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(REVIEW ARTICLE)

# A review on natural polymer locust bean gum

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## Abstract

Locust bean pods were utilized as cattle feed for a very long time but now its seed endosperm powder is utilized as locust bean gum in various industries such as food, cosmetic, pharmaceutical, textile, paint, mining, oil drilling and construction industries for its thickening and stabilizing properties. In pharmaceutical industries, locust bean gum is used in the production of solid monolithic matrix systems, films, beads, micro-particles, nano-particles, inhalable and injectable systems, as well as in viscous liquid and gel formulations. Locust bean gum is used as an additive in food industry due to its thickening and stabilizing property. Its application for bakery purposes results in higher baked product yields; it improves the final texture and adds viscosity in dough. Addition of guar gum in cookies dough improves the machinability of the dough which helps in the better handling of dough with minimum requirement of energy and time.

**Keywords:** Natural polymer; Low-fat yoghurt; Plant Description; Edible films/coating; Antimicrobial activity

## 1. Introduction

Natural polymer is used as pharmaceutical excipients. Locust bean gum (LBG), also known as carob bean gum, is obtained from the endosperm of carob tree (*Ceratoniasiliqua*) seeds. *In situ* gel is a novel type drug delivery system. Locust bean pods were utilized as cattle feed for a very long time but now its seed endosperm powder is utilized as locust bean gum in various industries such as food, cosmetic, pharmaceutical, textile, paint, mining, oil drilling and construction industries for its thickening and stabilizing properties. In pharmaceutical industries, locust bean gum is used in the production of solid monolithic matrix systems, films, beads, micro-particles, nano-particles, inhalable and injectable systems, as well as in viscous liquid and gel formulations.[1]. World production of carob seeds is estimated at about 315,000 tons per year, produced from two lakhs hectare. The main producers include Morocco (38%), Spain (28%), Italy (8%), Portugal (8%), Greece (6%), Turkey (6%) and Cyprus (2%). recently, growing interest for locust bean gum has been observed due to its various industrial applications. Locust bean gum is used as a thickening and stabilizing agent in food, cosmetic and pharmaceuticals industries. In food industry it is a food additive with E-number E-410 in the European Union. Pharmaceutical applications of locust bean gum are mainly due to its ability as controlled release excipient in tablets. Biodegradability, low toxicity and low cost of locust bean gum contribute for its increasing utilization in various fields

## 2. Locust Bean Gum

It is obtained from Carob tree

**Common name:** *Ceratoniasiliqua* L., commonly known as *Carob gum*

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**Subfamily:** Caesalpinioideae

**Family:** Fabaceae

Locust bean gum is a white to creamy white powder obtained after milling of seed endosperm of fruit pod of the carob tree, a member of legume family, botanically known as *Ceratoniasiliqua* L. which is found in Mediterranean regions. Hence, locust bean gum is also known as carob gum. The carob seed is consists of three parts i.e. husk, endosperm and germ. The processing of carob gum first involves the removal of hull from the seed which can be attained via thermo-mechanical or by chemical treatment. After removal of the outer layer i.e., the hull, the seeds are split lengthwise and the germ portion is separated from the endosperm of carob seed. Further, the isolated endosperms are subjected to grinding, sifting, grading, packaging and finally marketed as locust bean gum or LBG. All the operations in LBG processing are designed such that any impurity from husk or germ portion can be avoided which can ultimately alter the properties of the carob gum.

### 2.1. Uses

Locust bean pods were utilized as cattle feed for a very long time but now it's seed endosperm powder is utilized as locust bean gum in various industries such as food, cosmetic, pharmaceutical, textile, paint, mining, oil drilling and construction industries for its thickening and stabilizing properties. In pharmaceutical industries, locust bean gum is used in the production of solid monolithic matrix systems, films, beads, micro-particles, nano-particles, inhalable and injectable systems, as well as in viscous liquid and gel formulations. In these dosage forms, locust bean gum performs different functions such as binders, viscosity enhancers, stabilizers, matrix formers, drug release modifiers, coatings, disintegrators, solubilizes, emulsifiers, suspending agents, gelling agents, and bio adhesives. Biopharmaceutical applications of locust bean gum are mainly attributed to its gelling capacity and synergies with other polysaccharides. The most common application of locust bean gum is the formulation of oral delivery systems based on tablets, hydrogels and multiparticulate systems. Apart from the binding and stabilizing ability, locust bean gum also acts as a bioactive substance which has hypolipidemic effect, decreasing low density lipoprotein (LDL) cholesterol due to high dietary fiber content [2].

