CHAPTER I
INTRODUCTION

A biomaterial is a synthetic material used to restore injury tissue or to improve functionality of the living tissue [Ratner et al., 2004]. A large number of patients was saved by using biomaterial (Biomedical application). Biomaterial can be classified into four groups: polymers, metals, ceramics and composites [Shi et al., 2004 & Meena et al., 2010]. Polymeric biomaterials (PB) are polysaccharides (starch, cellulose, chitin, alginate, hyaluronate etc.) or proteins (collagens, gelatins, caseins, albumins) and / or synthetic and biodegradable polymers (Polyvinyl alcohol (PVA), Polyvinylpyrrolidone (PVP), Polyetheleneglycol (PEG), Polylactic acid (PLA), Polyhydroxy acid (PHA) etc.). All the polymeric biomaterials have to be evaluated in terms of their biocompatibility, mechanical properties and biodegradation to determine if they are suitable for specific medical applications.

Nowaday, polymeric biomaterials are applying for drug delivery, tissue engineering, biomedical sensing, skin grafting, medical adhesives and textiles etc. It also covers targeted artificial nerve, target drug delivery and bone tissue regeneration etc. From a practical perspective, medical applications of polymers fall into three broad categories: (i) extracorporeal uses (catheters, tubing, and fluid lines; dialysis membranes/artificial kidney; ocular devices; wound dressings and artificial skin), (ii) permanently implanted devices (sensory devices; cardiovascular devices; orthopedic devices; dental devices), and (iii) temporary implants (degradable sutures; implantable drug delivery systems; polymeric scaffolds for cell or tissue transplants; temporary vascular grafts and arterial stents ; temporary small bone fixation devices, transdermal drug delivery) [Anand et al., 2006 & Dumitriu et al., 2002].

Among all of the usage biomedical application, development of three prospective applications were interested including novel antibacterial wound dressing, artificial nerve and bone tissue regeneration.

The first part of the present research was aimed at fabrication of novel antibacterial wound dressing from polysaccharide. The copper (II) crosslinked alginate hydrogels were prepared using guluronic acid (G) preferable solvent (variation of the solvent pH in order to increase solubility of G-G blocks) with the aim

to increase the selectivity of the copper (II) crosslinked alginate and to increase gel flexibility. The copper (II) ion crosslinked alginate films were fabricated via solvent casting of alginate followed by immersion in copper (II) sulfate solutions to obtain two simultaneous benefits: an improved dimensional stability and good antibacterial activity. The immersed films were evaluated for their swelling behavior, weight loss, water content, water absorption, and water vapor transmission rate. Moreover, all of the immersed films were evaluated the potential for use as an anti-bacterial wound dressing using disc diffusion method against the several bacteria (gram positive bacteria, gram negative bacteria, methicillin resistant bacteria) as well as bacteria that was found in dermal infections. Also, the films were tested for their ability to accelerate blood coagulation and cytotoxicity.

The second task was focused on the synthesis of copper (II) stearate containing PVP hydrogel using gamma radiation. The antibacterial activity of copper and its derivatives were not significantly different from silver and its complex. However, there was not frequently studied because of instability of copper itself and can be easily oxidized from air. In order to overcome this problem, the long chain of copper (II) stearate was interested which expected less reactivity to oxidize in air. Copper (II) stearate was synthesized and then added to PVP solution in order to prepare hydrogel pad using gamma radiation. The hydrogel samples were tested for hydrogel properties and the potential for use as antibacterial wound dressing.

The third part of this research work was aimed at preparation of mimic nerve. Nanofibrous PAA tube was prepared by electrospinning process. The nanofibrous tubes were further improved thermal stabilization via crosslinking with Ethylene glycol in the acid catalyst. The PAA tube was used as an imitate nerve excitation model which can be expressed the phase transition of the Ca-influx to the surface of the tube. The several effects including concentration of surrounding salt, phase transition in the anesthetized region and temperature effect on the ion exchange of the mimic axon was investigated which can be measured phase transition from the contraction percentage of the tube after providing cations. In addition, the model of mimic nerve was evaluated for their potential use as artificial axons.

The last research task was focused on synthesis of bone substrate in order to reduce oxidative stress of the cells. Synthesis grafted gallic acid on collagen scaffold

through amine reactive group in collagen scaffold structure led to forming of ester bonds between gallic acid and collagen chains. All of GA-grafted collagen sample were used to be a three dimensional substrate for cell seeding including normal human fibroblast (cells from 2 patients) and Mesenchymal stem cells (cells from 6 patients) and then studied on cell proliferation and cell behavior before and after treating with pyocyanin.