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Biodegradation of Aliphatic Hydrocarbon Compounds by Bacterial Cultures

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ABSTRACT: In the present study biodegradation of alphatic hycarbon compounds by bacterial cultures has been targeted. Growth curves analysis of *Bacillus subtilis* PD6, *Bacillus sp.* PD9, *Enterobacter sp.* PD11 and *Bacillus sp.* PD14 during utilization of dodecane, hexadecane, octadecane, eicosane and tetracosane as a sole source of carbon for growth and energy was performed. During this study, the degradation of different aliphatic hydrocarbons was studied as a function of bacterial growth. The hydrocarbon degradation efficacy of different bacterial species (selected on the basis of preliminary screening studies) was determined by indirect method wherein, the change in COD (Chemical Oxygen Demand) was determined after a specific time interval (0 day to 6th day). Presence of aliphatic hydrocarbon degradation capability in the selected four bacterial cultures was substantiated by the PCR amplification of *alk*B genetic loci in three out of four cultures. Successful amplification of *alk*B gene loci in *Bacillus subtilis* PD6, *Bacillus sp.* PD9 and *Bacillus sp.* PD14 indicated that, these cultures are potential aliphatic hydrocarbon degraders and possess required genetic arsenal for degradation of n-alkanes.

KEYWORDS: Aliphatic hydrocarbons, Biodegradation, Bacterial Cultures, COD analysis, *alk*B gene, Growth curve analysis.

INTRODUCTION

Hydrocarbons of natural origin are widespread in the environment but because of the massive utilization of petroleum products, they are nowadays strongly involved in environmental pollution (Alexis Nzila (2018), Domde et. al., 2007). Biodegradation, naturally occurring (natural attenuation) or by engineered bioremediation (Das and Chandran, 2010), is a key process for the decontamination of polluted areas. Microorganisms have developed specific mechanism for the utilization of hydrophobic hydrocarbon compounds (Boucher-Nattali *et al.*, 2001). Bacterial oxidation of *n*-alkanes is a very common phenomenon in soil and water and is a major process in geochemical terms: the estimated amount of alkanes that is recycled per year amounts to several million tons from natural oil seepage and oil spills alone. Even more relevant are the alkanes (mainly waxes or paraffins) produced by plants, algae, and other organisms because they are available to bacteria throughout the biosphere (Smits *et al.*, 2002).

On an average, saturated and aromatic hydrocarbons together make up 80% of the oil constituents (Widdel and Rabus, 2001). Aliphatic hydrocarbon compounds constitute major component of petroleum oils and contaminate water and soil significantly because of release from automobile vehicular washing. Alkanes are major components of petroleumproducts (Head *et al.*,2006). Due to deliberate or inadvertent release into water bodies they are commonly found in contaminated environments (So *et al.*, 2001). Crude oil is mainly composed of hundreds of different hydrocarbon molecules, mainly alkanes from C1 to C40 straight chain, C6–C8 branched-chain, cyclohexanes, aromatics and compounds containing sulphur, nitrogen and oxygen (Stafford *et al.*, 1982, Hadibarata *et al.*, 2009). Since the saturated hydrocarbon fraction is the most abundant in crude oil, its biodegradation is quantitatively most important in oil bioremediation (Head *et al.*, 2006). n-Alkanes are relatively stable due to lack of functional groups, presence of only sigma bonds, nonpolar nature, and low solubility in water.

Aerobic microbial degradation of n-alkanes is known since almost a century, and the mechanisms of degradation, with the enzymes and genes involved, are rather well understood (Head *et al.*, 2006; Throne-Holst*et al.*, 2007).

In the present study total five aliphatic hydrocarbon compounds dodecane, hexadecane, octadecane, eicosane and tetracosane were chosen (Bahl and Bahl, 2008).