CHAPTER 1 INTRODUCTION

1.1 Background

Lignocellulosic biomass is the most abundant material in the world. Its sources range from trees to agricultural residues. Long ago, these materials were used as firewood, building materials and animal food. Nowadays, lignocellulosic materials are not just used in their old ways, their applications have expanded into the fiber level as in pulp and paper products, used for fibers in the textile industry, used as an adhesive component in the composite industry (lignin) or used as an important source of renewable energy.

The most abundant and renewable biomass on earth is lignocellulose, which contains three major polymer groups: cellulose, hemicellulose and lignin. In component, cellulose and hemicellulose comprise 40-60% of component. Cellulose consists of long polymers of β-1,4-linked glucose units. It forms a crystalline structure, whereas the structure of hemicellulose is that of any of several heteropolymers contain many different sugar monomers such as xylose, arabinose, galactose, mannose, and glucose.

Lignocellulose-degrading enzymes have become increasingly important, since the development of efficient lignocellulose degradation methods and the conversion of sugars to valuable products such as butanol and amino acids and utilizable forms of energy such as ethanol and methane could lead to less dependence on imported petroleum as a fuel and chemical source. Biodegradation of lignocellulose the major component of cellulose and hemicellulose is a complex process that requires the coordination of several enzymes (cellulolytic and xylanolytic enzymes).

However, enzymatic degradation of lignocellulose into simple monomeric sugar is not easy due to their recalcitrant nature. Microorganisms meet this challenge with the aid of multienzyme system. Aerobic bacteria produce numerous individual, extracellular enzymes with binding modules for different cellulosic conformations. Specific enzymes act in synergy to elicit effective hydrolysis. In contrast, anaerobic bacteria produce a unique extracellular multienzyme complex, called cellulosome. The cellulosome is a large multienzyme complex used for the efficient degradation of plant cell

wallpolysaccharides and macromolecular machine, whose components interact in a synergistic manner to catalyze the efficient degradation of cellulose whereas xylanosome are discrete, multifunctional, multienzyme complexes. These complexes play an important role in the degradation of hemicelluloses. Though much knowledge has been accumulated about the cellulosome, little is known about the xylanosome

Some microorganisms are reported to produce enzyme systems containing multiactivities. For example, *Clostridium thermocellum*, *Clostridium josui*, and *Bacteroides* sp. P-1, thermophilic and anaerobic bacteria, produce a multienzyme complex (cellulosome/xylanosome) when grown on cellulose as the substrate. Thus, it is interesting to investigate and produce cellulosome and xylanosome which are active and stable at thermophilic and anaerobic conditions.

1.2 Objectives

1. To screen thermophilic cellulolytic-xylanolytic bacteria under anaerobicconditions
2. To purify and characterize the cellulosome/xylanosome
3. To apply cellulolytic-xylanolytic anaerobic bacteria for degradation of lignocelluloses under thermophilic conditions

1.3 Scopes

1. Isolation of anaerobic thermophilic cellulolytic-xylanolytic bacteria from soil samples and identification of the isolated strains by morphological properties and 16S rDNA sequencing analysis
2. Studies on biochemical properties of the isolated multienzyme complex from cell pellet and culture supernatant such as molecular mass, protein composition, enzymatic activities and enzymatic hydrolysis.
3. Application of cellulolytic-xylanolytic anaerobic bacteria degradation of lignocellulose under thermophilic conditions

1.4 Benefits

1. This research will provide the new knowledge of multienzyme complex produced by bacterium, under anaerobic and thermophilic conditions.
2. Understanding the multienzyme complex system from the new cellulolytic/xylanolytic bacterium.
3. This bacterium and its multienzyme complex have the ability to adsorb to the insoluble substrates to hydrolyze. It may enable to improve biodegradation of insoluble substrates such as agricultural wastes, avicel or xylan by multienzyme complex for the production of industrial chemical, fuel, food and animal feed.