ABSTRAK

High Density Polyethylene (HDPE) merupakan salah satu jenis plastik sintetis yang mengandung alkana rantai lurus, panjang dan tidak mudah terdegradasi. Penelitian bertujuan untuk mendapatkan isolat fungi yang mampu mendegradasi plastik sintetis HDPE, serta mengidentifikasi jenis fungi berdasarkan sekuen area *Internal Transcriber Sequence* (ITS) rDNA. Selain itu, juga untuk mendapatkan kondisi degradasi optimum oleh enzim alkana hidroksilase beserta mekanismenya, sebagai kebaruan dalam penelitian. Tiga isolat fungi yang berasal dari daerah mangrove Wonorejo Surabaya yaitu LM 1020, LM 1021 dan LM 3010, telah berhasil dikarakterisasi kemampuannya dalam menghasilkan hidrofobin dengan metode *Oil Displacement Test* (ODT), aktivitas tegangan permukaan dan uji emulsifikasi. Ketiga isolat diuji potensinya dalam mendegradasi HDPE pada medium cair dengan berbagai parameter lingkungan yang berbeda, diantaranya adalah jenis medium, pH, suhu, dan konsentrasi substrat. Kemampuan degradasi HDPE oleh isolat fungi, dilihat dari nilai efisiensi degradasi, perubahan nilai persen transmitan pada *Fourier-Transform Infrared* (FTIR) dan hasil *Scanning Electron Microscope* (SEM). Sedangkan aktivitas dan karakteristik alkana hidroksilase dianalisis dengan metode Spektrofotometri dan SDS-PAGE. Mekanisme proses degradasi didasarkan dari hasil analisis *Gas Chromatography-Mass Spectrometry* (GC-MS). Berdasarkan analisis sekuen daerah ITS rDNA menggunakan metode Clustal W dan rekonstruksi pohon filogenetik menggunakan algoritma *neighbor joining,* ketiga isolat fungi termasuk jenis *Trametes polyzona* LM 1020, *Aspergillus terreus* LM 1021 dan *Aspergillus tamarii* LM 3010 serta terdaftar pada repositori GenBank dengan nomor aksesi berturut-turut adalah MN341223, MN386226 dan MN341224. Ketiga isolat mampu menghasilkan hidrofobin, yang membantu pelekatan fungi pada plastik. Nilai degradasi tertinggi oleh isolat fungi LM 1020, LM 1021 dan LM 3010 secara berturut-turut yaitu 1,15%, 0,918% dan 0,833%. Degradasi plastik sintetis HDPE optimum pada medium *Basal* (BM), pH 5, suhu 30 - 45 ^{o}C dan pada konsentrasi substrat 2 - 6 %. Enzim alkana hidroksilase ekstraseluler dari isolat LM 1021 merupakan enzim kompleks dengan berat molekul sekitar 46 kDa dan heksadekana sebagai substrat spesifiknya. Enzim alkana hidroksilase menunjukkan aktivitas optimum pada suhu 30 dan 45 ^{o}C, pH 5 dengan aktivitas sebesar 5,075 dan 5,398 U/mL, serta stabil pada suhu 45 - 65 ^{o}C selama 5 jam dan stabilitas pH pada rentang pH 4-10.

Kata kunci: Alkana hidroksilase, Degradasi, Fungi, HDPE, Mangrove Wonorejo

ABSTRACT

High Density Polyethylene (HDPE) is a type of synthetic plastic that contains long, straight chain alkanes and is not easily degraded. The research aims to obtain fungal isolates that can degrade synthetic HDPE plastics and determine the type of fungi based on the ITS (*Internal Transcriber Sequence*) rDNA area. In addition, it is also to obtain the optimum degradation conditions by the alkane hydroxylase enzyme and its mechanism, as a novelty in research. Three fungal isolates from the Wonorejo mangrove area of Surabaya, LM 1020, LM 1021 and LM 3010, have been characterized their ability to produce hydrophobins using the Oil Displacement Test (ODT) method, surface tension activity and emulsification tests. The isolates were tested for their potential in degrading HDPE in liquid medium with various different environmental parameters, including the type of medium, pH, temperature, and substrate concentration. The ability of HDPE degradation by fungi was seen from the value of the degradation efficiency, the percent transmittance of Fourier-Transform Infrared (FTIR) and the results of the Scanning Electron Microscope (SEM). Activity and characteristics of alkane hydroxylase were analyzed by Spectrophotometric method and SDS-PAGE. The mechanism of the degradation process was analyzed by Gas Chromatography-Mass Spectrometry (GC-MS). The isolates used in this study were *Trametes polyzona* LM 1020, *Aspergillus terreus* LM 1021 and *Aspergillus tamarii* LM 3010, based on the ITS rDNA sequence analysis using the Clustal W method and phylogenetic tree reconstruction using the neighbor joining algorithm. Accession numbers on the GenBank repository are MN341223, MN386226 and MN341224, respectively. All isolates were able to produce hydrophobins, which help the fungus adhere to the plastic. The highest degradation value by the fungal isolates LM 1020, LM 1021 and LM 3010 were 1.15%, 0.918% and 0.833%, respectively. The optimum degradation of HDPE was in basal medium (BM), pH 5, 30 – 45 ^{o}C and 2 - 6% concentration of substrate. The extracellular alkane hydroxylase enzyme from isolate LM 1021 is a complex enzyme with a molecular weight of about 46 kDa and hexadecane as its specific substrate. The enzymes show optimum activity at 30 and 45 ^{o}C, pH 5 with activities of 5.075 and 5.398 U/mL. Stable at 45 – 65 ^{o}C for 5 hours and stable in the pH range 4-10.

Keywords: Alkane hydroxylase, Degradation, Fungi, HDPE, Mangrove Wonorejo