

Response surface-based optimization of the biodegradation of a simulated vegetable oily ballast wastewater under temperate conditions using the Antarctic bacterium *Rhodococcus erythropolis* ADL36

Maryam Abubakar^a, Nur Muhamad Syahir Abdul Habib^a, Motharasan Manogaran^a, Nur Adeela Yasid^a, Siti Aisyah Alias^b, Siti Aqlima Ahmad^{a,b}, Jerzy Smykla^c, Mohd Ali Hassan^d, Mohd Yunus Abd Shukor^{a,*}

^aDepartment of Biochemistry, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra, Malaysia, UPM Serdang, Selangor 43400, Malaysia, Tel. +603-89466722; emails: mohdyunus@upm.edu.my (M.Y.A. Shukor), mairam90@gmail.com (M. Abubakar), syahirhabib@gmail.com (N.M.S.A. Habib), Tel. +603-8946 8297; email: adeela@upm.edu.my (N.A. Yasid), Tel. +603-8946 8292; email: aqlima@upm.edu.my (S.A. Ahmad)

^bNational Antarctic Research Centre, B303 Level 3, Block B, IPS Building, Universiti Malaya, Kuala Lumpur 50603, Malaysia, Tel. +603-79674387; email: saa@um.edu.my

^cInstitute of Nature Conservation, Polish Academy of Sciences, Mickiewicza, 33, 31-120 Kraków, Poland, Tel. +48 12 37 03 563; email: jertzysmykla@yahoo.com

^dDepartment of Bioprocess Technology, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra, Malaysia, UPM Serdang, Selangor 43400, Malaysia, Tel. +603-8946 6701; email: alihas@upm.edu.my

Received 24 November 2017; Accepted 26 November 2018

ABSTRACT

Discharge of vegetable oily ballast wastewater constitutes serious hazardous pollution to the environment due to its toxic effects on aquatic organisms and terrestrial animals consuming the waste. The damage is especially severe if the release of this waste occurred in temperate waters where biodegradation by existing marine microorganisms is limited due to the cold conditions. Biodegradation using cold-tolerant microorganism added to palm oil wastewater before discharge has never been studied as a method of remediation. This study aims to investigate the biodegradability of vegetable oil (palm oil) at 15°C by a cold-tolerant Antarctic bacterium under saline conditions for such purpose. The strain was cultured at different oil concentrations, temperature, pH, and inoculum size. Furthermore, the degradation of the oil was optimized using response surface methodology (RSM). Gravimetry and gas chromatography were utilized to monitor the biodegradation of the oil components. The results of the study show that maximum growth and biodegradation occur at 1% (v/v) of the oil, at 25°C, pH 6.8, and an inoculum size of 5% (v/v). The use of RSM resulted in an increase in bacterial growth of about 1 log unit. In conclusion, this study demonstrates a possible use of an Antarctic bacterium for the bioremediation of palm oil oily ballast wastewater in temperate waters.

Keywords: Palm oil; Oily ballast wastewater; *Rhodococcus erythropolis* ADL36; Bioremediation; Antarctica

* Corresponding author.