CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Municipal wastes generation whether it is solid or liquid, are continues to rise due to the increasing global population growth, uncontrolled consumption and attitudes toward spending. Quantities of waste generated are growing in response to the accelerated in population, rapid urbanization and industrialization (Chen *et al.*, 2016). Solid waste have been generated from various sources which are residential, industrial, commercial, institutional, construction and demolition, municipal services, process, agriculture and medical (Hoornweg, 1999). Trends in the composition in municipal solid waste (MSW) in most Asian showed that organic portion such as vegetable waste, yard waste and mixed waste are the dominant of waste generated (Gupta *et al.*, 2012). Thus, disposal and managements of municipal solid waste is growing importance throughout the world. Nowadays, the common municipal solid waste managements in Malaysia are open dumpsites, sanitary landfill, incineration, composting and recycling.

Municipal solid waste (MSW) contains significant quantities of plant-derived carbohydrates which have the potential to be exploited as a biomass source (Hussin *et al.*, 2013). Plant-drived carbohydrates refer to lignocellulosic materials that mainly consist of three polymers which are cellulose, hemicellulose and lignin (Agbor *et al.*, 2011) where cellulose and hemicelluloses are the most abundant biomasses on the earth (Khatiwada *et al.*, 2016). As stated by Barlaz (1998), municipal solid waste was composed of 40 to 50% cellulose, 9 to 12% hemicellulose and 10 to 15% lignin on a dry weigh basis, and the cellulose and hemicellulose account for about 90% of the biodegradable fraction.

About 75 to 80% constituents of municipal solid waste is organic and approximately 80% of this organic content is cellulosic materials (Khatiwada *et al.*, 2016). Cellulose is a natural polymer, a long chain made by the linking smaller molecules which the links in the cellulose chain are the type of sugar: β-D-glucose unit. Cellulose is the main building block of plant biomass where plants produce 4×10^9 tons of cellulose annually (Irfan *et al.*, 2012) and cellulose accounts as 50% of the dry weight of plant biomass (Sandhu *et al.*, 2013). The crystalline structure and insoluble nature of cellulose represents a big challenge in enzymatic hydrolysis. Thus, bacteria and participation of microbial cellulolytic enzymes are needed in the degradation and modification of cellulose in nature (Irfan *et al.*, 2012). For many years, cellulose degrading bacteria have been isolated and characterized from variety of sources such as soil, decayed plant materials, hot springs, organic matters, feces of ruminants and compost.

After cellulose, xylan is the second most abundant polysaccharide in nature and accounts for one third of the total renewable organic carbon on earth (Kalim *et al.*, 2015). Xylan is a major hemicellulosic polysaccharide found in the plant cell wall which represents up to 20-35% of the total dry weight of land plant (Kamble *et al.*, 2012). It is a heteropolysaccharide made up of a backbone of 1,4-linked β-D-xylopyranosyl residues which can be substituted to varying degrees with glucopyranosyl, α-L-arabinofuranosyl, acetyl, feruloyl and/or p-coumaryl side chain groups (Nagar *et al.*, 2012). Due to the structural and chemical variability in xylans, an array of specific hydrolytic enzymes is needed to break down these polymers to monomers. Several hydrolytic enzymes are required for the complete hydrolysis of xylan of which xylanase are most important. Xylanases are produced by diverse genera and species of microorganisms such as bacteria, fungi and actinomycetes. Xylanolytic enzymes from microorganisms have potential in various industrial processes such as food feed and pulp and paper industries (Nagar *et al.*, 2012).

1.2 Motivation

Waste to Wealth Project with Mercu Resolution Sdn Bhd is a platform to conduct this research to isolate microorganisms from the landfill soil. It is desired to determine and characterize microbial colony in a landfill soil in Kuala Terengganu, Malaysia. Knowledge concerning the microbial isolates from a landfill may help in understanding the type of metabolic activities occurring in such an ecosystem (Krishnamurthi *et al.*, 2013). In this research, the isolated microorganisms are indigenous microorganisms that are expected to be utilized for municipal solid waste degradation. Therefore, it can accelerate the degradation process to be more effective and efficient and also has possibility in reducing the amount of municipal solid waste to prolong the lifespan of the landfill. Lastly, the isolated microorganisms and enzyme produced by the isolates that can be used for the waste degradation may be sold to the potential customers especially to the landfill owners.

1.3 Problem Statement

The escalating metropolitan population resulted in increasing municipal solid waste generation but the conventional solid waste management practices inadequate. Improper management of these municipal solid waste can cause large contamination of soil, water and air which a significant contributor to greenhouse gas emissions and allow huge potential economic values uncaptured (Chen *et al.*, 2016). Moreover, the abundance of solid organic wastes in an ever decreasing land space in urban centres has become a nuisance and health hazard. Besides, municipal solid waste management costs are very expensive and require other alternative management such as incineration, sanitary landfill and their technologies. Biodegradation of is one of solid waste management that is economical, convenient and can also sustain our environment (Johari *et al.,* 2014). In order to cope with the increasing of population of earth and environmental disturbance, the isolation and characterization of microorganisms study needed by the scientist (Stefanis *et al.*, 2013). Therefore, it is necessary to adopt an indigenous, innovative, cost-effective and sustainable microbial technology to enhance municipal solid waste degradation, given the role the microbes play in the process.