Polysaccharides

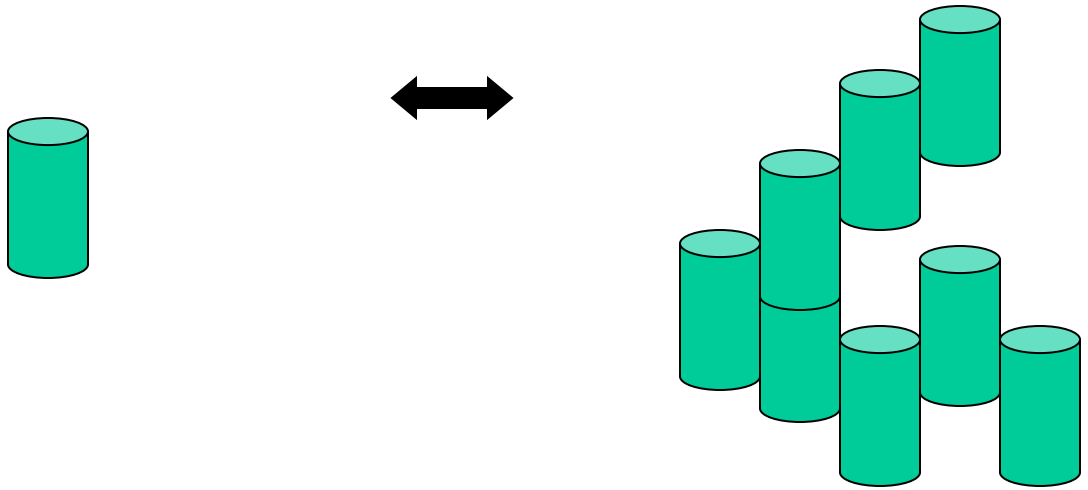
FDSC400

Sources of Polysaccharide

- Microbial fermentation
- Higher plants
  - seeds,
  - tree extrudates,
  - marine plants,
- Chemical modification of other polymers