### 2.2. Plant Description and Morphhology

**Figure 1** Fruit of *Ceratoniasiliqua*

Locust bean gum is extracted from the seed endosperm of the carob tree plant botanically known as *C. siliqua.* It belongs to the subfamily Caesalpinioideae of the Leguminosae family [2]. Carob plantis typical tree of semiarid environments. Itis very abundant in the Mediterranean region since ancient times and is currently produced in Spain, Italy, Cyprus and other Mediterranean countries. Its localization also extends to different regions of North Africa, South America, and Asia. Other known carob producing countries are Morocco, Greece, Algeria, Turkey, Israel, India and Pakistan. Carob plant is long-lived evergreen tree and after germination, it grows to about 10 m height in 10–15 years. The carob tree may not be fully grown until it is 50 years old and it starts to bear good quantities of pods at the age of 15 years. The pods reach to full size in July but are ripened in October. Hot and dry climatic conditions are required for good yields. Large trees can yield up to half ton of pods per annum. Carob tree yields large brown fruits known as carob pods. These

carob pods are sickle shaped and are 10–20 cm in length and 2–4 cm in width. These sickle shaped pods contain 10–15 oval shaped carob seeds or kernels. The polysaccharide from seed endosperm of carob tree is also referred in the literature as carob bean gum, carob seed gum, carob flour, or even ceratonia [3]. World production of carob seeds is estimated at about 315,000 tons per year, produced from two lakhs hectare. The main producers include Morocco (38%), Spain (28%), Italy (8%), Portugal (8%), Greece (6%), Turkey (6%) and Cyprus (2%). recently, growing interest for locust bean gum has been observed due to its various industrial applications. Locust bean gum is used as a thickening and stabilizing agent in food, cosmetic and pharmaceuticals industries. In food industry it is a food additive with E-number E-410 in the European Union. Pharmaceutical applications of locust bean gum are mainly due to its ability as controlled release excipient in tablets. Biodegradability, low toxicity and low cost of locust bean gum contribute for its increasing utilization in various fields [3-7].

### *2.3.* Variuos uses of *CeretoniaSiliqua .L*

#### *2.3.1. In food Application*

Locust bean gum is used as an additive in food industry due to its thickening and stabilizing property. Its utilization as stabilizer and thickener in food products is popular as itis obtained from a natural source. Its functionality is due to its water phase management in food products [8].

#### *2.3.2. Bakery products*

Its application for bakery purposes results in higher baked product yields; it improves the final texture and adds viscosity in dough. Addition of guar gum in cookies dough improves the machinability of the dough which helps in the better handling of dough with minimum requirement of energy and time[9]. Locust bean gum is also used to increase volume and to retard the aging of bakery products [10]. The addition of locust bean gum to wheat flour suspension decreases the pasting temperature and increases the peak viscosity, trough viscosity, breakdown, and final viscosity and setback values. Water absorption capacity and dough development time of wheat flour dough also increases on addition of locust bean gum [11]. Locust bean gum can also be used as binding agent as a substitute for gluten in gluten-free bread formulations based on corn starch with improved loaf volume and crumb structure [12-14].

#### *2.3.3. Noodles*

Incorporation of locust bean gum in noodles dough improves the dough rheology as well as the textural characteristics of the cooked noodles. Improvement in textural properties of noodles is attributed to the strengthening effect of gum on the gluten network which results in better textural properties of noodles. Addition of locust bean gum reduces the cooking loss and swelling index of noodles [15].

**Figure 2** Locust bean gum seed

#### *2.3.4. Low-fat yoghurt*

Low-fat yoghurt has a texture different from that of full-fat yoghurt. Fat component in food is mainly responsible for the texture of that product. There have been many studies reported in the literature related to improvement of texture and body of non-fat or low-fat yoghurt. The main examples are use of exopolysaccharides producing starter cultures and addition of food hydrocolloids which provide good stability and desirable texture in low-fat yoghurt [16]. Hydrocolloids and protein concentrations in lowfat yoghurt need to be optimized to allow for maximum interaction between the hydrocolloid and protein. If it is not optimized, then hydrocolloid–hydrocolloid or protein–protein interactions may predominate and ultimately affects the milk reactivity. The milk reactivity is highly dependent on gum concentration

[17]. Locust bean gum when added at 0.02% (w/w) to low-fat yoghurt, increases firmness, viscosity and water-holding capacity and reduces syneresis [18-21].

*2.3.5. Beverages*

Its application for bakery purposes results in higher baked product yields; it improves the final texture and adds viscosity in dough. Addition of guar gum in cookies dough improves the machinability of the dough which helps in the better handling of dough with minimum requirement of energy and time. Guar gum is soluble in hot water and most of the beverages require heat processing which enable the locust bean gum to use in beverages. It improves the keeping qualities of beverages via resistance to phase separation and thickening [22].

