2.1 Introduction

Alginate is an anionic polysaccharide, naturally occurring in brown seaweeds, and has been extensively studied and used in many biomedical applications due to its biocompatibility, minimal toxicity, and mild gelation achieved through addition of divalent cations such as Ca^{2+}, along with its availability at a relatively cheap price [1]. Alginate hydrogels can be prepared by different cross-linking techniques and agents; depending on the nature of cross-linking and density of the network, drugs ranging in size from small molecules to large macromolecular proteins can be released in a controlled manner from the alginate gel, which encapsulates them or carries them. Their structure has features similar to the extracellular matrices of biological structural tissues promoting their extensive application in wound healing medical devices, cell transplantation and in the delivery of bioactive drugs and proteins. Alginate wound dressings favor wound healing by maintaining a physiologically moist microenvironment, while inhibiting bacterial infection at the wound site.

Alginate gels find important and numerous applications in the pharmaceutical field as they may be orally ingested or given as injections into the body, without causing much discomfort to the patient. In tissue engineering, cell and organ transplants and implants made from alginate gels provide a substitute for regeneration for patients with damaged, nonfunctioning organs and tissues [2]. Hydrogels function by carrying a payload of regenerative cells and drugs to the site of damage, while also acting as a substrate for the growth of new tissue, whose structure and function can be guided by the mechanical flexibility, stiffness, and pore size of the alginate gel [3].

Alginate has been utilized in biomedical applications such as wound healing, drug delivery, and *in vitro* cell culture and has unexplored potential as a biomaterial for many tissue engineering problems. The suitability and fit of alginate for these applications are because of its biocompatibility, gelation under mild conditions, and the ease of synthetic modifications required to make alginate derivatives that have the required properties. Chemically modified alginate has found a crucial use as a carrier for dental follicle cells and suitable growth factors to initiate and promote periodontal regeneration while sustaining osteogenesis [4]. Similar to other hydrogels from agarose, polyvinyl alcohol, and acrylates, alginate gels have a limited mechanical stiffness and degrade gradually on exposure to physiological fluids, and the more general physical properties of absorption, swelling, and ion and small molecule binding and release could be modulated with the structure and compositional variation. The encapsulation of cells by