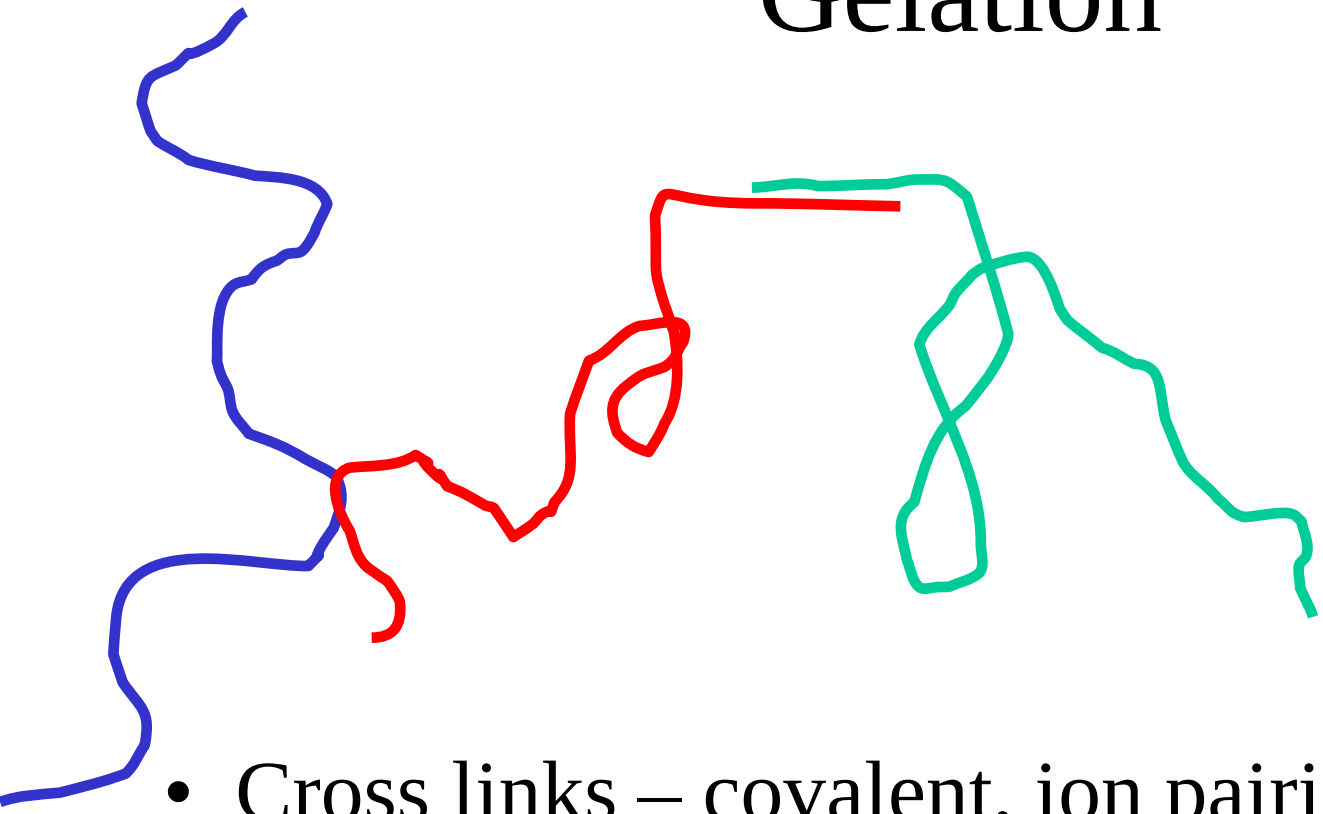
No calorific value; fiber

Solubility



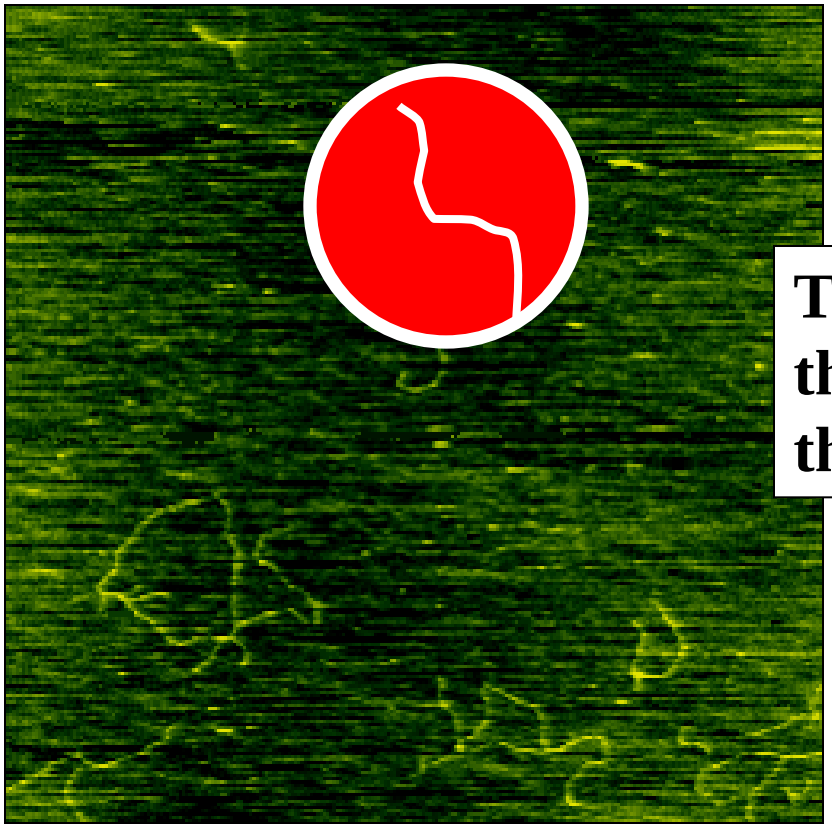
- Strong interaction with water = solubility
- Strong, extended interaction with polymer = insolubility
- Local, limited interaction with polymer = gelation

