

**THE EFFECTS OF COPPER, LEAD AND
MERCURY TREATMENTS ON PHYSIOLOGICAL
AND BIOCHEMICAL PROPERTIES OF FIVE
MARINE MACROALGAE**

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**MASTER OF SCIENCE
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Al-Fatihah to Izzatul Huda

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April 2015

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School : Fundamental Science

Heavy metals contaminating water bodies always be world's concern and searching for the method to remove it started few decades back. Methods to reduce and remove heavy metals from aquatic environment ranging from physical, chemical and biological methods. In this study, the use of marine macroalgae is to obtain knowledge and information on the ability to be a biomarker of heavy metals pollution. Marine macroalgae used in this study were three rhodophytes; *Gracilaria salicornia*, *Gracilaria manilaensis*, *Gracilaria* sp., one phaeophyte; *Sargassum* sp. and one chlorophyte; *Ulva reticulata*. Objectives of this study were to determine the amount of treated metals; copper (Cu), lead (Pb) and mercury (Hg) at two concentration (1 mg/L and 2 mg/L) accumulated in the tissue of the macroalgae by using atomic absorption spectrophotometer (AAS), to observe changes in surface structures by using scanning electron microscope (SEM) and to ascertain the effect on maximum

quantum yield (F_v/F_m), relative growth, chlorophyll (chl) content and amino acid composition by High-Performance Liquid Chromatography (HPLC). Results for metals accumulation showed positive accumulation where the accumulation increases when treated concentration increase with *G. manilaensis* gave all significant data for all treatments. SEM gave qualitative surface changes and Hg treatment affected most samples severely especially in *G. manilaensis*. F_v/F_m obtained in this study showed both increase and decrease results. Only *Sargassum* sp. gave data for 2 mg/L Hg making it can resist Hg toxicity. Most Hg treatments decreased chl content except in 1 mg/L Hg for *Gracilaria* sp. thus it may indicates chl can tolerate to metal stress. Amino acid composition in this study showed vary amino acid profile and *Sargassum* sp. gave the highest number of amino acid compare to other four species. Hg shows the most toxic effect on macroalgae compare to Cu and Pb because most of the treatments gave either no results or very low value. From the data obtained, macroalgae had the potential to be a biomarker for heavy metals pollution.

Abstrak tesis yang dikemukakan kepada Senat
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**KESAN RAWATAN LOGAM KUPRUM, PLUMBUM DAN MERKURI KE ATAS
PARAMETER FISILOGI DAN BIOKIMIA LIMA MAKROALGA MARIN**

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Logam berat yang mencemari air sentiasa menjadi perhatian dunia dan penyelidikan mengenai kaedah untuk menyingkirkannya bermula beberapa dekad yang lepas. Kaedah untuk mengurangkan dan menyingkirkan logam berat daripada persekitaran akuatik terdiri daripada kaedah fizikal, kimia dan biologi. Dalam kajian ini, penggunaan makroalga marin adalah untuk mendapatkan pengetahuan dan maklumat mengenai keupayaan untuk menjadi penanda biologi bagi pencemaran logam berat. Makroalga marin yang digunakan dalam kajian ini terdiri daripada tiga rhodophyta; *Gracilaria salicornia*, *Gracilaria manilaensis*, *Gracilaria* sp., satu phaeophyta, *Sargassum* sp. dan satu chlorophyta, *Ulva reticulata*. Objektif kajian ini adalah untuk menentukan jumlah penimbunan logam berat yang dirawat; kuprum (Cu), plumbum (Pb) dan merkuri (Hg) pada dua kepekatan (1 mg/L dan 2 mg/L) yang terkumpul di dalam tisu makroalga dengan menggunakan spektrofotometer penyerapan atom (AAS), untuk melihat perubahan pada struktur permukaan dengan menggunakan mikroskop imbasan elektron (SEM) dan untuk menentukan

kesan ke atas hasil maksimum kuantum (F_v/F_m), pertumbuhan relatif, kandungan klorofil (chl) dan komposisi asid amino dengan menggunakan *High Performance Liquid Chromatography* (HPLC). Keputusan untuk penimbunan logam menunjukkan penimbunan positif di mana peningkatan penimbunan diperoleh apabila kepekatan rawatan meningkat. *G. manilaensis* memberikan data signifikan untuk semua rawatan. SEM memberi perubahan permukaan kualitatif dan sampel pada rawatan Hg terjejas paling teruk terutamanya pada *G. manilaensis*. F_v/F_m diperolehi dalam kajian ini menunjukkan peningkatan dan penurunan keputusan. Hanya *Sargassum* sp. memberikan data untuk 2 mg/L Hg menjadikannya dapat menahan ketoksikan Hg. Kebanyakan rawatan Hg menurunkan kandungan chl kecuali dalam 1 mg/L Hg untuk *Gracilaria* sp. Oleh itu ia menunjukkan chl boleh toleransi dengan tekanan bahan logam. Komposisi asid amino dalam kajian ini menunjukkan perubahan pada profil asid amino dan *Sargassum* sp. memberikan jumlah asid amino tertinggi berbanding empat spesies yang lain. Hg menunjukkan kesan ketoksikan yang paling tinggi pada makroalga berbanding Cu dan Pb kerana kebanyakan rawatan memberi keputusan sama ada tiada atau nilai atau yang sangat rendah. Daripada data yang diperolehi, makroalga mempunyai potensi untuk menjadi penunjuk biologi bagi pencemaran logam berat.