

CAROB BEAN GUM
Chemical and Technical Assessment (CTA)

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1. Summary

Carob (locust) bean gum is mainly consisting of the high molecular weight (approximately 50,000-3,000,000) polysaccharides composed of galactomannans and is obtained from the endosperm of the seed of the carob (locust) tree, *Ceratonia siliqua* (L.) Taub (Fam. *Leguminosae*). It is used as thickener, stabilizer, emulsifier and gelling agent, and approved in most areas of the world (e.g. European Union, United States of America, Japan and Australia).

Carob bean gum was evaluated and ADI “not specified” was allocated at 25th JECFA (1981). The specifications were prepared at 35th JECFA (1989) and published in FNP 49 (1989) and republished in FNP 52 “Compendium of food additive specifications”. They were discussed at 42nd, 44th, 51st and 53rd JECFA, and their revised specifications were published in FNP 52 Add 2, 3, 6 and 7, and republished in FAO JECFA Monographs “Combined compendium of food additive specifications”. At 67th JECFA the Committee reviewed the specifications of “Carob bean gum” and noted that they were covered two grades of product. The Committee decided to prepare two specifications monographs, “Carob bean gum” and “Carob bean gum (clarified)”. Both monographs were designated tentative and published in FAO JECFA Monographs 3 (2006). Further information on gum content, solubility in water and a test method for methanol and isopropanol as residual solvents using capillary gas chromatography were required before the end of 2007. The outstanding information was received prior to the 69th meeting of JECFA.

2. Description

Carob bean gum, also known as locust bean gum, carubin or algaroba, is obtained from the endosperm of seed of the carob (locust) tree, *Ceratonia siliqua* (L.) Taub (Fam. *Leguminosae*). The carob tree is a large evergreen tree and its fruit is a long brown pod containing very hard brown seeds, the kernels. The seeds are dehusked by treating the kernels with dilute sulfuric acid or with thermal mechanical treatment, elimination of the germ followed by milling and screening of the endosperm (native carob bean gum). The gum may be washed with ethanol or isopropanol to control the microbiological load (washed carob bean gum). It may also be further clarified (purified, extracted) by dispersing in hot water, recovery with isopropanol or ethanol, filtering, drying and milling, which is called as clarified (purified, extracted) carob bean gum. Clarified carob bean gum in the market is normally standardized with sugars for viscosity and /or reactivity.

Carob bean gum is mainly consisting of the high molecular weight (approximately 50,000-3,000,000) polysaccharides composed of galactomannans.

The clarified gum has higher galactomannans content and no longer contains the cell structure.

The gum is a white to yellowish white, nearly odourless powder.

Carob bean gum is insoluble in most organic solvents including ethanol. It is partially soluble in water at ambient temperature and soluble in hot water. Carob bean gum typically needs heating to above 85° for 10 minutes for complete solubility.

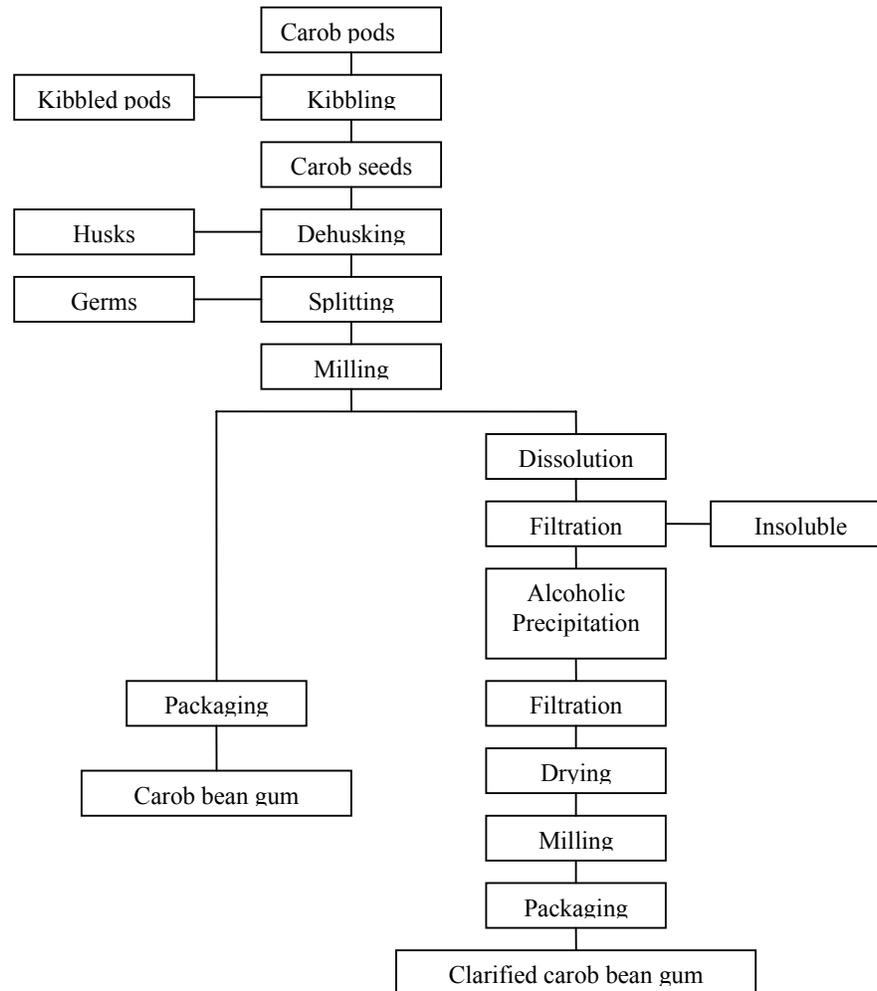
The gum may be precipitated from aqueous solution by some electrolytes, and, in particular, polyvalent ones such as lead acetate, phosphotungstic acid, and tannic acid. Solutions containing greater than 0.3% gum are gelled by the addition of borate at pH 7.5 or greater. The gel is reversed by decreasing the pH below 7.0, by heating, or addition of mannitol (a sequestrant for borate).