Gelation



- Cross links – covalent, ion pairing, co-crystallization

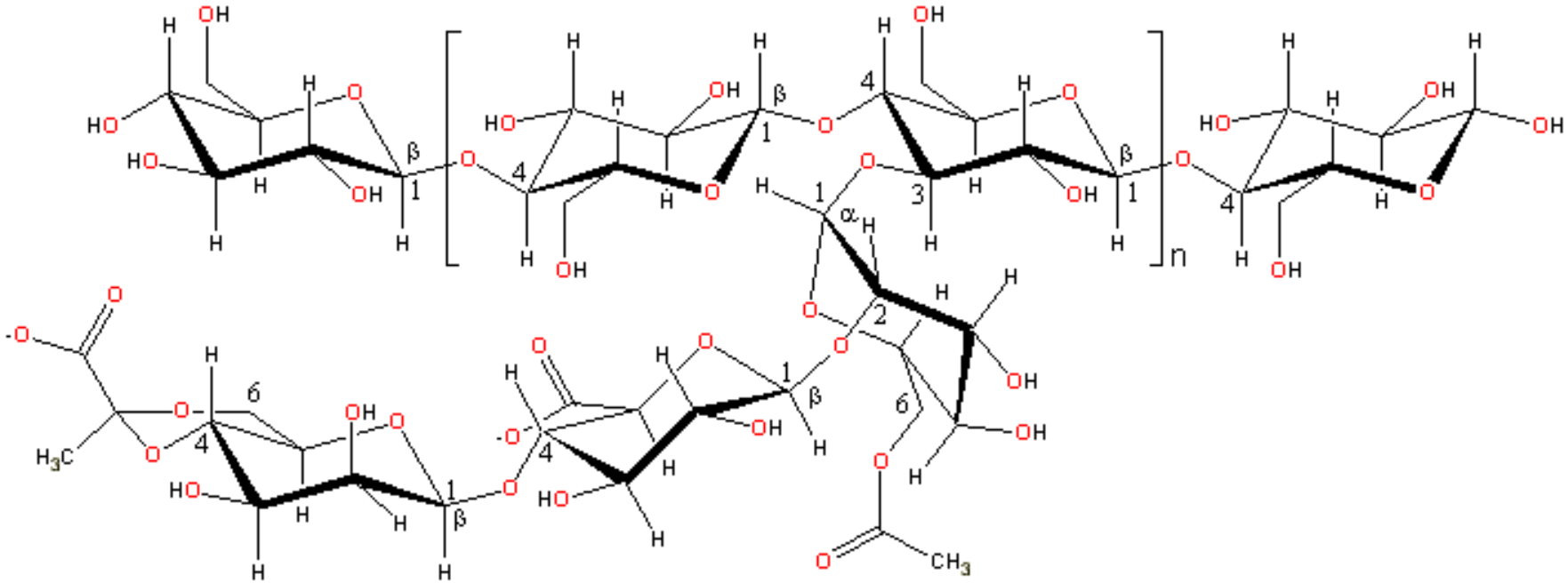
Viscosity



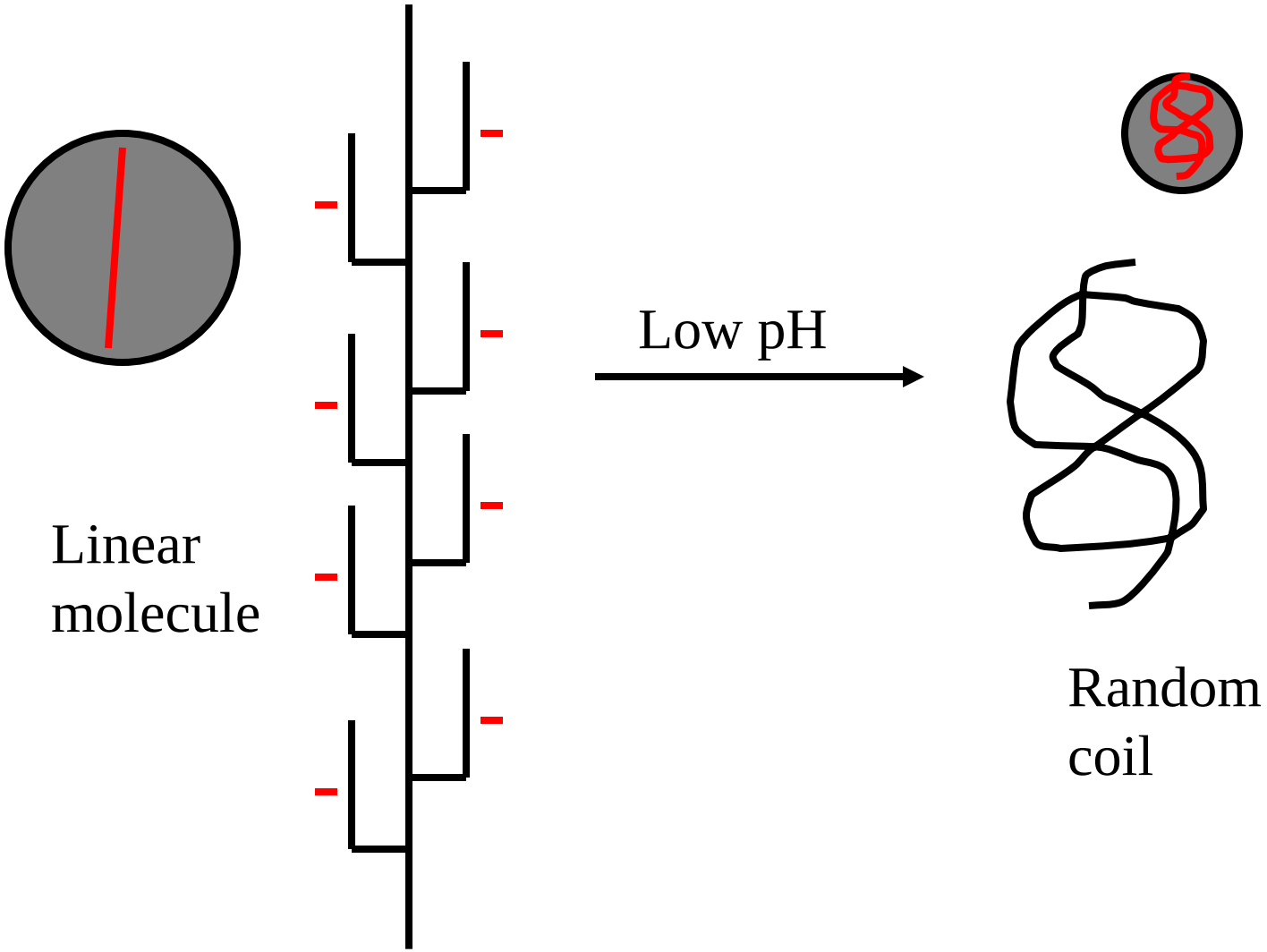
The radius of gyration is the sphere swept out by the polymer

Xanthan gum

- **Source**: Product of bacteria *Xanthomonas campestris*
- **Structure**: cellulose-like backbone (β-1,4-poly-glucose) with trisaccharide branches (stubs) on alternate monomers on the backbone carrying carboxylic acid residue
- **Functional Properties**: Water soluble, viscous, non-gelling. Viscosity is only slightly temperature dependant

