

1.1 Introduction

Alginates (ALGs) are naturally occurring anionic polysaccharides that are present as a structural component in cell walls of brown algae, mainly from *Macrocystis pyrifera*, *Ascophyllum nodosum*, and *Laminaria hyperborea* and as a capsular polysaccharide in bacterial strains like *Azotobacter* and *Pseudomonas*. It is present in the cell wall of brown algae as the calcium, magnesium, and sodium salts; therefore, it is usually referred to as “alginic acid and its salts.” Alginates are available commercially as sodium, potassium, or ammonium salts in filamentous, granular, or powdered forms. Their color ranges from white to yellowish-brown. The molecular weight of ALG generally ranges from 60,000 to 700,000 Da depending on the application [1]. The size (diameter) of ALG gel particles can be macro (greater than 1 mm), micro (from 0.2 to 1,000 μ m), or nano (less than 0.2 μ m). These gel particles have high water holding capacity to form a viscous gum and have adjustable chemical and mechanical properties that are dependent on the type of cross-linking agent used. As a natural ingredient, ALG gel particles are attractive for various biological applications because they are biocompatible, nontoxic, biodegradable, and relatively cheap [2, 3]. Alginate is also a significant component of the biofilms produced by the bacterium *Pseudomonas aeruginosa*, the major pathogen in cystic fibrosis, that confers it a high resistance to antibiotics and killing by macrophages.

1.2 History

Alginate was discovered in the late 19th century by a British Pharmacist, E.C.C. Stanford, who called it “algin,” which was a viscous solution obtained initially from Laminariaceae. Since its discovery in 1883, it has become an important industrial product that is commercially obtained from coastal brown seaweeds. Later its extracts were termed as “alginic acid.” Its commercial production started in 1929. It has been estimated that algal ALGs are produced nearly 38,000 tons worldwide annually, and their major part contributes to food and pharmaceutical industries because of their increased demand [4].

1.3 Structure

Alginates are linear biopolymers of 1,4-linked β -D-mannuronic acid (M) and 1,4 α -L-guluronic acid (G) residues (Figure 1.1) organized in homogenous (poly-G, poly-M) or heterogenous (MG) block patterns. The G and M block