REVIEW ARTICLE e-ISSN: 2349-0659 p-ISSN; 2350-0964

# Guar gum: Properties and its Role in Pre-diabetes and Cholesterol – A Review

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## Abstract

The guar bean (*Cyamopsis tetragonoloba*) is an erect annual legume and its grows about 2'–9' high. The buds of these plants start out white and change into a light pink as the flower opens. These flowers then turn deep purple and are followed by fleshy seed pods, which are allowed to ripe and are harvested in summer. The gum extracted from the guar beans forms a gel in water, commonly referred to as guar gum. Guar is extremely draught resistant. The guar seeds used in making medicine are useful in pre-diabetic conditions and the early stages of late-onset diabetes. This review is incorporated with the uses of guar gum and its role in conditions such as pre-diabetes and cholesterol.

**Keywords:** Guar bean, Guar gum, Pre-diabetes, Type 2 Diabetes mellitus

**Key Messages:** Guar gum is a galactomannan which is derived from the endosperm of the guar plant (cyamopsistetragonolobus). Various studies also show that the ingestion of guar gum in low quantity is effective in controlling or delaying the progression of pre-diabetes in to type 2 Diabetes mellitus. Since it is abundant with dietary fibre it also plays an important role in cholesterol metabolism.

*Asian Pac. J. Health Sci*., (2021); DOI:** 10.21276/apjhs.2021.9.1.7

## Introduction

Guar gum is derived from the seeds of the drought tolerant plant *Cyamopsis tetragonoloba*, a member of Leguminosae family.[1] Guar gum is a novel agrochemical which is derived from endosperm of cluster bean. It is used as additive in food, pharmaceuticals, paper, textile, explosive, oil, well drilling, and cosmetics industry.[2] It is also beneficial in the control of certain health conditions such as diabetes, bowel movements, heart disease, and colon cancer.[3]

Guar gum is a gel-forming galactomannan obtained by grinding the endosperm portion of the guar bean seeds. The guar gum plant is generally a sun-loving plant, tolerant of high environmental temperatures but very susceptible to frost.[1] For maximum growth, the plant requires a soil temperature of 25–30°C and, ideally, a dry climate with sparse but regular rainfall.[4]

The guar gum is one of the important crops grown in India and Pakistan where it has been grown for centuries as food for humans and animals. India accounts for about 80% of the total guar production in the world. The leading producer of guar gum includes Rajasthan, Gujarat, Haryana, and Punjab. The rain pattern of monsoons in India and Pakistan becomes an ideal condition for the guar gum.[3]

The guar gum is also referred to as cluster bean, Guaran, Cyamopsis, Guarina, Clusterbean, and Calcutta lucerne.[5]The guar gum contains about 75–85% polysaccharide, 5–6% of protein, and 8–14% moisture and other components.[6]

The guar bean also claims to be one of the traditional plants in existence and has also been used in folklore medicine. This acts as an appetizer, cooling agent, digestive aid, and laxative which are useful in healthy dyspepsia and anorexia. Vitamins C, K and A, iron, folate, manganese, and dietary fiber are also found to be present in guar bean. Due to the hard texture, this vegetable is barely used in home and factory preparations, though it is abundantly available in local market and the rate is also cheap. One of the main reasons for this bean being unpopular is lack of awareness among people about the nutritional benefits of them.[7]

Various studies show that guar gum may be effective at lowering blood sugar. This is because it is a type of soluble fiber, which can slow the absorption of sugar and lead to a reduction in blood sugar levels. In a study, persons with diabetes were given 4 times a day for a period of about 6 months. The study found that guar gum led to significant decrease in blood sugar and a 20% drop in LDL cholesterol.[8]

Pre-diabetes may be defined as the state of impaired fasting glucose and/or impaired glucose tolerance. Pre-diabetes is indicated by higher than normal blood glucose levels which may be progressed into diabetes mellitus.[9]

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**How to cite this article:** Grace JM, Karthiga K. Guar gum: Properties and its Role in Pre-diabetes and Cholesterol – A Review. Asian Pac. J. Health Sci., 2021;9(1):37-39.

