Response surface-based optimization of a novel molybdenum-reducing and cyanide-degrading *Serratia* sp. strain HMY1

H.M. Yakasai\(^a,b\), K.I. Karamba\(^c\), N.A. Yasid\(^a\), M.I.E. Halmi\(^d\), M.F. Rahman\(^a\), S.A. Ahmad\(^a\), M.Y. Shukor\(^a\)*

\(^a\)Department of Biochemistry, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia, UPM 43400 Serdang, Selangor, Malaysia, Tel. +603-8946 8297, email: adeela@upm.edu.my, (N.A. Yasid), Tel. 603-89466722, email: fadhillep3@gmail.com (M.F. Rahman), Tel. +603-8946 8292, email: aqlima@upm.edu.my, (S.A. Ahmad) Tel. 603-89466722, email: mohdyunus@upm.edu.my/yunus.upm@gmail.com (M.Y. Shukor)

\(^b\)Department of Biochemistry, Faculty of Basic Medical Science, Bayero University Kano. P. M. B 3011, Kano state, Nigeria, Tel. +2348034966925, email: hmyakasai.bch@buk.edu.ng (H.M. Yakasai)

\(^c\)Department of Microbiology, Faculty of Science, Bauchi, State University, Gadau Main, Campus, Gadau, Bauchi State, Nigeria, Tel. +2348065927314, email: kabirukaramba@gmail.com (K.I. Karamba)

\(^d\)Department of Land management, Faculty of Agriculture, Universiti Putra Malaysia, UPM 43400 Serdang, Selangor, Malaysia Tel. +603-89474925, email: m_izuaneffendi@upm.edu.my (M.I.E. Halmi)

Received 10 November 2018; Accepted 29 December 2018

**ABSTRACT**

The success of microbial-based remediation processes relies on finding the suitable microorganism that can efficiently tolerate and detoxify contaminants in polluted sites. In this work, a bacterium that reduces as high as 100 mM sodium molybdate to molybdenum blue (Mo-blue) and can grow on 100 mg/L of potassium cyanide as a nitrogen source is reported for the first time. The isolate was tentatively identified as *Serratia* sp. strain HMY1 based on partial 16S rDNA molecular phylogeny. Molybdate reduction in this strain was supported (in descending order of efficiency) by electron donor sources like sucrose, galactose, fructose, glucose, mannitol, xylitol and sorbitol, whereas ammonium sulfate, nicotinamide, cysteine, aspartate, phenylalanine, asparagine, acrylamide and glutamate were the nitrogen sources that supported Mo-blue production. Optimization of molybdate reduction was carried out via one-factor-at-a-time (OFAT) and Response Surface Method (RSM). A preliminary screening experiment using the Plackett-Burman design indicated the factors molybdenum, phosphate and incubation time were significant out of seven factors screened. Response Surface Method was then utilized to further optimize molybdenum reduction using the Central Composite Design (CCD). The optimum predicted conditions via RSM were molybdenum at 55 mM, phosphate at 3.95 mM and incubation time of 48 h. Compared to OFAT, RSM optimization showed a remarkable increase from an absorbance value of 8.06–13.91, respectively. The maximum tolerable cyanide concentration for molybdenum reduction was 25 mg/L. The reduction characteristics and cyanide tolerance of strain HMY1 suggest that it would be useful in future bioremediation of polluted sites and treatment of water bodies contaminated with both molybdenum and cyanide.

**Keywords:** Molybdenum; Mo-blue; cyanide-degrading; Bioremediation, *Serratia*

*Corresponding author.