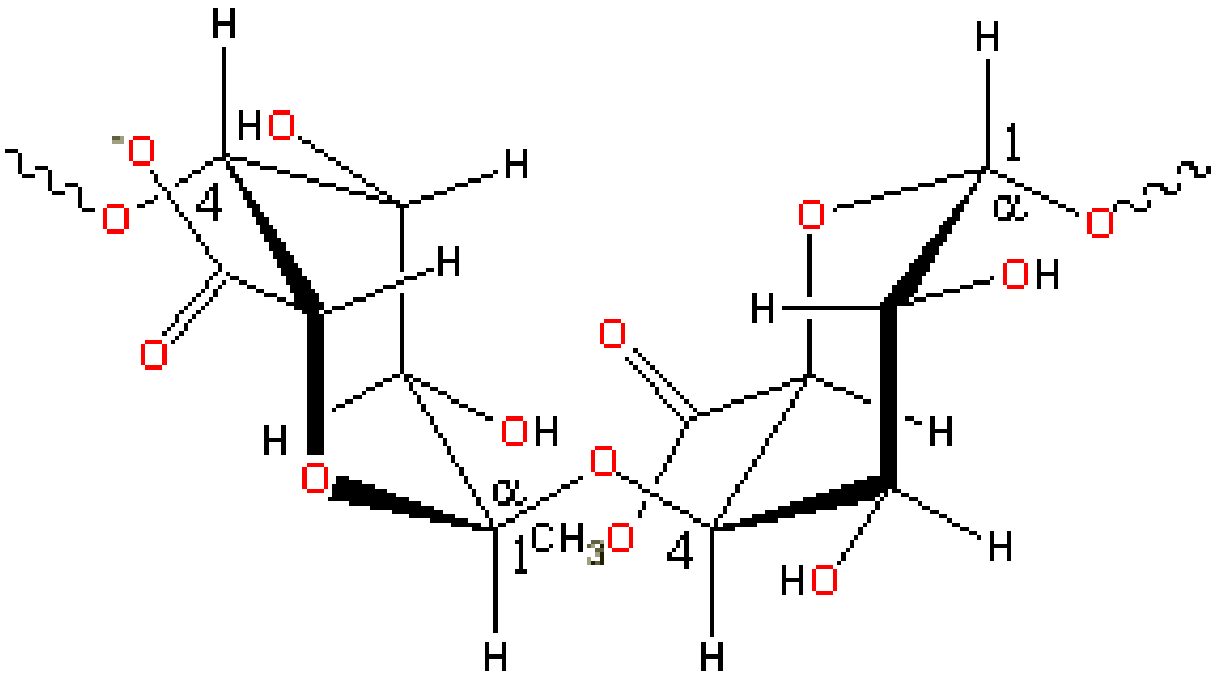


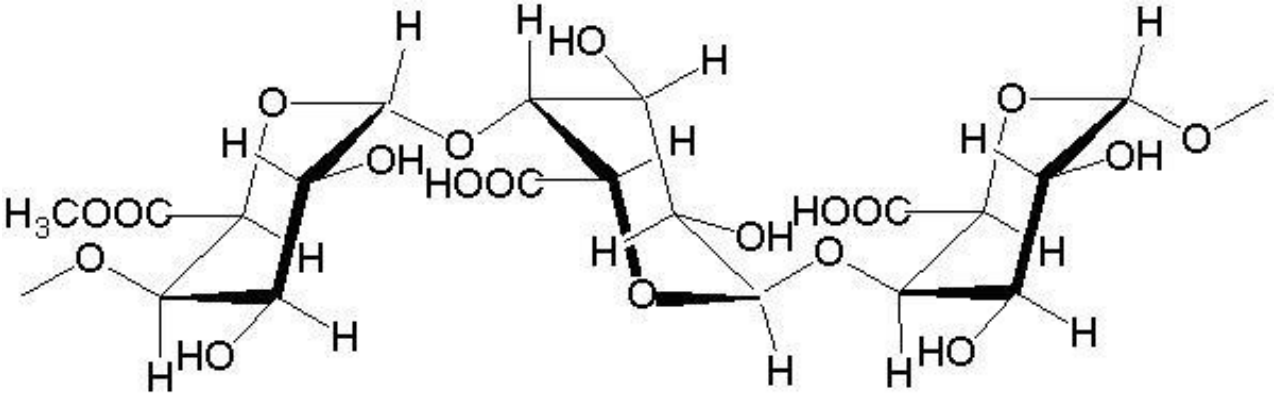
Xanthan: Structure-function



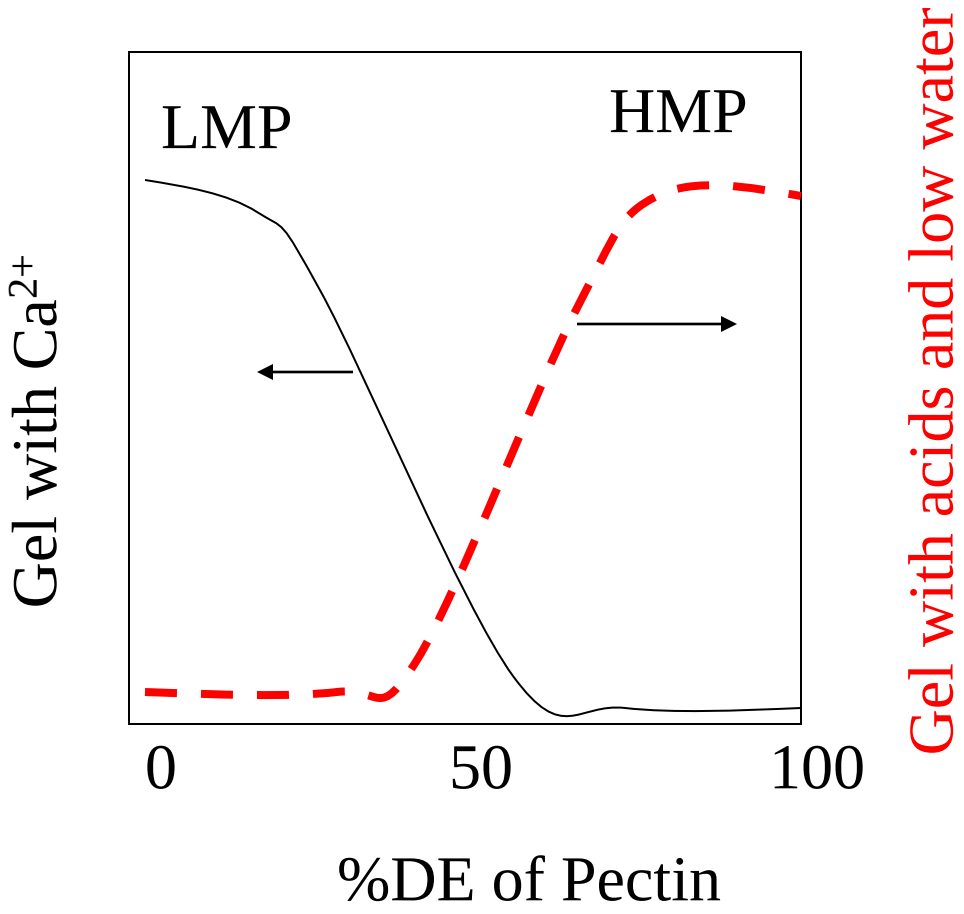
Pectin

- **Source**: Cell walls of higher plants (citrus rind)
- **Structure**: Largely a linear polymer of polygalacturonic acid with varying degrees of methyl esterification. (Also some branches – HAIRY REGIONS)
  - >50% esterified is a high methoxy (HM) pectin
  - <50% esterified is a low methoxy (LM) pectin
- **Functional Properties**: High methoxy pectin will gel in the presence of acid and high sugar concentrations. Low methoxy pectin will gel in the presence of calcium.



