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Isolation, screening and characterisation of cyanide-degrading *Serratia marcescens* strain aq07

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ABSTRACT

Biodegradation is now being considered as the best form of cyanide transformation because it is less expensive and has fewer hazards than other conventional methods. Soil and drainage water samples from the premises of Univerisiti Putra Malaysia (UPM) Serdang, were collected at different points and analysed for available bacteria. 28 bacteria were isolated from the samples and subjected to in-vitro cyanide remediation assay by using spectrophotometric method. Six bacterial isolates were observed to have cyanide-degrading ability. Screening was conducted in three phases that include primary, secondary and tertiary screening. In the primary phase of the screening, the six bacterial isolates were assayed for cyanide-degrading activity using 25 ppm filter-sterilised KCN in a buffer medium (pH 7.0) containing 5 g/L glucose, and 0.5% yeast extract. It was observed that three isolates have a greater potential of converting cyanide, degrading above 70%. The three isolates were further subjected to screening which is the secondary screening by incorporating 100 ppm of filter sterilised KCN. All three isolates showed good ability of degradation removing above 60% of the cyanide. The isolate tagged as AQ-007 was found to have a better degradation capability, removing 75% of the cyanide while isolate AQ-003 and AQ-004 degraded 61.5% and 64.6% respectively. The tertiary screening phase was carried out using resting cells of the bacteria. The resting cells illustrates that it is the best form of inoculums. Isolates AQ-003 removed 92.8%, AQ-004 remediated 92.9% and AQ-007 degraded 98% of the cyanide. Isolate AQ-007 was considered to be the preferred bacteria for further research because it degrades higher than the other two isolates. Bacterial identification based on 16s rRNA gene sequence analysis of this bacteria showed a 97% identity with *Serratia marcescens*. It has been registered in the GenBank as *Serratia marcescens* Strain AQ07 with accession number KP213291

Keywords: Biodegradation, Bacteria, Potassium cyanide, Resting cells.

INTRODUCTION

Cyanide has the chemical formula CN with a molecular mass of 26.007 g/mol. Potassium and sodium cyanides are alkali metal cyanides commonly used for gold recovery (Aitimbetov et al., 2005; Fatma et al., 2009). Electroplating, metal plating industries etc use cyanide in their production and as a result, cause contamination of the soil and water bodies in the environment by altering the biogeochemical cycle (Parma et al., 2012). The transformation methods for cyanide commonly used today are physical or chemical processes such as alkaline chlorination, hydrogen peroxide method, and sulphur/air oxide process, copper catalysed chemical process (Maniyam et al., 2011). These processes are considered to be more expensive than bioremediation and also generate chemical wastes that must be treated appropriately before discharging to the environment (Dash et al., 2009).

Microorganisms such as bacteria, fungi and algae have the potential of converting potassium cyanide (Barclay et al., 1998; Fatma et al., 2009). Bioremoval of cyanide has been reported to be cheaper than chemical and physical techniques and quicker than natural oxidation (Ozel et al., 2010; Dash et al., 2009). Obliteration of cyanide in wastewaters and tailing solutions by competent microorganisms has been suggested as an alternative to long-practiced chemical methods for the obliteration of cyanide. Biological processes of treating industrial effluents have been stated to have high capital expenditure but low operating expenditure. Therefore, these systems are more cost-effective than the conventional process. Biological process that could satisfy the need for removal and environmental management has now been put into practice in some countries (Dash et al., 2009). Some bacteria are able to convert cyanide as a result of the utilisation of certain pathways via the use of enzymes. These bacteria utilise the cyanidase (cyanide