# Chapter I

# Introduction

## 1.1 Introduction

Gamma Poly Glutamic Acid (γ-PGA) is a naturally occurring poly amino acid that is synthesized by certain strains of *Bacillus* (Kubota *et al*., 1993). γ-PGA is an unusual anionic polypeptide in which D-and/or L-glutamic acid units are polymerized via γ-amide linkages between α-amino and γ-carboxylic groups (Kang *et al*., 2007). Its γ-carboxylate side chains can be chemically modified to introduce various bioactive ligands, or to modulate the overall function of the polymer (Tachibana *et al*., 2003; Shimokuri *et al*., 2004). γ-PGA cannot be synthesized by polycondensation of glutamic acid, because intramolecular cyclization predominantly proceeds to form a stable five-membered lactam, pyroglutamic acid. Unlike general poly (amino acid)s, γ-PGA has unique characteristics on enzymatic degradation and immunogenicity. γ-PGA is resistance against many proteases because γ-linked glutamic acids are not easily recognized by common proteases (Obst and Steinbuchel, 2004).

γ-PGA is a compound of mucilage produced by *Bacillus subtilis* in fermented soybeans and by several *Bacillus* species as an extracellular polymer. γ-PGA has molecular weights ranging from 100,000 to over 1,000,000 (Kubota *et al*., 1993). Because γ-PGA is not a chemically synthesized product but exists naturally in foods,

it is generally regarded as safe. It is completely biodegradable and nontoxic to humans (Yoon *et al.,* 2000). Several studies have shown that γ-PGA is helpful in increasing intestinal calcium absorption as well as intensifying the strength and content of the femur (Lee *et al*., 2006), enhances immune-stimulating activity and potentially improves antitumor activity (Kim *et al*., 2007). For medical applications, the special chemical properties of the γ-PGA polymers helps to render drug water-soluble transport to tumor sites and control the release of drug over time.

Several bacterial strains secrete γ-PGA outside the cells; however, they need nutrient and long cultivation times for γ-PGA production. For the commercial production of γ-PGA, it is necessary to increase the productivity and decrease the nutrient supply.

This study aimed to isolate an efficient γ-PGA producing bacteria strain, able to produce large quantity of γ-PGA. The efficient γ-PGA producing isolate was identified using morphological, biochemical and phylogenetic studies. The obtained results was confirmed by Restriction Fragment Length Polymorphism (RFLP) analysis. The molecular weight of γ-PGA was determined by Sodium dodecyl sulfate poly acrylamide gel electrophoresis (SDS PAGE) electrophoresis.