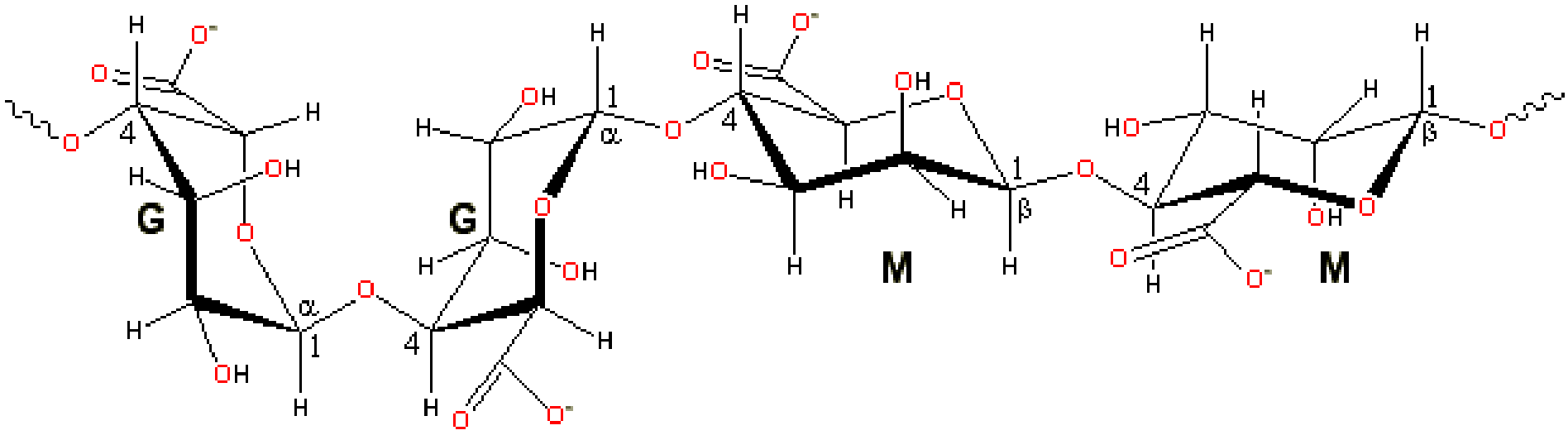


High and Low Methoxy Pectin

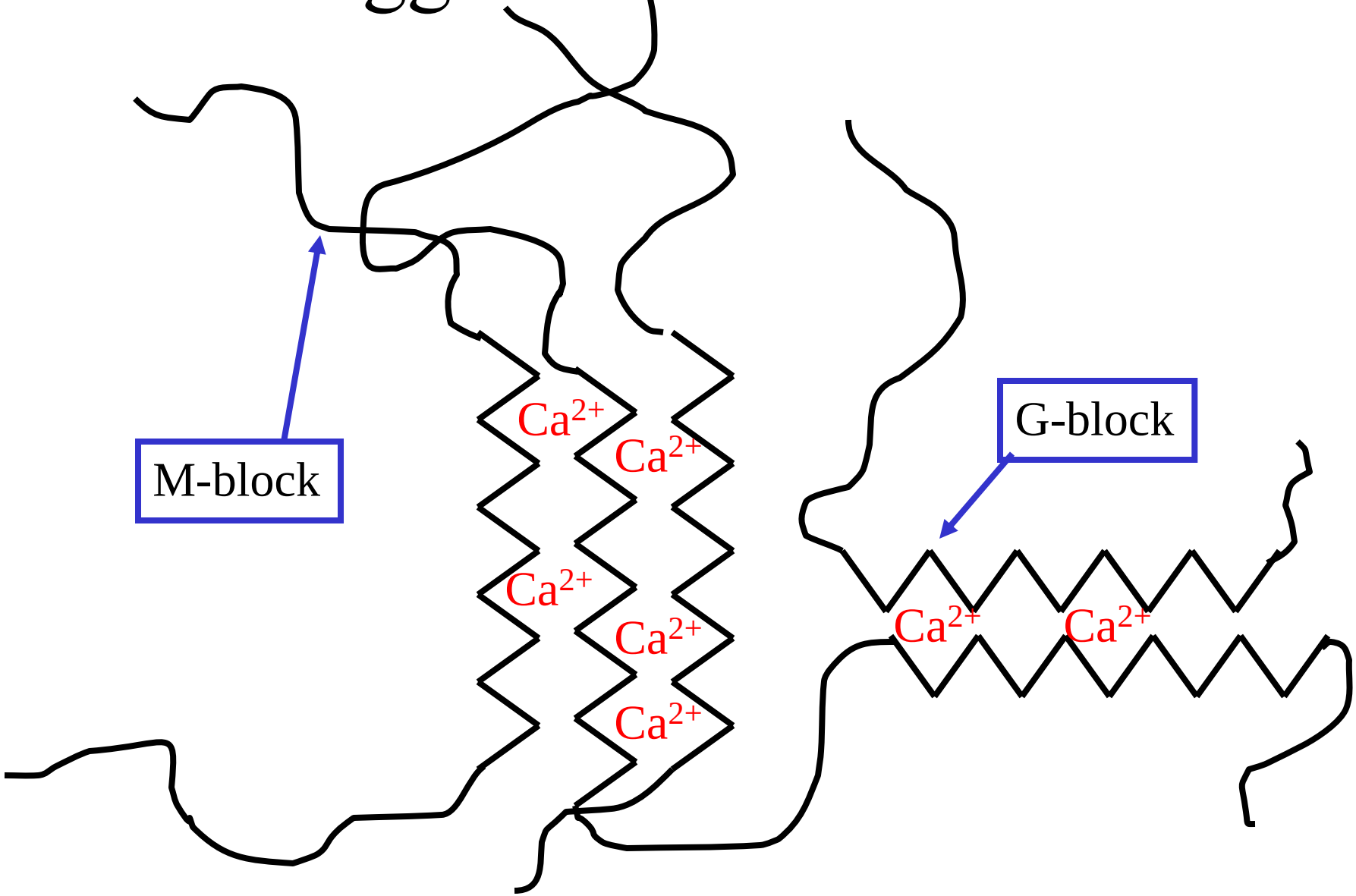


Algin

- **Source**: Seaweed extract
- **Structure**: linear polysaccharide containing two types of residue (i.e., a co-polymer): β-D-mannopyranosyluronic acid and (M) α-L-gulopyrasonic acid (G)
- **Functional Properties**: Viscous in aqueous solution, gels in the presence of Ca^{2+} (or low pH). Gels are temp stable
- PGA (propylene glycol alginate)

