RESPONS PERTUMBUHAN, EKSPRESI GEN KETAHANAN DAN EVALUASI MODEL KINETIKA PADA *Echinodorus palifolius* (Ness & Mart.) J.F.Macbr. DAN *Euglena* sp. TERHADAP MERKURI DALAM SISTEM *FWS-CW*

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INTISARI

Limbah merkuri dari Pertambangan Emas Skala Kecil (PESK) memberikan andil pencemaran merkuri tertinggi di dunia (35%). Berbagai upaya mengurangi pencemaran merkuri di lingkungan akibat PESK telah dilakukan, mulai dari metode *capping, dredging* sampai pembakaran/*thermal*. Namun metode tersebut membutuhkan biaya tinggi, penambang emas kecil tidak akan mampu menutup pembiayaanya. Pengurangan merkuri dengan menggunakan tumbuhan, mikrobia maupun alga dilakukan untuk mengatasi permasalahan tingginya biaya remediasi. Metode ini berhasil mengurangi limbah merkuri namun belum sebaik metode *thermal* karena biomassa yang rendah pada tumbuhan serta pertumbuhan yang tidak pesat. Di sisi lain reaktor *Free Water Surface-Constructed Wetlands (FWS-CW)* terbukti menjadi reaktor yang mampu menurunkan kadar logam berat pada media air. Penelitian ini menggabungan hiperakumulator tumbuhan tingkat tinggi (*Echinodorus palifolius)* dengan alga yaitu *Euglena* sp. dalam meremediasi merkuri pada reaktor *FWS-CW*. Tujuan penelitian ini adalah untuk mempelajari pertumbuhan *E. palifolius* dan *Euglena* sp. pada system *FWS-CW* yang mengandung merkuri, mempelajari karakter anatomis daun, tangkai daun dan akar *E. palifolius,* menentukan model kinetika biosorpsi (*Pseudo 1 dan Pseudo 2*) dalam penyerapan merkuri serta menguji gen ketahanan (glutation) pada *E. palifolius*. Penelitian menggunakan $HgCl_2$ dalam setiap liter air. Organisme ditumbuhkan selama 18 hari menggunakan rancangan acak lengkap (RAL). Sampel efluen diambil pada hari ke 3, 7 dan 14. Pengukuran parameter pertumbuhan tanaman dilakukan pada hari ke-18 sedangkan pertumbuhan *Euglena* sp. diukur pada hari ke-9. Pembuatan preparat anatomis daun, akar dan tangkai daun tanaman *E.palifolius* dilakukan setelah 14 hari perlakuan, begitupun uji merkuri pada organ tanaman *E. palifolius.* Deteksi gen ketahanan dilakukan setelah 14 hari perlakuan dengan variasi konsentrasi 25 ppm, 50 ppm dan 75 ppm Hg. Remediasi dilakukan oleh *Euglena* sp., asosiasi antara *E. palifolius* dan *Euglena* sp. serta oleh *E. palifolius* saja. Data pertumbuhan dianalisis menggunakan ANOVA (taraf kepercayaan 95%) dilanjutkan dengan DMRT pada parameter kuantitatif (pertumbuhan, kadar klorofil, diameter *metaxylem*, diameter *stele* dan ketebalan korteks). Deteksi gen ketahanan menggunakan metode qRT *PCR* untuk melihat ekspresi gennya. Parameter lingkungan berupa pH, suhu dan intensitas cahaya. Kandungan merkuri pada media air dimasukkan dalam pemodelan kinetika (*Pseudo 1 dan Pseudo 2*). Hasil penelitian menunjukkan pertumbuhan asosiasi *Euglena sp. dan E. palifolius* masih optimal pada cekaman 50 ppm merkuri, tanaman *E. palifolius* maupun *Euglena* sp. meremediasi merkuri dengan cara absorbsi dan dapat dijelaskan dengan model kinetik *Pseudo-Second Order*, merkuri terakumulasi pada jaringan parenkim di organ akar yaitu di bagian korteks akar, dan terdapat gen *GSH* pada *E. palifolius* sebagai gen ketahanan terhadap merkuri.

Kata Kunci : *Euglena* sp., *Echinodorus palifolius*, merkuri, gen ketahanan, *FWS-CW*.

GROWTH RESPONSE, RESISTANCE GENE EXPRESSION AND KINETIC BIOSORPTION MODEL EVALUATION IN *Echinodorus palifolius* (Ness & Mart.) J.F.Macbr. AND *Euglena* sp. ON MERCURY IN THE *FWS-CW* SYSTEM

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ABSTRACT

Mercury waste from Small Scale Gold Mining (PESK) provides the highest mercury pollution in the world (35%). Various efforts to reduce pollution in the environment due to ASGM have been carried out, ranging from capping and dredging to burning/thermal methods. However, this method requires high costs, small gold miners will not be able to cover the expenses. Reducing mercury using plants, microbes, and algae is carried out to overcome the problem of high remediation costs. This method successfully reduces liquid waste but is not the best thermal method because of the low biomass of plants and slow growth. On the other hand, the free water surface-constructed wetlands (*FWS-CW*) reactor has proven to be a reactor capable of reducing heavy metal levels in air media. This research combines the hyperaccumulator of higher plants (*Echinodorus palifolius*) with algae, *Euglena* sp, in remediating mercury in the *FWS-CW* reactor. The research aims to study the growth of *E. palifolius* and *Euglena* sp. in the *FWS-CW* system containing mercury, study the anatomy characters of leaves, petioles, and roots of *E. paifolius*, determine kinetic biosorption models (pseudo 1 and pseudo 2) by *E. paifolius* and *Euglena* sp. and testing gene resistance (glutation) in *E. palifolius*. The study used $HgCl_2$ in every liter of air. The organisms were grown for 18 days using a completely randomized design. Effluent samples were taken on days 3, 7 and 14. Plant growth parameters were measured on day 18 while the growth of *Euglena* sp. was carried out on the 9^{th} day. Making anatomical preparations of leaves, roots, and petioles of *E.palifolius* plants was carried out after 14 days of treatment, as well as testing for mercury on the organs of *E.palifolius* plants. Resistance gene detection was carried out after 14 days of treatment with varying concentrations of 25 ppm, 50 ppm, and 75 ppm Hg. Remediation was carried out by *Euglena* sp., an association between *E. palifolius* and *Euglena* sp. as well as by *E. palifolius* alone. Growth data were analyzed using ANOVA (95% confidence level) followed by DMRT on quantitative parameters (growth, chlorophyll content, metaxylem diameter, stele diameter, and cortex thickness). Detection of gene resistance uses the qRT *PCR* method to see gene expression. Environmental parameters include pH, temperature, and light intensity. The mercury content in the water medium is included in kinetic modeling (pseudo 1 and pseudo 2). The results showed an association between the growth of *Euglena* sp. and *E. palifolius* is still optimal at 50 ppm mercury, *E. palifolius* and *Euglena* sp. remediate mercury by absorption and can be explained by a Pseudo-Second Order kinetic model, mercury accumulates in the parenchymal tissue in the root organs, in the root cortex, and there the *GSH* gene in *E. palifolius* as a gene for resistance to mercury.

Keywords: *Euglena* sp., *Echinodorus palifolius*, mercury, resistance gene, *FWS-CW*.