CHAPTER 1
INTRODUCTION

1.1 State of problem

The presence of benzo(a) pyrene (BaP), a five-ring polycyclic aromatic hydrocarbon (PAH), in the environment has raised the environmental concern because of its toxicity and carcinogenic potential for mammals (IARC, 1983; Grimmer *et al.*, 1991; ATSDA, 2003). Benzo(a)pyrene was one of the high molecular weight, 5 ring-PAHs which was listed as one of the priority pollutants classified as a carcinogen by the US Environmental Protection Agency and an ATSDR public health statement (USEPA/ATSDR, 1999). In addition, BaP was ranked at the number 9 from 275 priority list of hazardous substances (CERCLA, 2003). The toxicity of BaP was highly concerned because of its ability to accumulate in animal tissues, to cause cancer and hormone disruption as well as its potential to affect the reproduction. Moreover, BaP was found to depress immunology function (Irwin, 1997; McCarthy et al., 2003).

The principle natural sources of BaP were forest fires, volcanic eruption, pest fires and burning of crude oil. While anthropogenic sources include the incomplete combustion of coal, oil, gas, wood, rubbish and other organic substances, incinerator, vehicle exhausts and cigarette (Cerniglia, 1992; Pothuluri & Cerniglia, 1998; Bicimi, 2002). BaP has been reported to derive from automobile and accounted for 98%. The diesel powered vehicles are the major sources of lighter PAHs to the atmosphere, gasoline vehicles were the dominant sources of the higher molecular weight PAHs, such as BaP (Harkov et al., 1984). Human exposure was mainly from smoking, inhalation of polluted air and eating food contaminated with products of combustion or prepared in such a way (smoked, charcoal broiled) where the polycyclic aromatic hydrocarbons are generated. (Irwin, 1999; Stolyhwo & Sikorski, 2005).

Among other treatments in order to reduce the contaminated amount of BaP in the environment, the biological treatment was one of the interesting alternatives. The biotransformation of BaP by fungi was of our interest because of its rapid

colonization and high tolerance of the toxin (Bennett *et al.*, 1996; Suillia, 2003; Robinovich *et al.*, 2004).

Pterocarpus macrocarpus Kurz. was plants which normally found at the both sides of the main traffic roads in Bangkok. There was the interesting report noted that the levels of PAHs deposited on the plant might be used as an indicator of air pollution (Lodovici et al., 1994). Therefore, leaves and bark of *Pterocarpus macrocarpus* Kurz. located along the traffic road in Bangkok were used as the potential sources of fungi able to degrade BaP.

1.2 Objectives:

The main objective of this research was to investigate the biotransformation ability of the isolated fungus towards BaP. Four sub-objectives were as followed:

1.2.1 Isolate the fungal species from various parts of plants which were able to degrade or biotransform benzo(a)pyrene (BaP)

1.2.2 Determine the degradation rate of BaP by the isolate(s)

1.2.3 Investigate the optimum conditions for BaP biotransformation

1.2.4 Identify the intermediate(s) and propose possible biodegradation pathway

1.3 Hypotheses:

1.3.1. The fungi isolated from various parts of plant(s) exposed to the burning smoke and/or the incomplete combustion of vehicle exhaust had the potential to degrade benzo(a) pyrene.

1.3.2. The information obtained from this research regarding the biotransformation pathway as well as the optimum conditions were useful for further application to mitigate BaP contamination.

1.4 Scope of study:

Since the biotransformation of BaP by fungi was of our great interest, we proposed to have a research performed as followed:

1.4.1. Fungi species able to degrade BaP were isolated from leave and bark of *Pterocarpus macrocarpus* Kurz. The initial concentration of BaP used for screening was 100 ppm.

1.4.2. The kinetics of the BaP degradation was investigated.

1.4.3. The conditions for BaP biotransformation were optimized.

Alternative carbon source and other conditions were tested to optimize the BaP biodegradation.

1.4.4. The intermediate(s) of BaP biotransformation were identified and the possible biodegradation pathways of BaP of the isolate were proposed.

1.5 Benefit from this work

The research results would offer information, if not groundbreaking, of the fungal biotransformation of BaP. The results were used as an experimental basis for the development of new microbiological process to decontaminate BaP. During the optimization of biotransformation conditions, the experiments were designed, where possible, for further practical application. Finally, it would be expected that the knowledge obtained from this research would contribute as one of the alternatives for the environmental remediation of BaP as well as other PAHs.