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# Anti-atherosclerotic effects of konjac

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Submission date: April 3, 2015; Acceptance date: April 28, 2015: Publication date: April 30, 2015

## ABSTRACT

Definition: The Konjac plant comes from the genus Amorphophallus. Japanese food uses Konjac cake. Konjac contains almost no calories and has a great amount of dietary fiber. Here, we reviewed possible anti-atherosclerotic effects of konjac, using the search Pubmed ®. Konjac ingestion is beneficially associated with obesity, blood pressure, and lipid and glucose metabolism. However, evidence is lacking on the relationship between konjac ingestion and development of atherosclerotic diseases. To better understand the anti-atherosclerotic effects of konjac, future studies will be performed, preferably with larger numbers of subjects.

**Keywords:** atherosclerosis, body weight, glucose, konjac mannan, low-density lipoprotein-cholesterol

## INTRODUCTION

The Japanese use the Konjac plant's root in cooking. Some foods include: konnyaku (konjac cake), jelly, oden (a dish of various ingredients, including konnyaku stewed in soy-flavored dashi), and Misodengaku (skewered and roasted konjac with miso coating). Konjac is rich in

dietary fiber and contains little to no calories. Konjac glucomannan, a soluble dietary fiber, is used as a component of supplements for weight loss. Here, we review possible anti-atherosclerotic effects of konjac. References were found through Pubmed searches.

## Anti-Obesity Effect of Konjac

To investigate the effect of konjac glucomannan on body weight in overweight or obese individuals, Zalewski BM, et al. reported a systematic review of randomized controlled trials (RCTs) [1]. Six RCTs assessing the effectiveness of konjac glucomannan vs. placebo were included. In the konjac glucomannan group, three RCTs reported a significant reduction in body weight, compared with the control group at weeks 2, 4, 5, 8 during the intervention. However, none of the RCTs reported a favorable effect of glucomannan on body mass index (BMI). They concluded that there is some evidence that konjac glucomannan may help to reduce body weight in the short term, but not BMI in overweight or obese adults.

Keithley J, et al. also reported a critical review on the effects of konjac on body weight [2]. According to their review, at doses of 2-4 g per day, konjac glucomannan resulted in significant weight loss in overweight and obese individuals.

## Effects of Konjac on Blood Pressure, Lipid and Glucose Metabolism

Table 1 displays more published articles about effects of konjac on lipid and glucose metabolism in humans. These articles were found through Pubmed ®. Vasques CA, et al. performed a placebo-controlled double-blind and randomized study. They evaluated the effects of Garcinia cambogia plus Amorphophallus konjac (94.9% glucomannan) in the treatment of obesity [3]. Fifty-eight subjects were given daily doses of either garcinia (2.4 g) or konjac (1.5 g), or a placebo prior to their main meals. This treatment had no significant effect on anthropometric parameters, triglyceride (TG), or glucose levels. However, the study showed a significant reduction in total cholesterol (TC), low-density lipoprotein-cholesterol (LDL-C), and high-density lipoprotein (HDL)-C. The treated patients' LDL-C/HDL-C ratio fell from 2.9 to 2.5 after 12 weeks.

Other researchers performed a parallel-arm, double-blind, placebo-controlled trial to study the effects of supplementing a carbohydrate-restricted diet with konjac mannan (3g/day) on metabolic parameters [4]. Both groups demonstrated decreases in body weight, body fat, systolic blood pressure, waist circumference, and plasma glucose levels. After 12 weeks, HDL-C and TG improved significantly in the groups consuming fiber (+10% and -34%) and placebo (+14%,

Table 1. Published articles about effects of konjac on lipid and glucose metabolism

| Authors | Study design/Subjects | Results/Conclusions |
|---|---|---|
| Vasques CA, et al. [3] | Double-blind randomized study, garcinia (2.4 g/day) + konjac (1.5 g/day) vs. placebo for 12 weeks; 58 obese subjects (BMI 30.0-39.9 $kg/m^2$) | A significant reduction was observed in TC (-32.0 ± 35.1 mg/dL) and LDL-C (-28.7 ± 32.7 mg/dL) in the treated group |
| Wood RJ, et al. [4] | Parallel-arm, double-blind, placebo-controlled design, carbohydrate-restricted diets with supplement with konjac mannan (3g/day) (n = 15) or placebo (n = 15) for 12 weeks ; 30 overweight and obese men (BMI, 25-35 $kg/m^2$) | Adding to carbohydrate-restricted diets provides no additional benefits to the diet alone |
| Chen HL, et al. [5] | Randomized, double-blind, crossover clinical trial, konjac glucomannan supplement (3.6 g/day) for 28 days; 22 diabetic subjects (BMI 25.5 ± 3.2 $kg/m^2$) with elevated blood cholesterol levels (FPG between 6.7-14.4 mmol/L) | The konjac glucomannan supplement improved blood lipid levels by enhancing fecal excretion of neutral sterol and bile acid and alleviated the elevated glucose levels in diabetic subjects |
| Vuksan V, et al. [6] | Konjac mannan fiber-enriched test biscuits (0.5 g of glucomannan per 100 kcal of dietary intake) vs. wheat bran fiber control biscuits for 3-week treatment with a 2-week washout; 11 (BMI 28 ± 1.5 $kg/m^2$) were recruited, the inclusion criteria: impaired glucose tolerance, reduced HDL-C, elevated TG, and moderate hypertension | A diet rich in high-viscosity konjac glucomannan improves glycemic control and lipid profile |

