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Factors affecting toxic lead(II) ion bioremediation by *Fusarium equiseti* isolated from the mangrove soil environment of southeast Borneo

Wahab Abideen Akinkunmi*[1], Awang Ahmad Sallehin Awang Husaini[1], Azham Zulkharnain[1], Tay Meng Guan[2] and Hairul Azman Roslan[1]

[1,3]Department of Molecular Biology, [2]Department of Chemistry, Faculty of Resource Science and Technology,Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia.
[3]Department of Biological Sciences, Faculty of Pure and Applied Sciences, Osun State University, P.M.B 4494, Osogbo, Nigeria.
Email: abidec1430@yahoo.com

ABSTRACT

Aims: Electronic waste (e-waste) is an inorganic pollutant which causes a serious environmental problem since it contains toxic heavy metals, which cannot be removed from contaminated sites easily. The use of biomaterials for removing heavy metals from contaminated soil and wastewater has emerged as a potential alternative method to the conventional techniques. The present study were aimed to isolate efficient lead tolerant fungi from mangrove soil environment and measure its capability for lead removal from aqueous solution. **Methodology and results**: Lead tolerant fungal strains were isolated from soil samples using PDA (Potato Dextrose Agar) supplemented with varied concentrations of lead ions (100-500 mg/L). The most tolerant fungal strain was successfully isolated and identified molecularly as *Fusarium equiseti* KR706303. The isolated fungus was used for biosorption studies using Potato dextrose broth (PDB) supplemented with lead ions. The effects of pH, temperature, initial metal concentration, biomass dose and age, agitation and contact time to the Pb(II) removal efficiency were monitored in the study. The results showed that the optimal parameters for the removal of lead ions such as heavy metal concentration and pH were 300 mg/L, with a maximum Pb(II) adsorption of 97.9% observed at pH 4 and temperature of 30 °C during the batch biosorption experiments. The optimal parameters for biomass dose, agitation speed, contact time and biomass age were observed at 0.04 g, 150 rpm, 60 min and fifth day; respectively.
Conclusion, significance and impact of study: The observation in this study revealed that the biomass of the isolated *Fusarium equiseti KR706303* has the potential to be used as a biosorbent for heavy metal particularly Pb(II) removal from the contaminated sites. The technology is simple, efficient, cost effective and environmental friendly.

Keywords: fungi, e-waste, *Fusarium equiseti*, heavy metal, lead(II) removal.

INTRODUCTION

The electronic waste, or e-waste poses a global concern because it is one of the fastest growing solid waste streams in the world, growing at the rate of 3-5% per annum; approximately three times faster than any other individual waste streams. E-waste is made up of numerous substances including lead, cadmium, mercury, hexavalent chromium, and brominated flame retardants that are major threats to human health and the environment. (Dursun *et al.*, 2003)

Although some of the e-wastes are recycled, the rest gets disposed into landfills such as agriculture fields and lakes (Ramasamy *et al*., 2011) leading to soil and water pollution. One of the most important environmental issues is the presence of heavy metal contamination in aqueous streams, arising from the discharge of metal-containing effluents into water bodies (Hawari and Mulligan, 2006; Ramasamy *et al*., 2011). According to Liu *et al*. (2008), lead is non-biodegradable and concerns for ectotoxicity is increasing. World Health Organization (WHO) in 2007 reported lead as one of the more common air pollutants. Lead reaches the human body through drinking of affected water, inhaling polluted air particularly from automobiles, peeling of paints and through food chain via cereals, vegetables, fishes and meat.

The biosorption of heavy metals using fungal strains has been widely and intensively studied by researchers world-wide (Al-Kadeeb, 2007; Azila *et al.*, 2008; Al-Fakih, 2011; Jaya *et al.*, 2013). Fungi have been reported as an efficient economic source for the removal of toxic heavy metals from aqueous solution, because the fungal cell wall has different functional groups which are involved in metal binding, and that the fungi can be easily isolated from environment for metal biosorption purposes (Wang and Chen 2006; Iskandar *et al.*, 2011). Fungal isolates

***Corresponding author**

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