**Source of support:** Nil

**Conflicts of interest:** None.

**Received:** 23/08/21 **Revised:** 19/09/21 **Accepted:** 17/10/21

## Guar Gum

Guar gum is a soluble dietary fiber produced from the seed of guar plant. It works as a bulk laxative. When ingested, it expands in the presence of water and tends to normalize bowel functions. This also works like other fibers like, it absorbs glucose and lipids in the gut, decreases their absorption, and lowers blood glucose by slowing the delivery of carbohydrate to the small intestine and increasing hepatic extraction of insulin.[10]

The guar plant is about 0.6 m high and pods are 5–12.5 cm long and contain an average 5–6 light brown seeds. Guar gum is insoluble in hydrocarbons, fats, alcohols, esters, and ketones. Chemically, guar gums have a linear chain of (1–4)-linked β-D-mannopyranosyl units with (1–6)-linked α-D-galactopyranosyl residues as side chain with mannose: galactose ratio is approximately 2:1[Figure 1].[5]

Guar bean is an annual legume crop mainly grown in the regions of India and Pakistan, some minor amounts of this bean are grown in the United States, Australia, and Africa. It can be consumed as a whole bean, as cattle feed or can be used as a green manure. Guar bean contains large endosperm that contains galactomannan gum, a substance which forms a gel when combined with water, which is commonly known as "Guar gum" (*C. tetragonoloba*).[12]

## Preparation of Guar Gum

Guar gum is extracted from the guar kernels. In recent times due to increased awareness of the beneficial properties of guar gum, the demand for them has also increased along adjacently. The manufacturing processes are carried out depending upon on the requirement of the end product. The commercial production of guar gum generally uses roasting, differential attrition, sieving, and polishing. The extraction process of guar gum from guar seed is done as follows,

- Step 1: Splitting of the guar seed (the germ)
- Step 2: Undehusked guar splits are obtained
- Step 3: Dehusking the guar splits (gives husk with approximately 35–40% gum residue)
- Step 4: Dehusked guar splits are obtained (approximately 90% husk with husk residue)
- Step 5: Flaking of the guar splits
- Step 6: Hot air grinding
- Step 7: Guar gum powder is obtained (approximately 90% gum)[5]

## General Composition of Guar Gum per 100 g

- Calorie: 16
- Total carbohydrate:11 g
- Protein: 4 g
- Fiber: 3 g
- Iron: 1 mg
- Calcium: 130 mg
- Galactomannan: 75–85%
- Ash: 0.5–1.0%
- Moisture: 8.0–14%[13]

## Benefits of Guar Gum

- Guar gum is used to deliver drug to colon due to its drug release retarding property and susceptibility to microbial degradation in the large intestine
- Guar gum and its derivatives are used as a binder and disintegrate in tablets to add cohesiveness to drug powder[5]
- Supplementation of guar gum in the diet was also found to reduce the laxative requirement, incidence of diarrhea, and symptoms of irritable bowel syndrome
- Guar gum shows glucose and cholesterol lowering effects because of its gel forming properties
- It also helps in weight loss and prevention of obesity. Due to gel forming capacity of guar gum soluble fiber, an increased satiation is achieved because of slow gastric emptying
- Adequate intake of guar gum as dietary fiber helps in the maintenance of bowel regularity, significant reductions in total and LDL cholesterol, control of diabetes, enhancement of mineral absorption, and prevention of digestive problems like constipation.[3]

## Risk Factors Associated with Guar Gum

Various studies have been conducted in animals to test the harmful effects of guar gum. The harmful effects are observed only when the guar gum is given to the animals at a high concentration of about 10–15% on weight basis. This high concentration was found to reduce growth of animal due to decreased feed intake and impaired digestion.

It is also considered that the high viscosity of the intestinal tract contents, resulting from intake of guar gum at higher concentration, is the major cause of the negative effects. Ingestion of guar gum above 0.5–1.0% showed negative effects such as higher viscosity, decreased protein efficiency, and lipid utilization. Higher concentration of guar gum affected the nutritional properties of food and also the physiochemical and sensory properties of food product.[3]

