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Optimisation of biodegradation conditions for cyanide removal by *Serratia marcescens* strain AQ07 using one-factor-at-a-time technique and response surface methodology

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Abstract Gold mining companies are known to use cyanide to extract gold from minerals. The indiscriminate use of cyanide presents a major environmental issue. *Serratia marcescens* strain AQ07 was found to have cyanide-degrading ability. Optimisation of biodegradation condition was carried out utilising one factor at a time and response surface methodology. Cyanide degradation corresponded with growth rate with a maximum growth rate of 16.14 log cfu/mL on day 3 of incubation. Glucose and yeast extract are suitable carbon and nitrogen sources. Six parameters including carbon and nitrogen sources, pH, temperature, inoculum size and cyanide concentration were optimised. In line with the central composite design of response surface methodology, cyanide degradation was optimum at glucose concentration 5.5 g/L, yeast extract 0.55 g/L, pH 6, temperature 32.5 °C, inoculum size 20 % and cyanide concentration 200 mg/L. It was able to stand cyanide toxicity of up to 700 mg/L, which makes it an important candidate for bioremediation of cyanide. The bacterium was observed to degrade 95.6 % of 200 mg/L KCN under the optimised condition. Bacteria are reported to degrade cyanide into ammonia, formamide or formate and carbon dioxide, which are less toxic by-products. These bacteria illustrate good cyanide degradation potential that can be harnessed in cyanide remediation.

Keywords Biodegradation · Cyanide · One factor at a time (OFAT) · Response surface methodology (RSM) · *Serratia marcescens*

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1 Introduction

Cyanide is utilised in the extraction of gold from its ore. It is used in electroplating industries, metal plating industries and polymer synthesis; these activities have caused contamination to the environment by altering the biogeochemical cycle (Parmar et al. 2012). The release of cyanide into the environment inflicts severe hazard to the maintenance of the ecosystem (Sepúlveda et al. 2010). Precious metal mining industries, metal coking and nitrile polymer industries generate over 3 billion litres of cyanide-contaminated waste annually (Towil et al. 1978). Malaysia has suffered gold mine cyanide-related problem in recent times. Preliminary studies conducted on gold mining impact on the health of humans in Malaysia reveals a likely connection among gold mine operations and persistent levels of cyanide compounds in nearby communities

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