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ORIGINAL PAPER

Biodegradation of phenol by cold-adapted bacteria from Antarctic soils

Gillian Li Yin Lee[1] · Siti Aqlima Ahmad[1,2] · Nur Adeela Yasid[1,2] · Azham Zulkharnain[3] · Peter Convey[2,4] · Wan Lutfi Wan Johari[5] · Siti Aisyah Alias[2,6] · Gerardo Gonzalez-Rocha[7] · Mohd Yunus Shukor[1]

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Abstract

Phenol is an important pollutant widely discharged as a component of hydrocarbon fuels, but its degradation in cold regions is a great challenge due to the harsh environmental conditions. To date, there is little information available concerning the biodegradation of phenol by indigenous Antarctic bacteria. This study addresses the isolation of three phenol-degrading bacterial strains from King George Island, Antarctica. Based on preliminary screening, three isolates (AQ5-05, AQ5-06 and AQ5-07) capable of completely degrading 0.5 g/L phenol within 120 h at 10 °C were selected for detailed study. Two were identified as *Arthrobacter* spp., and one *Rhodococcus* sp., based on 16S rRNA sequences. All strains were non-motile, Gram positive, oxidase negative and catalase positive. A study on the effects of parameters including temperature, pH, salinity and nitrogen source was conducted to optimise the conditions for phenol degradation. This revealed that the three isolates were psychrotolerant with the optimum temperature for phenol degradation between 10 and 15 °C. This study suggests the potential use of cold-adapted bacteria in the bioremediation of phenol over a wide range of low temperatures.

Keywords South Shetland Islands · Bioremediation · Psychrotolerant · One-factor-at-a-time · *Arthrobacter* · *Rhodococcus*

Introduction

Antarctica, the Earth's last largely pristine continent, is facing increasing challenges from anthropogenic impacts on its ecosystem (Tin et al. 2009; Lana et al. 2014; Vodopivez et al. 2015). Even though there is no native human population, and the limited number of settlements is virtually restricted to national scientific research stations, the spatially very limited ice-free areas of Antarctica are particularly sensitive to the effects of soil and water contamination (Lana et al. 2014; Litova et al. 2014). Areas most exposed to the risk of locally sourced pollution in Antarctica are primarily in the vicinity of the scientific research platforms and their logistic support facilities, nearshore commercial fishing operations, and scientific research or other visitor (tourist) sites that utilise fossil fuels for transportation or on-site energy generation (Prus et al. 2015). Oil spillage is one of the biggest concerns in Antarctica (Luz et al. 2006; Tin et al. 2009). Examples of reported Antarctic pollutants include

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✉ Siti Aqlima Ahmad
aqlima@upm.edu.my; aqlimaahmad@gmail.com

[1] Department of Biochemistry, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

[2] National Antarctic Research Centre, B303 Level 3, Block B, IPS Building, Universiti Malaya, 50603 Kuala Lumpur, Malaysia

[3] Department of Molecular Biology, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

[4] British Antarctic Survey, NERC, High Cross, Madingley Road, Cambridge CB3 0ET, UK

[5] Department of Environmental Sciences, Faculty of Environmental Studies, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

[6] Institute of Ocean and Earth Sciences, Universiti Malaya, B303 Level 3, Block B, Lembah Pantai, 50603 Kuala Lumpur, Malaysia

[7] Laboratorio de Investigacion en Agentes Antibacterianos, Facultad de Ciencias Biologicas, Universidad de Concepcion, Concepcion, Chile