

for studying its ion binding properties [80]. Ca-alginate has been used in several applications such as removal of heavy metal from water bodies and various medical applications [81–84]. Apart from the ultimate binder, calcium, other metals such as Fe have been used for binding with alginates and have been used in human dermal fibroblasts [85].

14.4.5 Gel Formation Ability

Alginates are best known for their property as a gelling agent. They are obtained from nature as Ca, K, Na, and Mg salts. Of the other forms, Na-alginate is used as the best gelling agent. Since Na-alginates are soluble in both hot and cold waters, they are used as thickeners, emulsifiers, and gel-forming agents in food industry [86]. Addition of calcium to alginic acid causes them to be converted into gels. But this is crucial since it results in instantaneous precipitation rather than forming gels. Therefore, it is very much essential to be done in a controlled environment where the pH is lowered gradually below the pKa of guluronic acid and addition of slowly hydrolyzing lactones is entertained [86].

As discussed earlier, the gelling of alginate is instantaneous once the addition of calcium is started. It has been found that calcium lactate was found to have the shortest gelling time of 3 minutes, whereas calcium carbonate was found to have the longest gelling time of more than 3 days at 20°C and 60°C, respectively [87]. It has been denoted before that alginates with G blocks have better gelling ability when binding with ions, but as far as its gelling ability for absorption or immobilization is concerned, M block was found to have better gel swelling ability than the G blocks, and also the gel swelling ability of G blocks was found to be increased by addition of sodium ions into the fiber [88]. In the field of medicine, Ca-treated alginate gels were found to be used in bone-like apatite formations [89, 90].

14.4.6 Biological Properties

Alginates do not have any nutritional values, but their physical properties of gel formation and reacting with polymers of food components such as proteins under favorable conditions make them to be useful in maintaining the structure of certain processed foods and pet foods. Therefore, they have been used as thickeners, softeners, and gelling agents in food industry [86]. As far as its medicinal application is concerned, the use of alginate in the field of medicine first initiated with transplantation of encapsulated pancreatic islets of Langerhans. But this was found to cause