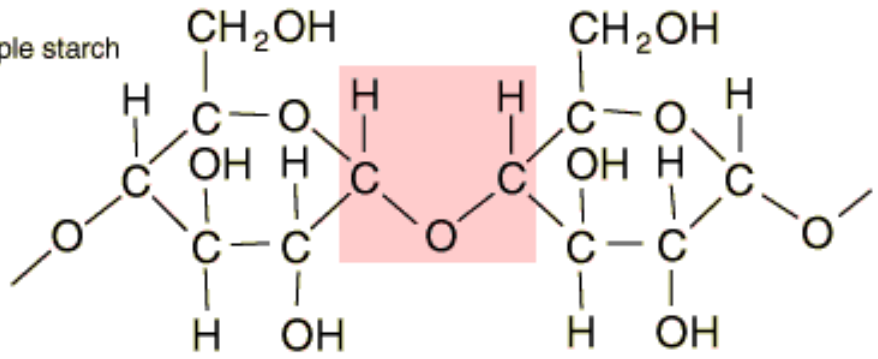

G
G
M
M

“Egg-box” Structure



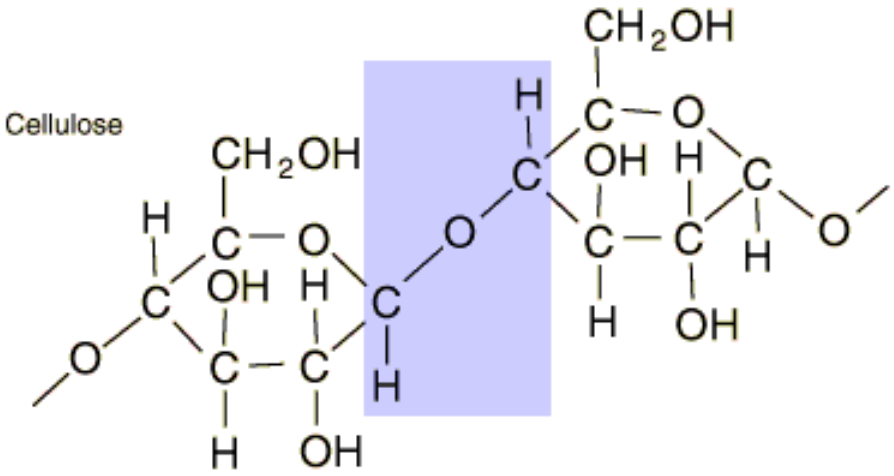
Cellulose Gums

Simple starch

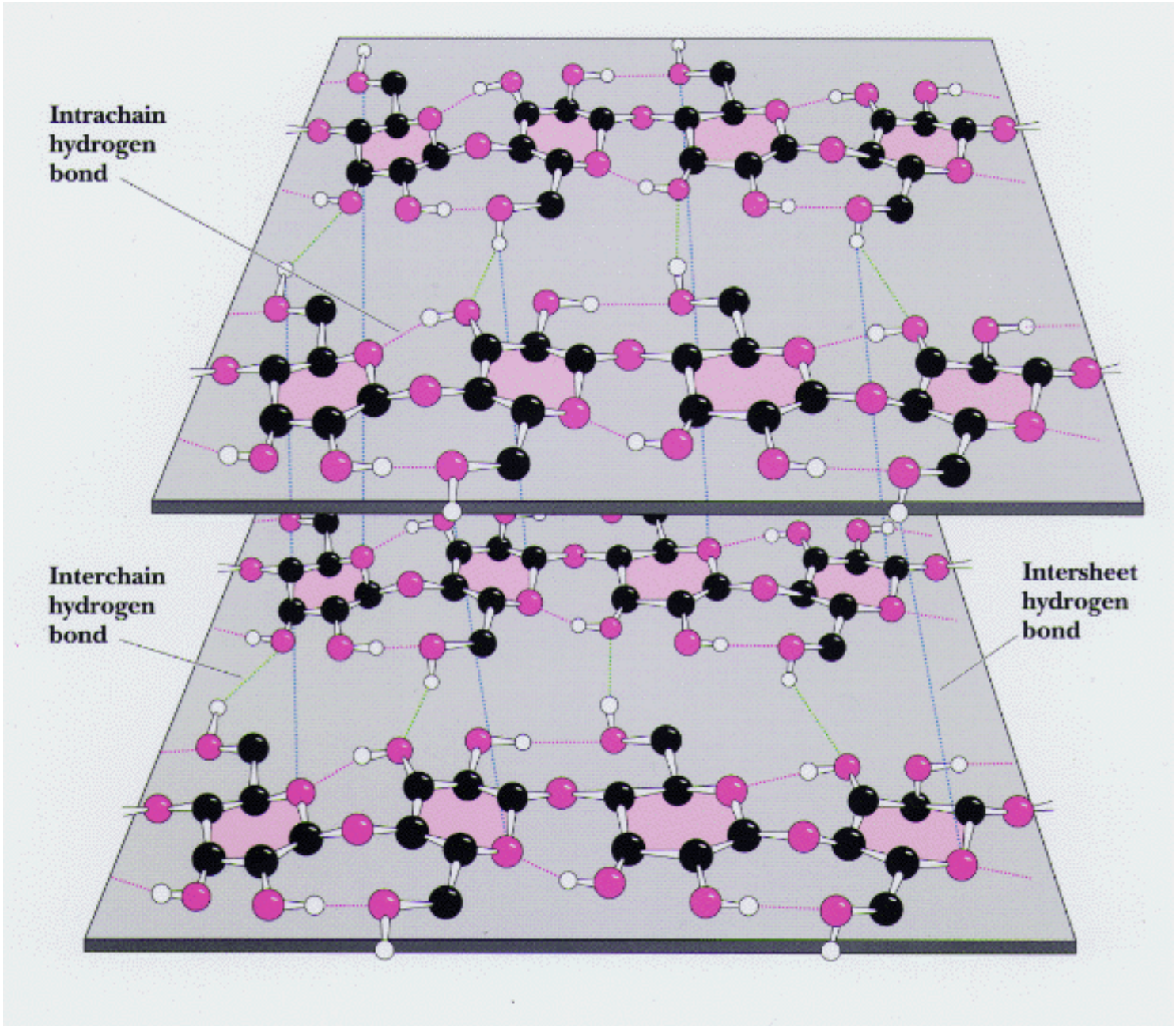


α1-4

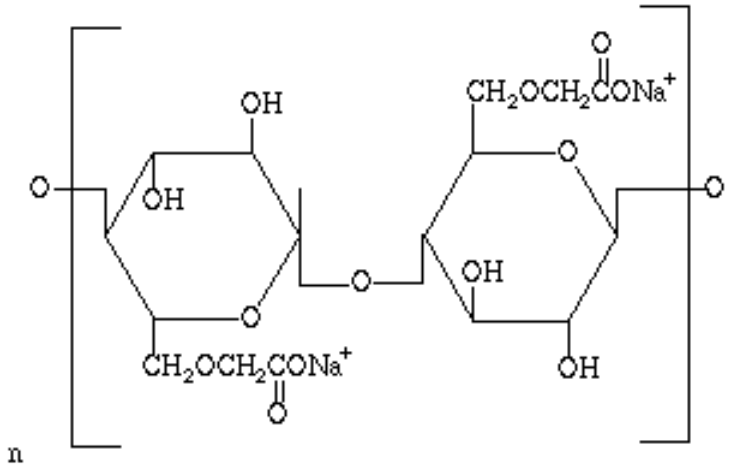
Cellulose



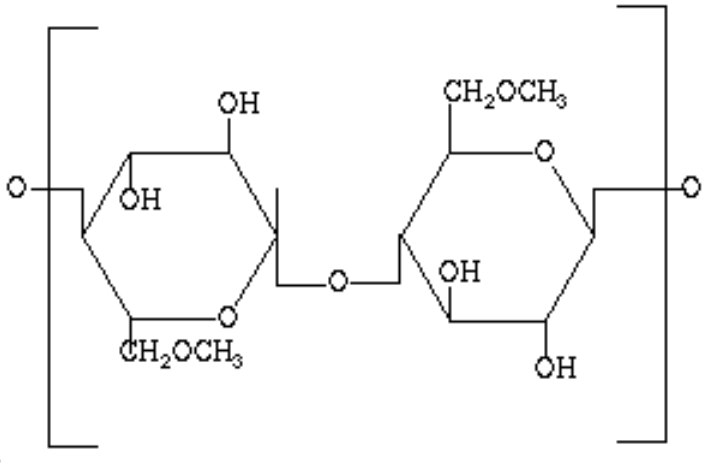
β1-4


Intrachain
hydrogen
bond
Interchain
hydrogen
bond
Intersheet
hydrogen
bond

Carboxymethylcellulose



