



UNIVERSITI
TEKNOLOGI
MARA

ISETC2025

2ND INTERNATIONAL SCIENCE,
ENGINEERING AND TECHNOLOGY
COLLOQUIUM



THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A
SUSTAINABLE WORLD

ORGANIZED BY:
FACULTY OF APPLIED SCIENCES
UNIVERSITI TEKNOLOGI MARA
PERAK BRANCH, TAPAH CAMPUS
MALAYSIA

CO-ORGANIZED BY:



**2nd International Science, Engineering and Technology Colloquium
(ISETC 2025)**

Faculty of Applied Sciences,
Universiti Teknologi MARA,
Perak Branch, Tapah Campus,
35400 Tapah Road, Perak, Malaysia.

Colloquium date: 9th July 2025

Publication date: 9th September 2025

Proceedings of Extended Abstracts

EDITORS

Dr. Emi Norzehan Mohamad Mahbob

Dr. Saiyidah Nafisah Hashim

Ms. Lili Widarti Zainuddin

Ms. Nurul Nazwa Mohammad

Ms. Rozaina Saleh

e-ISBN: 978-629-97630-5-5

Copyright © 2025 ISETC

Published by Faculty of Applied Sciences, Universiti Teknologi MARA,
Perak Branch, Tapah Campus, 35400 Tapah Road, Perak, Malaysia.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, 35400 Tapah Road, Perak, Malaysia.

PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob

Dr. Saiyidah Nafisah Hashim

Ms. Lili Widarti Zainuddin

Ms. Nurul Nazwa Mohammad

Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

HARNESSING *Enterobacter cloacae* SAW-2 FOR ENVIRONMENTAL CLEANUP: A DUAL APPROACH TO MOLYBDENUM AND PHENOLIC POLLUTION

Mohd Khalizan Sabullah^{1*}, Mohd Yunus Abd. Shukor²

¹*BioAgriTech Research Group, Faculty of Science and Technology, Universiti Malaysia Sabah,
88400 Kota Kinabalu, Sabah, Malaysia*

²*Department of Biochemistry, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia,
43800 Serdang, Selangor, Malaysia*

**Corresponding author: khalizan@ums.edu.my*

Abstract: Millions of tonnes of heavy metals and organic pollutants are produced or used annually through industrial activities, and a large share of these substances pollute the environment. In the long term, bioremediation is the most affordable method for removing them, especially at low concentrations where other approaches like physical or chemical methods are less effective. The study explores how a molybdenum-reducing bacterium from polluted soil can decolorize different phenolics, separate from its molybdenum reduction function. Based on biochemical analysis, the bacterium was preliminarily identified as *Enterobacter cloacae* strain Saw-2. Optimal reduction of molybdate to Mo-blue by the bacterium occurs at a pH of 6.3 to 6.8 and a temperature of 34 to 37°C. Glucose exhibited as the most preferred electron donor for the reduction up to 30 mM of molybdate concentration with a phosphate concentration of 5.0 mM. Cd²⁺, Hg²⁺, Cu²⁺, and Ag²⁺ at 2 ppm inhibited molybdenum reduction around 20 to 45% of enzymatic activity. Phenol and catechol served as growth substrates for the bacterium.

Keywords: *Enterobacter cloacae* strain Saw-2, bioremediation, heavy metals, molybdenum, phenol

INTRODUCTION

Heavy metals and organic pollutants are released in large volumes by industrial activities each year, with molybdenum notably posing a risk because of its toxicity when present in high concentrations. Molybdenum is vital in small doses, but excessive levels pose a threat to aquatic and land life and are commonly found in contaminated areas worldwide. Animals, including ruminants, can experience reproductive and developmental problems due to its effects. In addition, industrial waste frequently includes phenolic compounds that are extremely toxic to humans and ecosystems. Bioremediation through microorganisms offers a cost-efficient option, especially in environments with reduced oxygen levels characteristic of contamination. A bacterium recently isolated from polluted soil is presented in this study, which can reduce molybdenum and break down various phenolic compounds under static growth conditions, offering promising prospects for bioremediation of multiple pollutants (Zhang et al., 2013; Ahmad et al., 2013; AhmadPanahi et al., 2014).

MATERIALS AND METHODS

A soil sample from Kuching, Malaysia, yielded a molybdenum-reducing bacterium when cultured in low-phosphate media. Colonies exhibiting molybdenum reduction were isolated and analyzed. The isolate was evaluated for its capacity to decrease molybdenum levels under different conditions and in the presence of heavy metals. Different phenolic compounds were used as carbon sources to assess growth and molybdenum reduction under static microplate conditions. The physiological and morphological traits were confirmed through standard biochemical testing. GraphPad software was employed to perform statistical analysis to identify significant differences in Mo-blue production and bacterial growth between treatments (Ying et al., 2024).

