Guar Gum

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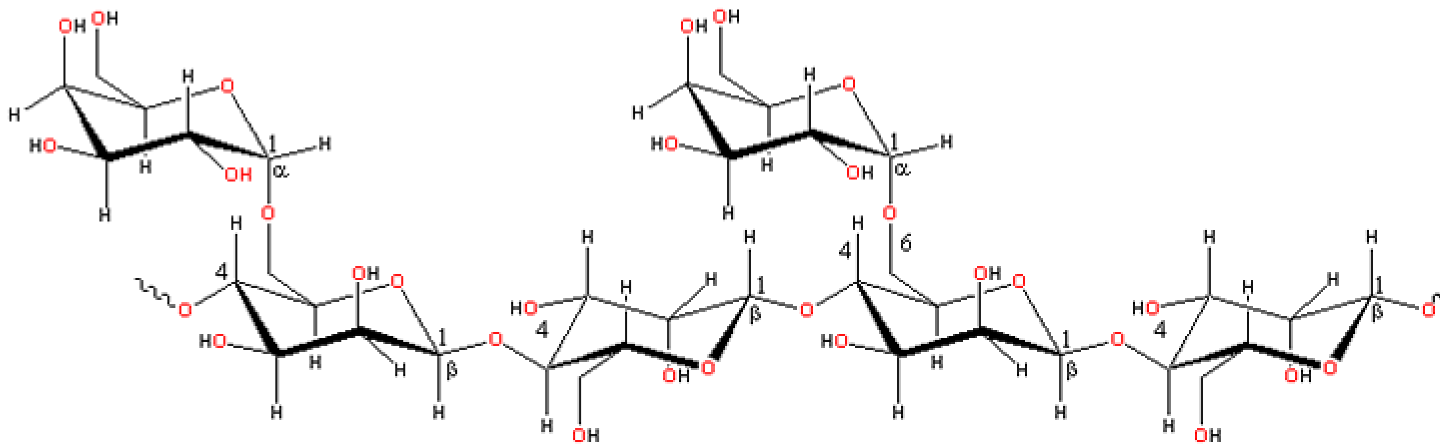
Source

Guar gum (E412, also called guaran) [2079] is extracted from the seed of the leguminous shrub *Cyamopsis tetragonoloba*, where it acts as a food and water store.

Structural unit

Guar gum is a galactomannan[a] similar to locust bean gum consisting of a (1⟶4)-linked β-D-mannopyranose backbone with branchpoints from their 6-positions linked to α-D-galactose (that is, 1⟶6-linked-α-D-galactopyranose). There are between 1.5 - 2 mannose residues for every galactose residue.



Molecular structure

Guar gum is made up of non-ionic polydisperse rod-shaped polymers consisting of molecules (longer than found in locust bean gum) made up of about 10,000 residues. Higher galactose substitution also increases the stiffness (that is, decreases the flexibility) but reduces the overall extensibility and radius of gyration of the isolated chains [291]. The galactose residues prevent strong chain interactions as few unsubstituted clear areas have the minimum number (about 6) required for the formation of junction zones. Of the different possible galactose substitution patterns, the extremes of block substitution and alternating substitution give rise to the stiffer, with greater radius of gyration, and most flexible conformations respectively (random substitution being intermediate) [291]. Its persistence length is greater than that for locust bean gum at about 10 nm [1378]. If the galactose residues were perfectly randomized, it unlikely that molecules would have more than one such area capable of acting as a junction zone, so disallowing gel formation. A block substitution pattern, for which there is some experimental evidence [322], would allow junction zone formation if the blocks were of sufficient length. Use of endo-1,4-β-D-mannanase and α-D-galactosidase have shown that shorter chain lengths and lower degrees of substitution lead to the formation of large, but soluble, assemblies while longer galactomannans have reduced solubility [1749]. Enzymatic hydrolysis of some of the galactose side chains may allow guar gum to be used to replace a dwindling locust bean gum supply.

Functionality

Guar gum is an economical thickener and stabilizer. It hydrates fairly rapidly in cold water to give highly viscouspseudoplastic solutions of generally greater low-shear viscosity when compared with other hydrocolloids and much greater than that of locust bean gum. High concentrations (~ 1%) are very thixotropic but lower concentrations (~ 0.3%) are far less so. Guar gum is more soluble than locust bean gum and a better emulsifier as it has more galactose branch points. Unlike locust bean gum, it does not form gels but does show good stability to freeze-thaw cycles. Guar gum shows high low-shear viscosity but is strongly shear-thinning. Being non-ionic, it is not affected by ionic strength or pH but will degrade at pH extremes at temperature (for example, pH 3 at 50 °C). It shows viscosity synergy with xanthan gum. With casein, it becomes slightly thixotropic forming a biphasic system containing casein micelles.

Guar gum retards ice crystal growth non-specifically by slowing mass transfer across solid/liquid interface.

Unfortunately for the food industry, guar gum has been found to be ideal for use by the oil and gas industry to extract gas and oil from source rocks using pressurized fluid (hydraulic fracturing, or 'fracking'). This has increased both the demand for guar and its price several-fold [1792].

Interactive structures are available (Jmol).

Footnotes

[a] Another galactomannan with lower substitution (with a mannose to galactose ratio of about 3:1) is tara gum (E417), obtained from *Cesalpinia spinosa*. It has properties between those of guar gum and locust bean gum. Higher substituted galactomannans are found in fenugreek gum (*Trigonella foenum-graecum*) and mesquite gum (*Prosopis juliflora*), with mannose to galactose ratio of about 1:1 (but possibly as high as 5:4 [492]) and 5:4 respectively. The higher substitution of these gums gives them improved solubility, dispersiveness and emulsification (although it appears that this emulsification activity is absent in the polysaccharide [492] but due to protein impurities [309]). [Back]

Source : http://www1.lsbu.ac.uk/water/hygua.html