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Isolation, Characterization, and Substrate Utilization of a Quinoline-Degrading Bacterium

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A Gram (+) rod-shaped organism identified as a *Rhodococcus* sp. capable of growth utilizing quinoline as the dominant carbon, energy, and nitrogen source was isolated from soil. The isolate, designated as *Rhodococcus* sp. Q1 was also capable of growth on 2-hydroxyquinoline, pyridine, 2,3-dimethylpyridine, catechol, benzoate, and protocatechuic acid, suggesting a diverse capacity for aromatic ring degradation. Concentrations of quinoline in excess of 3.88mM were toxic. Although ring nitrogen was released into the growth medium as ammonium, quinoline degradation was not limited by the availability of inorganic N. A degradation product was isolated and identified as 2-hydroxyquinoline on the basis of ultraviolet, fluorescence emission, and mass spectroscopy. When grown on quinoline or 2-hydroxyquinoline, this bacterium produced pigmented compounds. Copyright © 1996 Published by Elsevier Science Limited.

INTRODUCTION

In recent years there has been increasing concern over the public health threat presented by the introduction of *N*-heterocyclic compounds into the environment (Sims & O'Loughlin, 1989; Stuermer *et al.*, 1982; Zachara *et al.*, 1984). Little is known of the environmental fate of *N*-heterocycles. Quinoline and other related aromatic *N*-heterocycles, especially pyridine and alkylpyridines, are often found at locations associated with oil shale (Dobson *et al.*, 1985; Leenheer *et al.*, 1982) and coal processing (Pereira *et al.*, 1983; Stuermer *et al.*, 1982), and at wood treatment sites (Pereira & Rostad, 1985). In many cases, groundwater contamination has been substantial. Of particular concern has been the high water solubility and potential mobility of many *N*-heterocycles through soil (Leenheer & Stuber, 1981) which may contribute to groundwater contamination by these compounds.

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Among *N*-heterocycles, pyridine has been the most extensively investigated. Environmental fate and ecotoxicity (Jori *et al.*, 1983; Sims & O'Loughlin, 1989) of pyridines have recently been reviewed and this literature suggests that pyridines may be degraded biologically. Considerably less is known of the environmental fate of polycyclic aromatic *N*-heterocycles. Recently, evidence has been mounting to support biodegradation as a means of removing azaarenes such as quinoline from a range of environmental matrices including, surface water (Cassidy *et al.*, 1988), groundwater (Godsy *et al.*, 1992; Jensen *et al.*, 1988), and soil (Bennett *et al.*, 1985). While bacteria capable of degrading or transforming quinoline have been reported (Brockman *et al.*, 1989; Grant & Al-Najjar, 1976), and degradative pathways have been proposed (Miethling *et al.*, 1993; Schwarz *et al.*, 1989; Shukla, 1986), little attention has been given to potential nutrient limitations and to the substrate specificity of these organisms.

The objective of this study was to isolate and characterize a bacterium capable of using quinoline as the dominant C, N, and energy source.