RESULTS AND DISCUSSION

A molybdenum-reducing bacterium was obtained from soil contaminated in Kuching, Malaysia, and was tentatively classified as *Enterobacter cloacae* strain Saw-2 after biochemical testing and comparison with Bergey's Manual (Table 1). This bacterium is Gram-negative, motile, rod-shaped, and capable of reducing molybdate to molybdenum-blue, with a distinctive absorption spectrum peaking at 865 nm. The reduction of molybdenum was most effective at a pH of 6.5–6.8 and temperatures between 34°C and 37°C. Phosphate concentration played a crucial role in Mo-blue production, with maximum reduction at 5 mM and inhibition at higher levels. Glucose served as the optimal electron donor in the process of molybdate reduction. The bacterium tolerated molybdate concentrations of up to 60 mM but was affected negatively by heavy metals including cadmium, mercury, copper, and silver. Although molybdenum reduction was not supported by phenolic compounds, the strain's growth on phenol and catechol demonstrates its potential for cleaning up co-contaminated sites.

Table 1. Biochemical characteristics of *Enterobacter cloacae* strain Saw-2

Parameter	Result / Observation
Bacterial Identification	Tentatively identified as <i>Enterobacter cloacae</i> strain Saw-2 based on biochemical tests
Morphological Characteristics	Gram-negative, short rod-shaped, motile
Mo-blue Absorption Spectrum	Peak at 865 nm, shoulder at ~700 nm (indicative of heteropolymolybdate formation)
Optimal pH for Molybdate Reduction	6.5 – 6.8
Optimal Temperature	34 – 37 °C (no significant difference between values within this range)
Best Electron Donor	Glucose > Sucrose > Maltose > L-Rhamnose > Raffinose > D-Mannose > Lactose
Optimal Phosphate Concentration	5 mM (higher concentrations inhibited Mo-blue production)
Optimal Molybdate Concentration	15 – 30 mM (up to 60 mM tolerated with reduced efficiency)
Effect of Heavy Metals	Inhibited by Cd ²⁺ , Hg ²⁺ , Cu ²⁺ , Ag ⁺ at 2 ppm (45.5%, 36.8%, 28.4%, and 24.4% inhibition respectively)
Phenolic Compound Utilization	No molybdenum reduction observed; however, the bacterium grew on phenol and catechol
Potential Application	Suitable for bioremediation of co-contaminated sites with molybdenum and phenolics

CONCLUSIONS

An isolate of Mo-reducing bacteria with the novel ability to break down phenolic compounds such as phenol and catechol has been obtained locally with optimal parameters that were determined (pH 6.5-6.8 at temperature around 34-37°C). The current phase involves purifying the molybdenum-reducing enzyme from this bacterium and examining phenolics biodegradation processes more thoroughly.

REFERENCES

- Ahmad, S. A., Shukor, M. Y., Shamaan, N. A., Mac Cormack, W. P., & Syed, M. A. (2013). Molybdate reduction to molybdenum blue by an antarctic bacterium. *BioMed Research International*, 2013. <http://doi.org/10.1155/2013/871941>
- AhmadPanahi, H., Hosseinzadeh, M., Adinehlo, H., Moniri, E., & Manoochehri, M. (2014). Removal of molybdenum from environmental sample by adsorption using modified aniline-formaldehyde with salicylic acid. *World Applied Sciences Journal*, 30(12), 1892–1898
- Caner C., Erdağı D., Şeker B., Altundağ H., Çeti N.G., Tunca H (2024). Effects of molybdenum to growth parameters and lipid content of two algae in Scenedesmaceae taxa. *Heliyon*. 11(1):e40847.
- Ying Z., Hejiao S., Caicai L., Haibo L., & Jianbo G. (2024). Role of molybdenum compounds in enhancing denitrification: Structure-activity relationship and the regulatory mechanisms. *Chemosphere*, 367, 143433
- Zhang, Y.L., Liu, F.J., Chen, X.L., Zhang, Z.Q., Shu, R.Z., Yu, X.L., Liu, Z.J. (2013). Dual effects of molybdenum on mouse oocyte quality and ovarian oxidative stress. *Systems Biology in Reproductive Medicine*, 59(6), 312–318. <http://doi.org/10.3109/19396368.2013.826296>.



Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023



Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

**PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK
MELALUI REPOSITORI INSTITUSI UiTM (IR)**

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

Setuju.

27.1.2023

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR

nar