

acid by reacting with dilute HCl; after purification, water-soluble powdered sodium alginates are formed [6]. The pathway that forms the alginate has the following steps: (i) synthesis of precursor substrate, (ii) polymerization and cytoplasmic membrane transfer, (iii) periplasmic transfer and modification, and (iv) export through the outer membrane [7].

10.2.1 Chemical Properties, Structure, and Characterization

Alginates are indeed linear block copolymers. The ratio of guluronate to manuronate in alginates differs; it depends on the sources from where alginates are extracted [8]. Alginates are composed of alternating M and G or consecutive G residues (GGGGGG), and M residues (MMMMMM) that are linked by block (1,4)-linkage of -d-mannuronate (M) and -l-guluronate (G) residues (Figure 10.1). The content of M and G as well as the length of each block depends on the sources of alginates. There are more than 200 different alginates that are currently being manufactured [9]. *L. hyperborea* are large brown algae having 60% of G-block (α -L-guluronic acid) content [10], whereas alginates from *A. nodosum* and *L. japonica* have a low content of α -L-guluronic acid blocks. G-blocks of alginate are supposed to play a role in intermolecular cross-linking with divalent cations like Ca^{2+} to form hydrogels (Figure 10.2); thus, the formation of hydrogel depends on physical properties of alginates and the ratio of M/G, length of G-block, and molecular weight [10].

The characterization of alternative polysaccharides of alginates is consolidated. Circular dichroism spectroscopy has been used to match the linear spectra of the alginate to model samples of well-characterized homopolymeric blocks [13]. NMR spectrum analysis has confirmed the monomer composition, along with the frequencies of the four doable diad structures FGG, FMG, FMM, and FGM (G = α -L-guluronic acid; M = β -D-mannuronic acid) [14]. Characterization of alginate samples by gel permeation chromatography indicates a polydispersed size distribution [15]. In the case of *A. vinelandii* and *Pseudomonas aeruginosa*, there is variation in average molecular weights from 80 to 290 kDa that was confirmed by light scattering [16]. The molecular weights

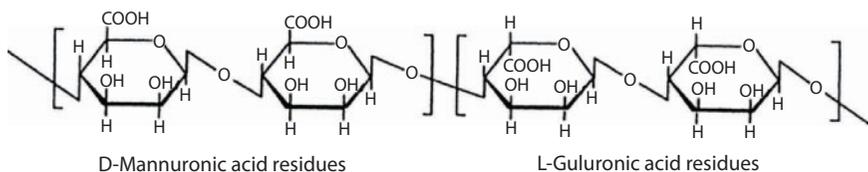


Figure 10.1 The (1-4)-linkage of alternate M and G residues of alginate [11].