3. Manufacturing

3.1. Manufacturing principle

The endosperms are recovered after separation of the husk and the germ and milled. The clarified gum is obtained by dissolution in hot water and then recovery by precipitation in ethanol or isopropanol.

Carob bean gum processing flow chart



3.2. Detailed manufacturing

The carob kernels are difficult to process, since the seed coat is very tough and hard. By special processes, the kernels are peeled without damaging the endosperm and the germ. The following procedures are applied:

Acid peeling process: The kernels are treated with sulfuric acid at a certain temperature to carbonize the seed coat. The remaining fragments of the seed coat are removed from the clean endosperm in an efficient washing and brushing process. The peeled kernels are dried and cracked and the more friable germ gets crushed. The germ parts are sifted off from the unbroken endosperm halves. The carob bean gum produced by this process is “whitish” and has higher viscosity.

Thermal peeling process: Alternatively, the kernels may be roasted in a rotating furnace where the seed coat more or less pops off from the rest. The endosperm halves are recovered from the burned husk and the

crashed germs. This process yields a product of somewhat darker colour. The effect is that no sulfuric acid as processing aid is necessary, and, therefore, no effluent originates from the production process.

Afterward, the isolated endosperm is ground to fine particle size powder which represents the final product "Carob Bean Gum".

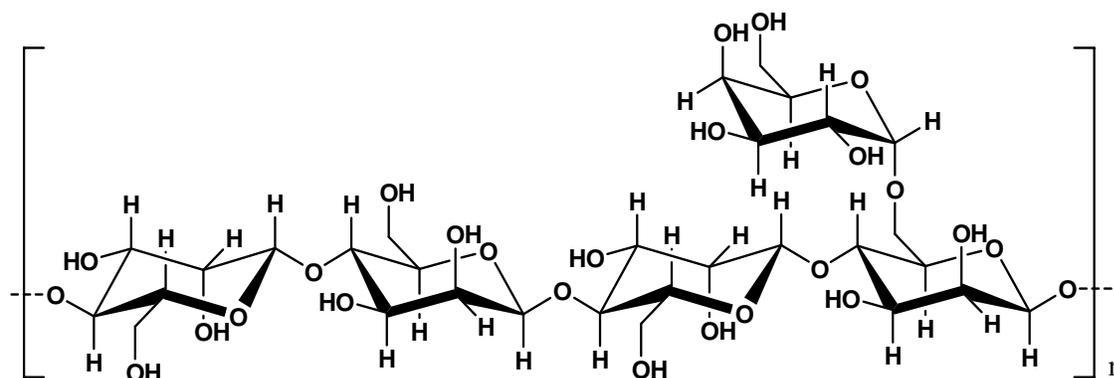
Clarified (Extracted, Purified) Carob Bean Gum

Carob Bean Gum is dispersed in water and dissolved by heating. This solution is filtered (with a filter aid) to remove insoluble material. From this clear solution, the Carob Bean Gum is precipitated with isopropanol or ethanol, the precipitate is filtered off, dried and ground to fine particle size powder.

4. Chemical characterization

4.1. Composition and properties

Carob bean gum is comprised of a high molecular weight polysaccharides composed of galactomannans consisting of a linear chain of (1→4)-linked β -D-mannopyranosyl units with (1→6)-linked α -D-galactopyranosyl residues as side chains. Standard texts report the molecular weight as approximately 310,000. However the INEC Technical Committee reports that the standard method using the consumption of sodium chlorite is unsuitable and recommends a gel permeation chromatography method. This provides a molecular weight range of 50,000 to 300,000. The mannose:galactose ratio of carob bean gum is approximately 4:1. The mannose and galactose content has been reported as 73-86% and 27-14%, respectively.



4.2. Possible impurities

The commercial samples of carob bean gum contain approximately 5-12% moisture, 1.7-5% acid-soluble ash, 0.4-1.0% ash, and 3-7% protein. The samples of clarified carob bean gum contain approximately 3-10% moisture, 0.1-3% acid-soluble matter, 0.1-1% ash, and 0.1-0.7% protein.

