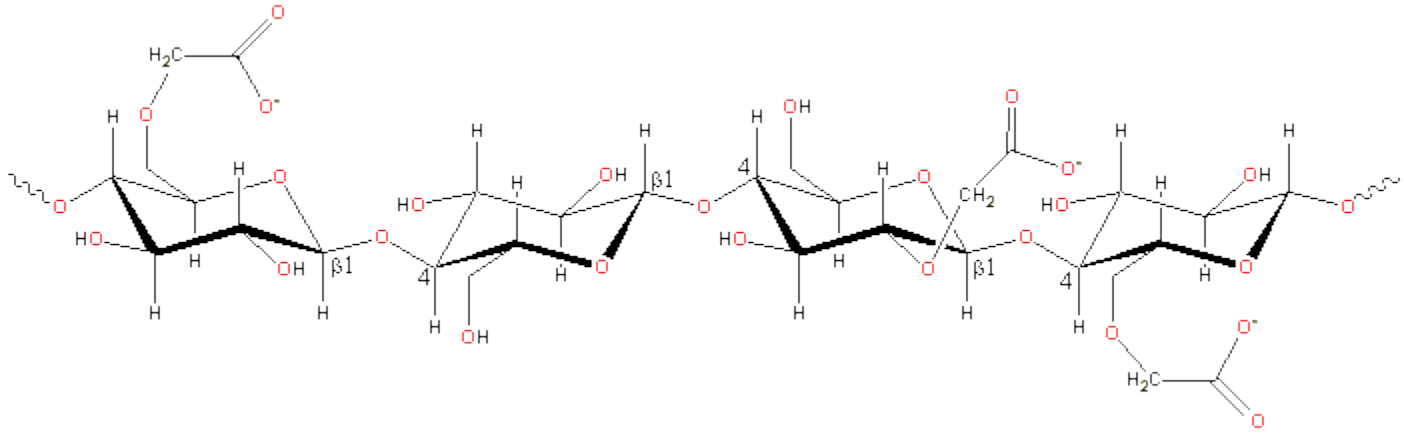
Carboxymethylcellulose (CMC)

Source

Carboxymethylcellulose (CMC; E466) is a derivative of cellulose formed by its reaction with alkali and chloroacetic acid.

Structural unit



The CMC structure is based on the β-(1⟶4)-D-glucopyranose polymer of cellulose. Different preparations may have different degrees of substitution, but it is generally in the range 0.6 - 0.95 derivatives per monomer unit.

Molecular structure

CMC molecules are somewhat shorter, on average, than native cellulose with uneven derivatization giving areas of high and low substitution. This substitution is mostly 2-O- and 6-O-linked, followed in order of importance by 2,6-di-O- then 3-O-, 3,6-di-O-, 2,3-di-O- lastly 2,3,6-tri-O-.linked. It appears that the substitution process is a slightly cooperative (within residues) rather than random process giving slightly higher than expected unsubstituted and trisubstituted areas. CMCmolecules are most extended (rod-like) at low concentrations but at higher concentrations the molecules

overlap and coil up and then, at high concentrations, entangle to become a thermoreversible gel. Increasing ionic strength and reducing pH both decrease the viscosity as they cause the polymer to become more coiled.

Functionality

Most CMCs dissolve rapidly in cold water and are mainly used for controlling viscosity without gelling (CMC, at typical concentrations, does not gel even in the presence of calcium ions). As its viscosity drops during heating, it may be used to improve the volume yield during baking by encouraging gas bubble formation. Its control of viscosity allows use as thickener, phase and emulsion stabilizer (for example, with milk casein), and suspending agent. CMC can be also used for its water-holding capacity as this is high even at low viscosity; particularly when used as the Ca^{2+} salt. Thus, it is used for retarding staling and reducing fat uptake into fried foods.

The average chain length and degree of substitution are of great importance; the more-hydrophobic lower substitutedCMCs are thixotropic but more-extended higher substituted CMCs are pseudoplastic. At low pH, CMC may form cross-links through lactonization between carboxylic acid and free hydroxyl groups.

The solution properties of a range of commercial CMC's have been investigated [879].

Interactive structures are available (Jmol).

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