## Role of Guar Gum in Pre-diabetes

Pre-diabetes is a serious and often overlooked disease that increases the risk for type 2 diabetes and cardiovascular events. Early diagnosis and intervention for pre-diabetes can prevent or delay disease progression. More than 86 million American adults have pre-diabetes and 90% are undiagnosed and unaware of the condition and its effects on health. Above the age of 45, the risk factors associated with pre-diabetes and diabetes include overweight and obesity, sedentary lifestyle, family history of TD2, and other conditions associated with insulin resistance. The prevalence of pre-diabetes in children and adolescence increased from 9% in 1999 to 23% in 2008 in the US. Pre-diabetes is also an independent risk factor for cardiovascular disease, persons with pre-diabetes often have cardiovascular problems associated with them. Even though the treatments for these conditions are same as the general population, the presence of pre-diabetes intensifies the risk and necessitates increased vigilance. The nutritional guidelines for individuals with pre-diabetes are same as the diabetes diet.[14]

In general, fiber moves through the body undigested and may help promote satiety while reducing appetite. Some studies have found that guar gum could help with weight loss and appetite control. A study also found that consuming additional 14 g of fiber may lead to 10% decrease in calorie consumption.

In 2015, a review of three studies found that guar gum improved satiety and reduced the number of calories consumed from snaking throughout the day.[15] Hence, it can be seen that the consumption of guar gum in marked levels may also prevent obesity which is one of the causes of transmission of pre-diabetes to Type 2 diabetes mellitus.

Guar gum is a hypocholesterolemic agent which reduces low-density lipoproteins, very low-density lipoproteins, and cholesterol and prevents cardiovascular problems and hypertension.[10]

## Role of Guar Gum in Cholesterol

In general, it is considered that a diet high in fiber, particularly soluble fiber is useful too control high cholesterol and glucose levels. It is inevitable to increase the dietary fiber commodities in the diet to reduce the threat of hypercholesterolemia and glycemic indices. The role of legumes like guar gum is indispensable to enhance the dietary fiber. In addition, it improves the level of dietary fiber in diets with special reference to soluble fibers that play a key role in lowering cholesterol and glucose. Some studies also suggest that

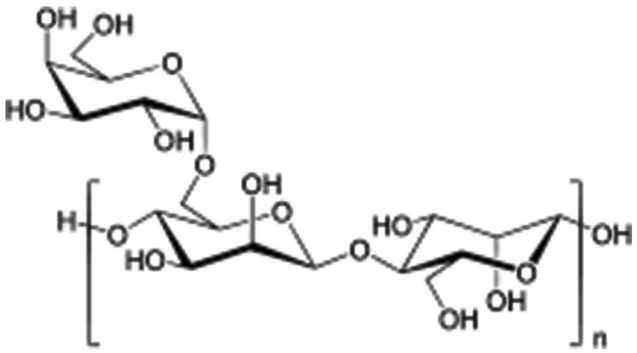

**Figure 1:** General structure of guar gum[11]

amalgamation of guar gum in wheat flour can be recommended to control high blood cholesterol and glucose levels.[12]

The regulation of cholesterol metabolism by guar gum was found that it is having hypocholesterolemic effect and shows as a protective role for cardiac disorders as indicated by various human trials in humans. Consumption of the water-soluble viscous forming fibers such as guar gum has consistently showed reduction in plasma cholesterol in humans.[16]

In a study conducted by Aro *et al*., 14 male subjects were supplemented with granulated guar gum. It was a 12-week double-blind cross-over trial in which the supplementation was given in the concentration of 15 g/d. A significant reduction in serum total cholesterol (7.27 ± 0.24 vs. 8.23 ± 0.26 mmol/l, mean ± SEM, $P < 0.01$) which was mainly due to a reduction in low-density lipoprotein cholesterol concentration (4.70 ± 0.19 vs. 5.32 ± 0.23 mmol/l, $P < 0.05$) was observed after 6 weeks on guar gum. They concluded that the significant reduction of serum total and LDL cholesterol concentration which was observed after 6 weeks on gaur gum is in accordance with the results of several studies on the effects of guar gum in hypercholesterolemic and normocholesterolemic subjects.[15]

## Conclusion

Guar gum is a galactomannan which is derived from the endosperm of the guar plant (*C. tetragonolobus*). Because of its versatile properties such as hydrogen bonding properties, flocculation properties, excellent thickening, stabilizing, and film forming properties, they are used in various pharmaceutical and food manufacturing processes. Some studies also show that the ingestion of guar is effective in controlling or delaying the progression of pre-diabetes. Since it is abundant with dietary fiber, it also plays an important role in cholesterol metabolism.

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