CHAPTER I

INTRODUCTION

Various countries, such as Thailand, Malaysia, Taiwan and Brazil, produce sugar from cane. Many by-products from sugar cane process, such as molasses, bagasse and fiber cake, are produced (Sirianuntapiboon et al., 2004). Molasses is the more important by-product and it is used as carbon source in fermentations, biofertilizer and feed for domestic animal (Dahiya et al., 2001). Molasses is commonly used as raw material in fermentation industries, especially for ethanol production because of its low-cost, availability and suitability for fermentation process. However, wastewater from molasses processing presents high organic load causing a large chemical oxygen demand (COD) and a large amount of colored substances which give dark brown color, to the effluents. After the conventional biological treatment, most of the organic load is removed but nevertheless the dark brown color still persists, it can even increase because of the repolymerization of colored compounds. The main colored compounds are known as melanoidins formed via "Maillard reaction" which is initiated by the condensation of an amine with a carbonyl group, often from a reducing sugar (Peña et al., 2003). The structural determination of the melanoidins thus remained a challenge over many decades, with little progress made. However, there are currently three main proposals for the structure of melanoidins: (i) polymer consisting of repeated units of furans and/or pyrroles, formed during the early stages of Maillard reaction, and linked by polycondensation reactions; (ii) low-molecular-weight colored substances, which are able to cross-link protein via amino groups of lysine or arginine to produce high-molecular-weight colored melanoidins; and (iii) melanoidin skeleton is mainly built up of sugar degradation products, from the early stages of Maillard reaction, polymerized through aldol-type condensation, and linked by amino compounds.

Melanoidins are major pollutant when discharged into a water resource system. They prevent the penetration of sunlight and affect the photosynthetic activity of aquatic plants. The high organic load of the effluent causes eutrophication. This will therefore create anaerobic conditions thereby killing most of the aerobic aquatic fauna (Bernardo et al., 1997; Raghukumar et al., 2004). When spread over soil,

molasses wastewater acidifies soil and affects agricultural crops (Raghukumar et al., 2004).

In Thailand, almost of the alcohol-producing industries use molasses as raw material and discharge molasses wastewater accounting for about 10 times the amount of alcohol produced. Several alcohol distilleries in Thailand have attempted to treat molasses-based distillery wastewaters by anaerobic methods such as methane fermentation and waste stabilization pond (WSP) system followed by aerobic treatment such as activated sludge system, aerated lagoon or oxidation pond (Hammer, 1991). However, by these treatment processes, almost all of melanoidins in distillery wastewater still remained and the chemical oxygen demand (COD) of the treated wastewater is higher than the standard permission value of the Department of Industrial Works, Ministry of Industry, Thailand (Department of Industrial Works, 1992)

As melanoidins are recalcitrant to biodegradation, the elimination of colored effluents in molasses-based distillery wastewater treatment system is mainly based on physical or chemical procedures such as adsorption, coagulation, precipitation, and oxidation. Although these methods are effective, they suffer from such short coming as requiring high reagent dosage, high cost, formation of hazardous by-products and intensive energy consumption. These methods also generate large amount of sludge. Therefore, as an alternative, biological treatments with microbe are drawing attention.

The present study explores the feasibility of using bacterial isolates for molasses decolorization, with the ultimate aim of application for molasses-based distillery wastewater treatment. In this work, a bacterial consortium capable of decolorizing molasses wastewater was isolated from various sources in Thailand. The identification of bacterial strains by 16S rDNA based molecular approach was performed. Different parameters for maximal molasses wastewater decolorization were tested. The performance of a carbon membrane bioreactor (MBR) process for treating the molasses-based distillery wastewater by bacterial consortium was also investigated.