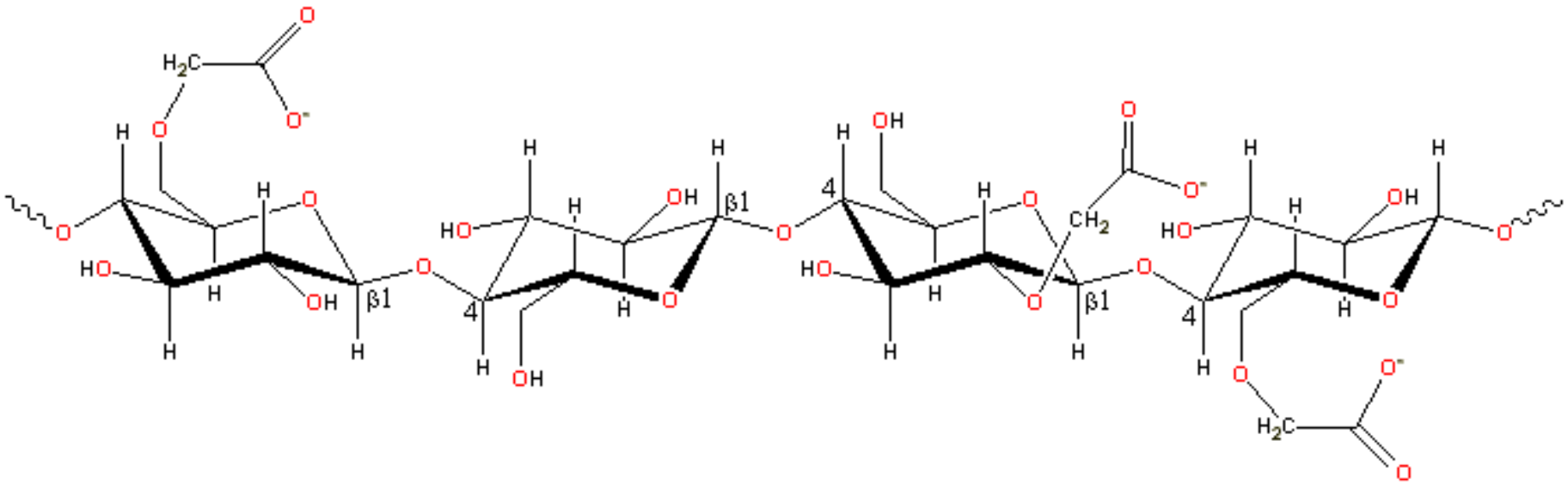
Methylcellulose



(may gel at high T)

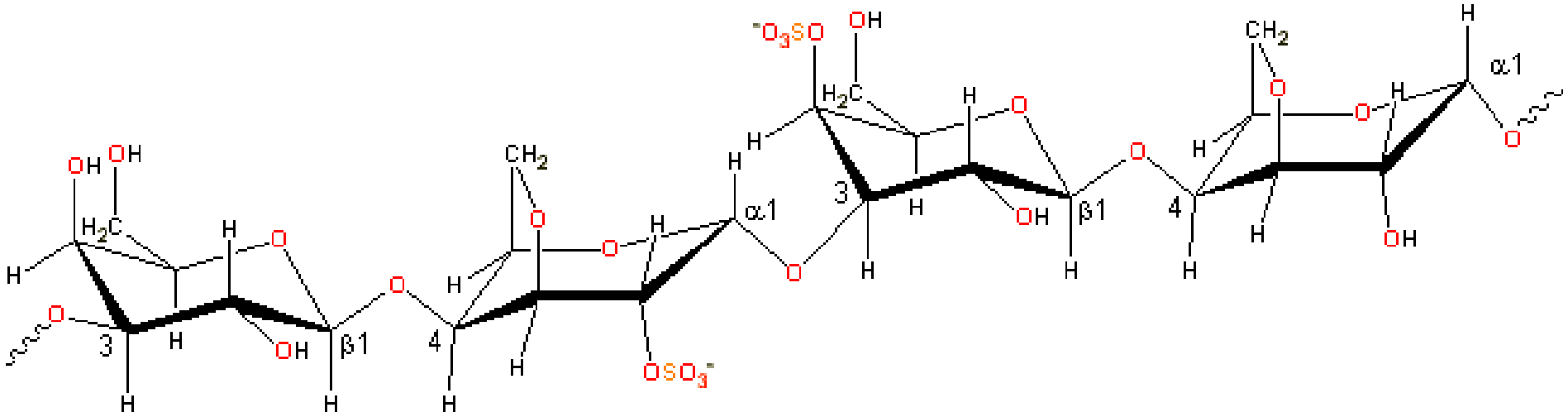
Carboxymethyl cellulose

- $-CH_2COO^-$
- High viscosity, non-gelling



Carageenan

- **Source**: Seaweed gum
- **Structure**: Linear D-galactopyranosyl chain with alternating 1,3 and 1,4 links. Some residues have one or two sulfate ester residues. Three broad types of repeating structure (ι, κ, and λ carageenan)
- **Functional Properties**: pH independent thickening. Double helix formation in κ or ι carageenan can lead to gelation.
  - κ-carageenan in dairy foods


OH
OH
H2C
H
O
H
O
3
H
OH
β1
H
O
4
CH2
O
H
H
H
OSO3-
α1
-O3SO
OH
H2C
H
O
3
H
OH
β1
O
4
CH2
O
O
H
H
α1
O

Gum Arabic

- Extrudate gum of the acacia tree
- Expensive – hard to source
- Low viscosity, non-gelling
- Complexed with a glycoprotein -surface active