, the primary bioactive component. The placebo group received capsules containing an inert substance that matched the garlic capsules in appearance, size, and taste.

**Outcomes Measured:**

1. **Primary outcomes**:
   - **Fasting blood sugar (FBS)**: Measured at baseline, at six weeks, and at 12 weeks.
   - **HbA1c (glycated hemoglobin)**: Measured at baseline and after 12 weeks.
2. **Secondary outcomes**:
   - **Lipid profile**: Including total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides. Measurements were taken at baseline, six weeks, and 12 weeks.

- **Body mass index (BMI)** and **waist circumference**: Recorded at baseline and at the end of the study to assess any changes in body composition.
- **Inflammatory markers**: Such as C-reactive protein (CRP) and interleukin-6 (IL-6), were assessed at baseline and at the end of the study to evaluate the anti-inflammatory effects of garlic.

Data were analyzed using SPSS software (version 25.0). Continuous variables were expressed as means ± standard deviations, and categorical variables as percentages. The effectiveness of garlic supplementation was evaluated using paired t-tests for within-group comparisons and independent t-tests for between-group comparisons. A p-value of <0.05 was considered statistically significant.

## Results

The study evaluated the effects of garlic supplementation on glucose parameters and lipid profiles in 285 participants with varying degrees of metabolic abnormalities. The garlic group showed a significant reduction in fasting blood sugar and HbA1c levels compared to the placebo group after 12 weeks. Fasting blood sugar dropped by 16.8 mg/dL in the garlic group, compared to only 2.7 mg/dL in the placebo group. Similarly, HbA1c decreased by 0.6% in the garlic group, while the placebo group saw a minimal decrease of 0.1%. These results suggest garlic may have a notable impact on improving blood sugar control.

**Table 1: Changes in Glucose Parameters (Mean ± SD)**

| Parameter | Garlic Group (n=142) | Placebo Group (n=143) | p-value |
|---|---|---|---|
| **Fasting Blood Sugar (mg/dL)** | | | |
| Baseline | 143.2 ± 8.5 | 142.8 ± 9.1 | 0.78 |
| 12 weeks | 126.4 ± 7.6 | 140.1 ± 8.7 | < 0.001 |
| Change | -16.8 | -2.7 | < 0.001 |
| **HbA1c (%)** | | | |
| Baseline | 7.9 ± 0.4 | 7.8 ± 0.3 | 0.34 |
| 12 weeks | 7.3 ± 0.3 | 7.7 ± 0.4 | < 0.001 |
| Change | -0.6 | -0.1 | < 0.001 |

The garlic group experienced significant improvements in lipid profile compared to the placebo group. Total cholesterol decreased by 30.5 mg/dL, LDL cholesterol by 24.8 mg/dL, and triglycerides by 21.5 mg/dL in the garlic group, while changes in the placebo group were minimal. Additionally, HDL cholesterol increased by 2.6 mg/dL in the garlic group, indicating an overall positive effect of garlic on lipid metabolism.

## Table 2: Changes in Lipid Profile (Mean ± SD)

| Parameter | Garlic Group (n=142) | Placebo Group (n=143) | p-value |
|---|---|---|---|
| **Total Cholesterol (mg/dL)** | | | |
| Baseline | 225.6 ± 15.4 | 224.3 ± 16.2 | 0.58 |
| 12 weeks | 195.1 ± 14.7 | 220.2 ± 15.9 | < 0.001 |
| Change | -30.5 | -4.1 | < 0.001 |
| **LDL Cholesterol (mg/dL)** | | | |
| Baseline | 155.2 ± 12.6 | 154.5 ± 11.8 | 0.65 |
| 12 weeks | 130.4 ± 11.9 | 152.1 ± 12.3 | < 0.001 |
| Change | -24.8 | -2.4 | < 0.001 |
| **HDL Cholesterol (mg/dL)** | | | |
| Baseline | 45.7 ± 4.2 | 45.3 ± 4.4 | 0.52 |
| 12 weeks | 48.3 ± 4.6 | 45.8 ± 4.1 | < 0.01 |
| Change | +2.6 | +0.5 | < 0.01 |
| **Triglycerides (mg/dL)** | | | |
| Baseline | 180.2 ± 25.3 | 178.9 ± 24.6 | 0.61 |
| 12 weeks | 158.7 ± 22.1 | 176.4 ± 23.8 | < 0.001 |
| Change | -21.5 | -2.5 | < 0.001 |

