

Xanthan Gum

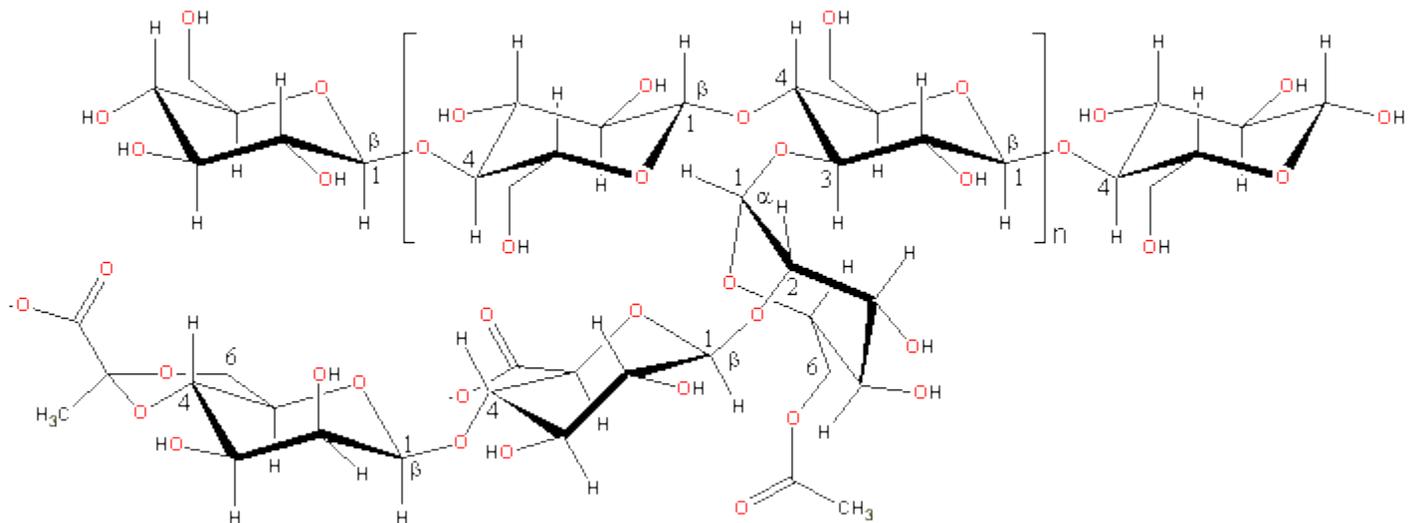
- ▼ Source
- ▼ Structural unit
- ▼ Molecular structure
- ▼ Functionality

Source

Xanthan gum (E415) is a microbial desiccation-resistant polymer prepared commercially on a large scale (>30,000 tons per year) by aerobic submerged fermentation from *Xanthomonas campestris*. It is naturally produced to stick the bacteria to the leaves of cabbage-like plants. It is relatively expensive by weight but becoming rather less so. As the media used to grow the *Xanthomonas* may contain corn, soy or other plant material, manufacturers should make clear if any residues may remain. A recent review is given at [1724].

Structural unit

Xanthan gum is an anionic polyelectrolyte with a β -(1 \rightarrow 4)-D-glucopyranose glucan (as cellulose) backbone with side chains of -(3 \rightarrow 1)- α -linked D-mannopyranose-(2 \rightarrow 1)- β -D-glucuronic acid-(4 \rightarrow 1)- β -D-mannopyranose on alternating residues. Slightly less than half (~40%) of the terminal mannose residues are 4,6-pyruvated and the inner mannose is mostly 6-acetylated (that is, the side chains are mainly β -D-mannopyranosyl-(1 \rightarrow 4)-(α -D-glucuronopyranosyl)-(1 \rightarrow 2)- β -D-mannopyranoside-6-acetate-(1 \rightarrow 3)-. Some side chains may be missing.



Molecular structure

Xanthan gum has a relatively reproducible specification as it is produced by fermentation. Each molecule consists of about 7000 pentamers and the gum is less polydisperse than most hydrocolloids. Its natural state has been proposed to be bimolecular antiparallel double helices. It may form a very stiff intramolecular (single molecule hairpin) double stranded helical conformation by the annealing of the less stiff 'natural' denatured elongated single stranded chains. The glucan backbone is protected by the side chains which lie alongside, making it relatively stable to acids, alkalis and enzymes (this is particularly important as preparations can contain cellulase). Use of different strains or fermentation conditions may give rise to differing degrees of acetylation and pyruvylation, which moderates the functionality.

The conversion between the ordered double helical conformation and the single more-flexible extended chain may take place over hours of annealing (equilibrating) at between 40 °C - 80 °C. The weakly bound network formed is highly **pseudoplastic**, viscosity reducing considerably with shear increase and returning in full immediately on release. High viscosity solutions (~1%) appear gel-like but still shear-thin. The rationale for this strange behavior is the hydrogen-bonded and entangled association between the side chains of the highly extended molecules, which resists dissociation. Shear thinning with greater strain is mainly due to the conformation of the side chains flattening against the backbone under shear, so reducing the intermolecular interactions.

Functionality

Xanthan gum is mainly considered to be non-gelling and used for the control of viscosity due to the tenuous associations endowing it with weak-gel shear-thinning properties. It hydrates rapidly in cold water without lumping to give a reliable viscosity, encouraging its use as thickener, stabilizer, emulsifier and foaming agent. The consistent water holding ability may be used for the control of syneresis and to retard ice recrystallization (ice crystal growth) in freeze-thaw situations; xanthan gel strength being improved on freeze-thaw [468]. Its most important property being its very high low-shear viscosity coupled with its strongly shear-thinning character. The relatively low viscosity at high shear means that it is easy to mix, pour and swallow but its high viscosity at low shear gives good suspension and coating properties and lends stability to colloidal suspensions. Being relatively unaffected by ionic strength, pH (1 - 13), shear or temperature it may be used in such products as salad dressings.

Xanthan gum is capable of synergistic interactions with galactomannans and glucomannans (for example, konjac mannan, E425; a non-ionic relatively rigid gelling, naturally partially acetylated, polysaccharide possessing a mixed (1→4)-linked β-D-mannopyranose/β-D-glucopyranose backbone with about 8% β-(1→6)-glucosyl branchpoints [477]). It synergistically forms thermoreversible soft elastic gels with **locust bean gum** on cooling mixtures; **locust bean gum** being preferred over **guar gum** as it has fewer galactose side chains and the interaction (here) concerning the smooth (1→4)-linked β-D-mannopyranose backbone regions. A greater proportion of **guar gum** (80:20) is required for optimal synergy compared to **locust bean gum** (50:50) with the associating complex not requiring segments of unsubstituted backbone [219]. The synergy is best at high xanthan extension and is thus reduced by high salt and low pH. Xanthan gums may contain cellulase, which prevents their use with cellulose derivatives. Interactive structures are available ([Jmol](#)).

Source : <http://www1.lsbu.ac.uk/water/hyxan.html>