ABSTRACT

Soil contamination by heavy metals has become a major environmental issue, particularly in agricultural areas near industrial zones. The excessive use of chemical fertilizers and pesticides has further exacerbated this problem. This study explores the potential of eco-enzyme derived from household kitchen waste and microbubble technology for the remediation of heavy metal-contaminated soil in the organic farming region of Poncokusumo, Malang. The research was conducted from November 2023 to February 2024. Soil samples were collected from contaminated agricultural land and analyzed using Inductively Coupled Plasma (ICP) to determine heavy metal levels before and after treatment. The eco-enzyme was produced through fermentation of organic waste, while microbubbles were introduced to enhance oxygen transfer and microbial activity. Additionally, bacterial consortia were isolated to assess their bioaccumulation potential. Results demonstrated that the combination of eco-enzyme and microbubble treatment significantly reduced heavy metal concentrations, with the highest bioaccumulation rates observed for Pb (79.2%), Cd (68.5%), Cr (74.1%), Mn (62.8%), Ni (59.3%), Cu (69.2%), and Zn (68.3%). The most effective microbubble injection was observed at dose 1 with an Optical Density of 1 at 10-14 hours. These findings highlight the effectiveness of eco-enzyme and microbubble technology as an innovative and sustainable approach to soil remediation, offering a potential solution for organic farming in contaminated areas. Further research is recommended to optimize the application process and evaluate long-term effects on soil health and crop productivity.

Keywords: *Eco-enzyme, microbubble, heavy metal remediation, bioaccumulation, bioremediation, contaminated soil, organic farming.*