

DEVELOPMENT OF INDONESIAN LOCAL BACTERIA FOR MASK WASTE BIODEGRADATION

by Dr. Anna Rakhmawati, S.Si.,M.Si.; Dr. Dra. Bernadetta Octavia, M.Si.; Dr. Siti Marwati, S.Si., M.Si

ABSTRACT

The use of masks during and after the COVID-19 pandemic has led to an increase in disposable mask waste. Disposable mask waste is difficult to degrade so it will endanger health and the environment. Therefore, an environmentally friendly and sustainable method with biodegradation using bacteria is needed. This research aims to develop bacteria isolated from landfills (TPS), mangroves, and beaches in Java, Indonesia for mask biodegradation. The research was conducted for two years. The first year of developing the potential of Indonesian local bacteria began with isolating bacteria from TPS, mangroves and beaches as well as studying the metagenome of the diversity of mask-degrading bacteria. The isolated bacterial were then characterized and identified. Moreover, the effect of differences media and environmental conditions was studied for optimal bacterial growth on a laboratory scale. Bacterial isolates that have the potential to be obtained by selecting the ability to degrade various types of masks. The differences of cell conditions and the environment that affect the degradation process are also determined. The degraded masks by bacteria were characterized by physical and chemical properties including functional groups with FTIR and surface observations with SEM-EDX. In year II, laboratory-scale simulations of selected bacterial isolates were carried out as a result of the first year's research. The research was initiated by determining the cellular mechanism of mask degradation by selected bacterial isolates. Testing of a consortium of different types of bacteria was carried out to determine the effectiveness of the degradation of various types of masks. Furthermore, the hazardous by-products of mask degradation including the presence of microplastics, heavy metals, and discoloration were investigated. The use of bacteria as a biodegradation agent is also expected to be able to overcome these by-products. Therefore, testing the ability of selected bacterial isolates to degrade microplastics, remove heavy metals, and reduce color. Simulations on the ability of selected bacterial isolates to degrade various types of masks were carried out on laboratory-scale substrates of soil, freshwater, brackish water, and seawater. In addition, simulations of the degradation of various types of masks were carried out by selected bacterial isolates at different times and environmental conditions such as pH, temperature, and light. The results of the first year's research carried out a bacterial metagenome study and obtained pure isolates of bacteria in mask waste from 9 locations i.e 3 TPS (Piyungan, Jatibarang, Burangkeng); 3 mangroves (Wanatirta, Tirang, Teluknaga); and 3 beaches (Parangtritis, Marina, Tanjung Pasir) located in Yogyakarta, Semarang, Tangerang and Bekasi. The results of the metagenome study show the diversity of bacteria with the dominance of Phylum Proteobacteria. The results of the selection of 302 pure bacterial isolates showed that 7 types of selected bacteria, namely *Bacillus cereus* (2), *Pseudomonas aeruginosa*, *Proteus mirabilis* (2), *Staphylococcus sciuri*, and *Staphylococcus arlettae* were superior in degrading various types of masks (duckbill, medical, KF94). The physiological, molecular, and ability of bacteria to degrade masks are known. Optimization of bacterial conditions and environmental factors that affect it has been carried out. The first year outcomes that have been achieved are two articles submitted in Scopus indexed international journals, one article published in Scopus indexed proceedings (AIP), one book chapter, and participation as a presenter in two international seminars. The results of the first year's research reached the Technology Readiness Level (TKT) were TKT 1 and TKT 2 while the second year would reach TKT 3.

Kata Kunci: *bacteria; biodegradation; isolation; mask; microplastic*