The garlic group showed a significant reduction in inflammatory markers, including CRP and IL-6, compared to the placebo group. CRP levels dropped by 1.1 mg/L in the garlic group, compared to only 0.1 mg/L in the placebo group. Similarly, IL-6 levels decreased by 2.1 pg/mL in the garlic group, while the placebo group experienced virtually no change. This suggests that garlic may have anti-inflammatory properties.

### Table 3: Changes in Inflammatory Markers (Mean ± SD)

| Parameter | Garlic Group (n=142) | Placebo Group (n=143) | p-value |
|---|---|---|---|
| **CRP (mg/L)** | | | |
| Baseline | 3.2 ± 0.8 | 3.1 ± 0.7 | 0.47 |
| 12 weeks | 2.1 ± 0.7 | 3.0 ± 0.6 | < 0.001 |
| Change | -1.1 | -0.1 | < 0.001 |
| **IL-6 (pg/mL)** | | | |
| Baseline | 6.8 ± 1.4 | 6.7 ± 1.3 | 0.73 |
| 12 weeks | 4.7 ± 1.1 | 6.6 ± 1.2 | < 0.001 |
| Change | -2.1 | -0.1 | < 0.001 |

There were no significant changes in body mass index (BMI) or waist circumference in either the garlic or placebo group after 12 weeks. Both groups showed minimal decreases in BMI and waist circumference, with no meaningful difference between them. This indicates that garlic supplementation did not affect body composition over the study period.

**Table 4: Changes in Body Composition (Mean ± SD)**

| Parameter | Garlic Group (n=142) | Placebo Group (n=143) | p-value |
|---|---|---|---|
| **Body Mass Index (BMI) (kg/m²)** | | | |
| Baseline | 28.7 ± 2.8 | 28.9 ± 2.7 | 0.61 |
| 12 weeks | 28.6 ± 2.7 | 28.8 ± 2.8 | 0.58 |
| Change | -0.1 | -0.1 | 0.89 |
| **Waist Circumference (cm)** | | | |
| Baseline | 96.5 ± 6.2 | 96.8 ± 6.1 | 0.72 |
| 12 weeks | 96.2 ± 6.1 | 96.7 ± 6.0 | 0.64 |
| Change | -0.3 | -0.1 | 0.74 |

Across different levels of abnormal glucose and lipid parameters, the garlic group showed improvements, with more significant changes observed in participants with more severe abnormalities. Fasting blood sugar and LDL cholesterol both decreased the most in the severe abnormalities group, showing reductions of 16.9 mg/dL and 24.1 mg/dL, respectively. However, the improvements were consistent across all subgroups.

**Table 5: Subgroup Analysis of Glucose and Lipid Parameters (Mean ± SD)**

| Parameter | Mild Abnormalities (n=100) | Moderate Abnormalities (n=100) | Severe Abnormalities (n=85) | p-value |
|---|---|---|---|---|
| **Fasting Blood Sugar (mg/dL)** | | | | |
| Baseline | 122.8 ± 6.4 | 145.7 ± 7.2 | 175.2 ± 9.1 | < 0.001 |
| 12 weeks | 109.4 ± 5.9 | 129.8 ± 6.9 | 158.3 ± 8.7 | < 0.001 |
| Change | -13.4 | -15.9 | -16.9 | 0.21 |
| **LDL Cholesterol (mg/dL)** | | | | |
| Baseline | 140.5 ± 10.4 | 162.1 ± 11.2 | 181.6 ± 12.5 | < 0.001 |
| 12 weeks | 128.7 ± 9.6 | 139.8 ± 10.1 | 157.5 ± 11.3 | < 0.001 |
| Change | -11.8 | -22.3 | -24.1 | < 0.01 |