| | | |
|---|---|---|
| Vuksan V, et al. [7] | Konjac glucomannan fiber-enriched test biscuits (0.7 g/ 100 kcal of glucomannan) vs. placebo wheat bran fiber biscuits during 3-week with a 2-week washout period; 11 hyperlipidemic and hypertensive type 2 diabetic patients treated conventionally by a low-fat diet and drug therapy | Konjac glucomannan fiber added to conventional treatment may ameliorate glycemic control, blood lipid profile, and sBP in high-risk diabetic individuals |
| Arvill A, et al. [8] | Double-blind crossover, placebo-controlled study. 3.9 g glucomannan or placebo daily for 4 weeks; 63 healthy men | Glucomannan fibers reduced TC by 10%, LDL-C by 7.2%, TG by 23%, and sBP by 2.5% |
| Zhang MY, et al. [9] | An ordinary diet plus foods containing refined konjac meal vs. the control group consumed only the ordinary diet for 45 days; 110 elderly people with hyperlipidemia | In the konjac meal, TG, TC and LDL-C were significantly lowered at the end of the trial, whereas HDL-C and apolipoprotein-AI were significantly elevated |
| Walsh DE, et al. [10] | An eight-week double-blind trial, glucomannan fiber or placebo was given in 1-g doses, 1 h prior to each of three meals per day; 20 obese subjects | A significant mean weight loss (5.5 lbs) by glucomannan over an 8-week period. Serum TC and LDL-C were significantly reduced (21.7 and 15.0 mg/dL, respectively) in the glucomannan treated group |
| Huang CY, et al. [11] | Subjects were given konjac food for 65 days; 72 type 2 diabetic subjects | FPG and 2-h postprandial blood glucose on the 30th and the 65th days were significantly reduced, and the glycosylated hemoglobin was reduced at the end of the trial. No significant changes in blood lipid indexes were observed, except that TG of subjects with hypertriglyceridemia (> 200 mg/dL) significantly decreased by 118.7 mg/dL |

BMI, body mass index; FPG, fasting plasma glucose; HDL-C, high-density lipoprotein -cholesterol; LDL, low-density lipoprotein; sBP, systolic blood pressure; TC, total cholesterol; TG, triglyceride.

-43%). In the konjac mannan group, LDL-C decreased by 17.6% at week 6 and 14.1% at week 12. LDL-C reductions were significant in the placebo group only after 12 weeks (-6.0%). They concluded that adding konjac mannan to a carbohydrate-restricted diet provided no additional benefits.

For 28 days, Chen HL, et al. evaluated the effects of a konjac glucomannan supplement (3.6 g/day) on blood lipid and glucose levels in hyperlipidemic type 2 diabetic patients [5]. Compared to the effects of a placebo, konjac glucomannan reduced LDL-C (20.7%), TC/HDL-C ratio (15.6%), a major apolipoprotein of LDL, apolipoprotein B (12.9%) and fasting glucose (23.2%). In contrast, konjac glucomannan increased fecal neutral sterol and bile acid concentrations by 18.0% and 75.4%, respectively.

The effects of supplementing a high-carbohydrate diet with fiber from konjac mannan on metabolic parameters was also investigated in subjects with insulin resistance [6]. Researchers observed reductions in TC (12.4±3.1%), LDL-C (22±3.9%), TC/HDL-C ratios (15.2±3.4%), LDL-C/HDL-C ratios (22.2±4.1%), apolipoprotein B (15.1±4.3%), and serum fructosamine (5.2±1.4%) during konjac mannan treatment, compared with the control.

The effects of konjac mannan fiber on metabolic parameters was also studied in high-risk type 2 diabetic patients [7]. Compared to a placebo, konjac mannan significantly reduced serum fructosamine (5.7%), TC/HDL-C ratio (10%), and systolic blood pressure (6.9%). Konjac mannan did not significantly change other metabolic parameters, such as body weight.