*2.3.6. Edible films/coating*

The use of edible films or coatings composed of natural polymers and food additives have been constantly increasing in the food industry to enhance the shelf life of fresh fruits, vegetables and meat products. These films/coatings can be produced from biopolymers such as polysaccharides, proteins, lipids, resins, with or without the addition of plasticizers and surfactants [23]. Locust bean gum has been used to form edible films/coatings due to its edibility and biodegradability and can be used as an alternative to reduce negative effects of minimal processing on fresh-cut fruits [24]. Hydrophilic properties of locust bean gum provide a good barrier due to its carbon dioxide permeability, oxygen permeability, water vapor permeability, tensile strength and elongation-at-break under certain conditions. Locust bean gum in edible film and coating may also serve as carrier of additives and bioactive components [25]. Edible films formed by mixed systems of locust bean gum and k-carrageenan showed improved properties. The addition of -carrageenan to locust bean gum improved the barrier properties of the film which leads to decrease in water vapor permeability. Improved values of elongation-at-break of edible films were also reported when the ratio of k-carrageenan and locust bean gum was mixed in the ratio of 80:20% (w/w). K-carrageenan and locust bean gum blend films enhance the tensile strength compared to tensile strength of films prepared individually by k- carrageenan and locust bean gum. Improvement in k-carrageenan and locust bean gum film properties are reported due to hydrogen bonds interactions between k-carrageenan and locust bean gum observed via Fourier Transform Infrared (FTIR) spectroscopy analysis [26]

*2.3.7. Non Food application*

Locust bean pods were utilized as cattle feed for a very long time but now its seed endosperm powder is utilized as locust bean gum in various industries such as food, cosmetic, pharmaceutical, textile, paint, mining, oil drilling and construction industries for its thickening and stabilizing properties. In pharmaceutical industries, locust bean gum is used in the production of solid monolithic matrix systems, films, beads, micro-particles, nano-particles, inhalable and injectable systems, as well as in viscous liquid and gel formulations. In these dosage forms, locust bean gum performs different functions such as binders, viscosity enhancers, stabilizers, matrix formers, drug release modifiers, coatings, disintegrators, solubilizers, emulsifiers, suspending agents, gelling agents, and bio adhesives [27]. Biopharmaceutical applications of locust bean gum are mainly attributed to its gelling capacity and synergies with other polysaccharides. The most common application of locust bean gum is the formulation of oral delivery systems based on tablets, hydro gels and multi particulate systems. Apart from the binding and stabilizing ability, locust bean gum also act as a bioactive substance which has hypolipidemic effect, decreasing low density lipoprotein (LDL) cholesterol due to high dietary fiber content [28].

### 2.4. Chemical constituent

Galactomannans are linear polysaccharides consists of -(l–4)-mannose backbone with single d-galactopyranosyl units attached via -(l–6) linkages as side branch. These side branches are not distributed uniformly in the main backbone chain [20,30]. There are also present some unsubstituted -d-mannopyranosyl chain segments, alternating with -d-mannopyranosyl units substituted with -d-galactopyranosyl side branches [31,32]. Carob galactomannan is one ofthe commercial galactomannans guar gum and tara gum; and among these galactomannans LBG has the lowest galactose content about twenty percent [33,36]. Locust bean gum generally has an average mannose to galactose ratio of about 3.5 which is highest among the commercially available galactomannan such as guar gum (1.8) and tara gum (3.0). The degree of galactose substitution on mannose chain affects water solubility of the galactomannan [37-40].

### 2.5. Medicinal and pharmacologic action [41-45].

- Antimicrobial activity
- Antioxidant properties
- Laxative properties

- Abdominal pain
- Wound healing
- Malaria and fever
- Antidiabetic activity
- Effect on cardiovascular system and blood
- Antivenom activities
- Effect on cellular system
- Hepatoprotective and antiasthmatic activity
- Antiinflammatory and analgesic activity
- Effect on enzyme
- Helminthes infections (parasitic worms)
- Diarrhea and dysentery

## 3. Conclusion

Locust bean pods were utilized as cattle feed for a very long time but now its seed endosperm powder is utilized as locust bean gum in various industries such as food, cosmetic, pharmaceutical, textile, paint, mining, oil drilling and construction industries for its thickening and stabilizing properties. In pharmaceutical industries, locust bean gum is used in the production of solid monolithic matrix systems, films, beads, micro-particles, nano-particles, inhalable and injectable systems, as well as in viscous liquid and gel formulations. Approximately some years ago oral drug delivery system drugs were available in market and these systems have more advantages due to patient's acceptance and ease of administration.

## Compliance with ethical standards

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*Disclosure of conflict of interest*

The Authors declare no conflicts of interest relevant to this article.

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