Isolation, identification and analysis of DDT-degrading bacteria for agriculture area improvements

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Abstract
Dichlorodiphenyltrichloroethane (DDT) is an organochlorine pesticide that can persist in the environment resulting in environmental problem with chronic effects on human and animal health. Biodegradation is a potential method to detoxify the recalcitrant compounds. In this study, the potential for biodegradation of DDT through enrichment and isolation of DDT-degrading bacteria from soil and water in agricultural area was done. Microorganisms grew in minimal media with DDT as the only carbon source. Six from 40 bacterial isolates were selected by increasing concentrations of DDT. The DDT degradation was quantified by the enrichment cultures degrading S4-67.95%, S13-65.05%, S37-65.45%, S39-67.25%, W30-65.20%, and W37-67.55% of the initial amount of DDT, respectively, in 7 days. Further, the optimal of temperature, pH, and salinity of the isolate has also been investigated and revealed that an optimum temperature at 37 – 45ºC was able to growth at a wide range of NaCl and pH. These promising DDT-degrading isolates were tentatively identified biochemical and MALDI-TOF MS characterization as 3 groups: Pseudomonas stutzeri (3 isolates), Pseudomonas aeruginosa (2 isolates), and Bacillus firmus (1 isolate).

Key words: DDT, biodegradation, pesticide, bioremediation, organochlorine compounds

Introduction
Dichlorodiphenyltrichloroethane (DDT) is a pesticide/insecticide in an organochlorine group used in agricultural area all around the world. Although DDT functioned as a highly effective and efficient pesticide, it is also very recalcitrant and appeared to undergo slow degradation in the environment and ability to bioaccumulation in the upper trophic levels of food chains, and deleterious effects on non-target organisms are, however, undesirable consequences of persistence. It was proposed that DDT can accumulate in human organ and even human secreted 9.

DDT was introduced to Thailand in agricultural and health aspects for long time ago. In 1983, DDT was banned since it posed adverse effects to human health and environment 17. Nevertheless, DDT is still used to eradicate insect-related malaria diseases since 1994. A survey by the Pesticide Research Division (Department of Agriculture, Thailand) reported that many rivers in Thailand were contaminated with persistent organic pollutant (POP) pesticides including DDT. Therefore widespread contamination of DDT in soil and sediments had already occurred. Several samples (water and sediment) collected from the major rivers around the agricultural areas were contaminated with DDT, endosulfan, diekdrin, aldrin, heptachlor, dicofo, hexachlorocyclohexane (HCH), endrin, and chlordane. Residue concentrations of DDT and other POPs in water and sediments ranged from 0.01 to 1.20 µg/L and 0.01 to 7.43 mg/kg, respectively 7. Sonkong et al. 17 reported that the determination of p,p′-DDT in soil samples from 23 agricultural areas in Songkhla province found DDT residue in the ranges of 0.17-9.84 ng/g soil 17.

Biodegradation is one of the processes which effectively degraded DDT contaminated environment 18. Organochlorine pesticides, especially DDT, can easily biodegraded by microorganisms via enzyme system, i.e., dehydrochlorination, reduction, dechlorination, oxidation and isomerization of the parent molecules 14. Under aerobic and anaerobic conditions microorganisms could degrade DDT and its metabolites, dichlorodiphenylchloroethane (DDD) and dichlorodiphenyl-dichloroethylene (DDE), into non-chlorinated compounds, such as 4-chlorobenzoic acid or 4,4-dichlorobenzophenone , which are not harmful to the environment 4, 10, 12. Moreover, these processes are effective, minimal hazardous, versatile and environmental friendly.

This study was concerned the way to detoxify DDT contaminated environment by microorganisms. Since the advantages of microorganisms offer an inexpensive, simpler and more environmentally friendly strategy to reduce environmental pollution than non-biological options 8. The aim of this research was to isolate and characterize microorganisms that could biodegrade DDT from the microflora of soil and water in agricultural area. Moreover, the growth and DDT biodegradation characterization properties of selected bacterial isolates were determined. Physical and chemical characterization for potential application as a DDT biodegradation activity and identification the DDT-degrading isolates to species level were elucidated. The isolation of indigenous soil bacteria with the ability to degrade organochlorine pesticides such as DDT has provided us with