Arvill A, et al. studied the effects of konjac glucomannan on serum lipids in 63 healthy men [8]. Konjac glucomannan reduced TC by 10%, LDL-C by 7.2%, TG by 23%, and systolic blood pressure by 2.5%. Konjac mannan did not significantly change other metabolic parameters, such as: body weight and HDL-C.

In experimental subjects who ingested an ordinary diet with foods containing refined konjac meal, serum TG, TC and LDL-C were significantly lowered, whereas HDL-C and apolipoprotein AI levels were significantly elevated [9]. The differences in TC, TG, LDL-C and HDL-C levels between the two groups were statistically significant.

An 8-week double-blind trial was conducted to test purified glucomannan fiber as a food supplement in 20 obese subjects [10]. Results revealed significant weight loss in patients who ingested glucomannan. Serum TC and LDL-C were also significantly reduced in the glucomannan group.

Huang CY, et al. studied the effects of konjac food for 65 days in type 2 diabetic patients [11]. Fasting blood glucose and 2-h postprandial blood glucoses on the 30th and the 65th days

Table 2. Summary of effects of konjac on anthropometric parameters, blood pressure, lipid and glucose metabolism

| | |
|---|---|
| **Anthropometric parameters** | |
| Body weight | ↓ or → |
| Body mass index | → |
| **Blood pressure** | |
| Systolic blood pressure | ↓ |
| Diastolic blood pressure | → |
| **Lipid metabolism** | |
| TC | ↓ |
| LDL-C | ↓ |
| HDL-C | ↓ or → or ↑ |
| TG | → or ↓ |
| LDL-C/HDL-C | ↓ |
| TC/HDL-C | ↓ |
| Apolipoprotein B | ↓ |
| Apolipoprotein AI | ↑ |
| **Glucose metabolism** | |
| FPG | → or ↓ |
| Fructosamine | ↓ |
| 2h postprandial blood glucose | ↓ |
| Glycosylated hemoglobin | ↓ |

FPG, fasting plasma glucose; HDL-C, high-density lipoprotein-cholesterol; LDL, low-density lipoprotein; TC, total cholesterol; TG, triglyceride.

were significantly reduced, after the konjac food ingestion. The glycosylated hemoglobin was also reduced at the end of the trial. Serum TG in subjects with hypertriglyceridemia significantly decreased.

### The Underlying Mechanisms of Konjac-Mediated Improvement in Obesity, Lipid and Glucose Metabolism

Konjac's water-absorbing capacity results in the creation of highly viscous solutions, which reduces the stomach's emptying speed and modifies the kinetics of duodenal fat absorption [12]. Chen HL, et al. observed that fecal neutral sterol and bile acid concentrations increased with konjac glucomannan supplementation. This suggests that the konjac glucomannan supplement improves blood lipid by enhancing fecal excretion of neutral sterol and bile acid [5]. The possible mechanism for konjac-mediated lipid-lowering action may include an inhibition of cholesterol absorption in the jejunum [13], in addition to bile acid absorption in the ileum [14] by viscosity. Jenkins DJ, et al. studied the effects of either guar, pectin, gum tragacanth, methylcellulose, wheat bran, or cholestyramine equivalent to 12 g fiber addition on post-50-g glucose loading hyperglycemia [15]. The reduction in the mean peak rise in blood glucose concentration for each substance positively correlated with its viscosity. The same result occurred with delay in mouth-to-cecum transit time. Therefore, viscous types of dietary fiber, such as konjac glucomannan, are likely to be therapeutically useful in modifying postprandial hyperglycemia. The improvement in glycemic control may be due to the konjac mannan-mediated gel-forming effect, which slows food absorption rates in the small intestine.

The summary of effects of konjac on anthropometric parameters, blood pressure, lipid and glucose metabolism are shown in Table 2.

## CONCLUSION

Ingestion of konjac is likely to benefit those suffering from obesity, blood pressure, and lipid and glucose metabolism. However, more evidence on the effects of konjac ingestion on metabolic parameters is required. Furthermore, evidence on the influence of konjac ingestion regarding development of atherosclerotic diseases is lacking. To better understand anti-atherosclerotic effects of konjac, future studies will be performed, preferably with a larger sample sizes.

**Abbreviations Used:** Randomized controlled trials (RCTs); body mass index (BMI); triglyceride

(TG); total cholesterol (TC); low-density lipoprotein-cholesterol (LDL-C), high-density lipoprotein (HDL)-C;

**Competing Interests:** The authors have no financial interests or conflicts of interest. Authors' Contributions: All authors contributed to this study.

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