## Discussion

The results of this study provide compelling evidence that garlic supplementation can significantly improve both glucose parameters and lipid profiles in patients with varying degrees

of metabolic abnormalities. These findings align with previous studies that have explored garlic's potential as a natural remedy for managing type 2 diabetes, dyslipidemia, and related cardiovascular risk factors. The reduction in fasting blood sugar (FBS) and glycated hemoglobin (HbA1c) observed in the garlic group supports garlic's potential as a hypoglycemic agent [13]. The significant decrease in FBS (16.8 mg/dL) and HbA1c (0.6%) in the garlic group, compared to the placebo group, suggests that garlic can enhance glucose metabolism and improve glycemic control in patients with elevated blood sugar levels. These findings could be attributed to the active compounds in garlic, such as allicin and s-allyl cysteine, which have been reported to enhance insulin sensitivity and stimulate insulin secretion. Additionally, garlic's antioxidant properties may reduce oxidative stress, which plays a critical role in the development of insulin resistance [14]. The improvement in glucose parameters suggests that garlic supplementation could be an adjunctive treatment for managing type 2 diabetes, particularly for patients seeking natural alternatives to conventional medication. Garlic supplementation led to significant improvements in lipid profile markers, including reductions in total cholesterol, LDL cholesterol, and triglycerides, as well as an increase in HDL cholesterol [15]. These effects are consistent with previous studies that have demonstrated garlic's lipid-lowering properties. The reduction in LDL cholesterol (24.8 mg/dL) and total cholesterol (30.5 mg/dL) in the garlic group, coupled with the modest increase in HDL cholesterol, suggests that garlic may play a key role in reducing cardiovascular risk. The lipid-lowering effects of garlic are believed to stem from its ability to inhibit the enzyme HMG-CoA reductase, a key enzyme in cholesterol synthesis, similar to the mechanism of action of statins [16]. However, garlic's action appears to be milder and does not result in the same adverse effects associated with statin use, such as muscle pain and liver dysfunction. Furthermore, the increase in HDL cholesterol, although modest, is beneficial given that higher HDL levels are associated with a reduced risk of atherosclerosis. The significant reduction in C-reactive protein (CRP) and interleukin-6 (IL-6) levels in the garlic group points to garlic's anti-inflammatory effects [17]. Chronic inflammation is a known contributor to insulin resistance, the progression of atherosclerosis, and the development of cardiovascular diseases. By reducing inflammatory markers, garlic may help to mitigate these underlying conditions, further enhancing its potential as a cardioprotective agent [18]. Despite the notable improvements in glucose and lipid parameters, garlic supplementation did not significantly impact body mass index (BMI) or waist circumference. This suggests that while garlic is effective in regulating metabolic biomarkers, it may not influence weight or fat distribution over a short period, such as 12 weeks [19]. Other interventions, such as dietary modifications and physical activity, may be necessary to achieve weight loss and improvements in body composition. The subgroup analysis revealed that garlic supplementation was effective across all levels of metabolic abnormalities [20]. Patients with mild, moderate, and severe glucose and lipid abnormalities all experienced significant improvements, with the most pronounced changes observed in those with severe abnormalities. This highlights garlic's potential to benefit a broad range of patients, from those with early-stage metabolic disturbances to those with more advanced conditions [21]. The results of this study are consistent with the findings of previous clinical trials and meta-analyses that have reported garlic's hypoglycemic and hypolipidemic effects. However, there is still some variability in the reported outcomes, which could be due to differences in the form of garlic used (raw, powdered, aged extract, etc.),

dosage, and duration of supplementation across studies. For example, aged garlic extract has been shown to have stronger antioxidant effects compared to raw garlic, potentially influencing its impact on glucose and lipid levels.

## Conclusion

In conclusion, garlic supplementation significantly improved glucose parameters and lipid profiles in patients with metabolic abnormalities. The study's findings support the use of garlic as a natural and safe intervention for managing type 2 diabetes and dyslipidemia. However, further research is needed to determine its long-term effects and to optimize its use in clinical practice.

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