

Mechanical properties, as measured by uniaxial compression and stress relaxation tests, for a range of high-M or high-G alginate gels, prepared from the alginate concentration in the range $0.75 \pm 1.5\%$ w/w, could be empirically modelled [43]. The alginates were fundamentally characterized by their percentage composition of G- and M-residues using NMR spectroscopy and by their viscosity. The specimen sizes (cross-section diameter of around 23 mm and height of 25 mm) were subjected to testing on Instron Universal testing machine with a 100 N load cell. Results showed that the yield stress (σ_{ER}) at failure increased along with increase in the effective alginate content, in high-G alginates, in concentration, and Mn, the average molecular weight values. The corresponding rupture strain was seen to be independent of alginate concentration and almost constant $\epsilon_{ER} = 0.536$ for high-M alginates and $\epsilon_{ER} = 0.503$ for high-G alginates. Square cylindrical specimens of alginate gels at 1.0% and 1.5% w/w nominal concentrations were loaded at a constant deformation rate of 2 mm sec^{-1} to assess the effect of stress relaxation on the compressive stress \pm strain relationship. After a strain of 25%—about 50% of the average strain at failure for the gels tested—was generated, the cross-head was stopped and the stress relaxation was monitored for as much as 30 min (far longer than the time required [0.05 min] to deform the specimens). M-rich alginates formed gels with a greater residual stress (A_0), practically constant and equal to about 34% of the initial relaxation stress $G(0)$, while G-rich ones formed gels with a smaller residual stress of the order of ca. 9% of $G(0)$. High-G alginate gels were stronger and brittle owing to the higher $G(0)$ and lower A_0 values.

With respect to mechanical properties, variation in the compression modulus of alginate gels and their shear moduli is due to the alginate composition, cross-linked nature, gelling conditions, and storage environment. At lower temperatures, Ca^{2+} cross-linking of alginate proceeds slowly, forming more ordered networks, with improved mechanical properties [44].

2.4 Modification of Alginates

2.4.1 Chemical Modification

Alginates have both hydroxyl and carboxyl functional groups, which are the sites for modification, and the presence of these polar moieties makes alginates hydrophilic in nature. Alginates can undergo chemoselective or stereoselective reaction due to the chemical reactivity of the functional group. It is essential to know completely the exact chemical reaction that