The possible impurities are:

- Husk (reflected by the Acid-insoluble-matter criterion)
- The germ (adequately reflected by the Protein criterion)
- Residual amounts of ethanol or isopropanol for washing or extraction solvent (limited to 1%, singly or in combination)
- Microbiological contamination

5. Functional uses

5.1 Technological function

Carob bean gum is used as thickener, stabilizer, emulsifier, gelling agent. Carob bean gum is compatible with xanthan gum and forms gel. It affects the gelling properties of carrageenan and agar.

5.2 Food categories and use level

In the United States, carob bean gum is listed for use as a stabilizer and thickener in the following foods:

<u>Food Category</u>	<u>Maximum Use Level (%)</u>
Baked goods & baking mixes	0.15
Non-alcoholic beverages & beverage bases	0.25
Cheeses	0.8
Gelatins, puddings, & fillings	0.75
Jams and jellies	0.75
All other foods	0.50

In the 1977 survey of the United States food industry, carob bean gum was reported as being used as a firming agent, flavouring agent, humectant, stabilizer, and thickener in the following foods:

<u>Food Category</u>	<u>Mean Use Level (%)</u>
Baked goods	
Cakes	0.20
Sweet rolls	0.80
Cookies	0.00055
Grain products & pasta	
Pasta with meat sauce	0.040
Fats & oils	
Dressings	0.023
Dietetic products	0.36
Milk products	
Chocolate milk	0.00015
Eggnog	0.059
Yogurt	0.039
Sour cream	0.073
Buttermilk	0.015
Other (includes evaporated, condensed & imitation milk)	0.099
Cheese	
Processed cheese	0.32
Cottage cheese	0.16
Cream cheese	0.46
Frozen dairy desserts	
Ice cream	0.055
Sherbets	0.10
Mellorine	0.072
Shakes & malts	0.071
Dietetic products	0.17
Other (includes frozen yogurt)	0.0050
Fruits & fruit juices	
Frozen fruit	0.093

Fruit drinks, ades	0.00057
Fruit pie fillings	0.091
Maraschino fruit	0.010
Other (include pickled, fruit salad)	0.075
Fruit & water ices, cup/stick types	0.21
Meat with pasta; hash; spreads	0.17
Egg substitutes	0.089
Fish & seafood	
Processed, unfrozen	0.030
Fabricated, frozen	0.15
Other (include shrimp cocktail, caviar, gefilte fish, etc.)	0.17
Condimental sauces	0.35
Frostings	0.092
Jams & jellies	
Flavoured jellies	0.12
Dietetic products	0.30
Other (include marmalade, conserves)	0.23
Sweet sauces & toppings	
Fruit type	0.23
Other (include nut, fudge, & marshmallow topping)	0.14
Maple syrup	0.0026
Gelatins, puddings, & custards	
Gelatin	0.25
Canned puddings	0.010
Dry puddings, to be cooked	0.12
Custard type pie filling	0.067
Other (include tapioca, rice, & bread puddings)	0.20
Soup & soup mixes	
Dry soup mixes	0.07
Bouillon	0.20
Non-alcoholic beverages	
Carbonated, fruit	0.00085
Diet non-colas	1.1
Alcoholic beverages	
Brandy, whiskey, vodka, mm	0.00039
Cocktails	0.0072
Cordials, liqueurs	0.30
Gravies & sauces	
Meat type	0.12
Milk based	0.12
Dairy product analogs (soy milk & imitation cheese)	0.30
Dietary supplements	5.0

Information from the sponsor indicates a normal use level of carob bean gum in ice-cream of 0.1 – 0.3%.

6. Reactions and Fate in Food

None noted.

7. References

Food Chemicals Codex, 5th Ed., 2004, pp. 256.

Evaluation of the Health Aspects of Carob Bean Gum as a Food Ingredient (SCOGS-3), 1972. Life Sciences Research Office, Federation of American Societies for Experimental Biology, Bethesda, MD, Contract FDA-72-85.

Kirk-Othmer Encyclopedia of Chemical Technology 3rd Ed, 1980. John Wiley & Sons, NY, Vol. 12, p. 59.

Belitz, H.D., and Groseh, W., 1987 .Food Chemistry, Springer-Verlag, Berlin, pp. 242-243.

United States Code of Federal Regulations, 2002. Title 21, Part 184.1343.

1977 Survey of Industry on the Use of Food Additives, 1979. Committee on GRAS List Survey - Phase III, Food & Nutrition Board, National Research Council, National Academy of Sciences, Washington DC, pp. 64-66.

The Merck Index, 12th Ed., 1996. Merck and Co., Inc., Ed by Susan Badavari, Whitehouse Station, N.J., USA, p327.

Handbook of Food Additives, 2nd Ed., 1972. Ed by Thomas Furia, CRC Press, Ohio, p318.

Phillips, G.O., Wedlock, D. J., and Williams, P. A., 1995. In “Gums and Stabilisers in the Food Industry”, Vol. 8. INEC communication to the JECFA Secretariat.