



UNIVERSITI PUTRA MALAYSIA

***TRACE ELEMENT IN SEAGRASSES FROM MERAMBONG SHOAL,
JOHORE***

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157291

**This project is submitted in partial fulfillment of the requirements for the
degree of Bachelor of Agriculture (Aquaculture)**

**DEPARTMENT OF AQUACULTURE
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ABSTRACT

Studies on trace element concentrations in seagrass in the temperate area have been carried out extensive over the world. However, trace element concentrations in seagrass from tropical area are of little information. Trace elements in seagrass (As, B, Cd, Cr, Fe, Hg, Ni, Pb and S), sediment (As, B, Cd, Cu, Cr, Na, Hg, Ni, Pb and S) and pore water (As, B, Cd, Cr, Na, Hg, Ni, Pb and S) were determined. Eight seagrass species; *Enhalus acoroides*, *Thalassia hemprichii*, *Halophila ovalis* big-leaved, *Halophila ovalis* small-leaved, *Halophila spinulosa*, *Cymodocea serrulata*, *Halodule uninervis* narrow-leaved and *Halodule uninervis* wide-leaved were collected at Merambong shoal, Johore during low tide for 5 months period from April to August. Fresh samples were dried and grind. Dried seagrass and soil sediment were subjected to wet digestion method while pore water were acidified to pH<2 prior to analysis using Perkin Elmer Optima 8300 ICP-OES. Sulfur concentrations were the highest for seagrasses ranged from 5920.30-9507.30 ppm followed by iron concentration (1242.60-7819.00 ppm) while the lowest was arsenic concentration ranged from 0.17-2.67 ppm. Mercury element was not detected in all seagrass species. Soil sediments were the highest concentration for sodium with 2950.20-8270.00 ppm while concentration of arsenic was the lowest (0.13-1.07 ppm). Mercury and boron elements were not detected in soil sediments. In pore water, concentration of sulfur was the highest (598.730-873.610 ppm) followed by boron (2.221-3.489 ppm). The concentrations of the compared trace element were relatively lower than the other studies.

ABSTRAK

Kajian ke atas kepekatan unsur surih dalam rumput laut di kawasan beriklim sederhana telah dijalankan meluas seluruh dunia. Walau bagaimanapun, sedikit maklumat berkaitan kepekatan unsur surih dalam rumput laut dari kawasan tropika. Unsur-unsur surih dalam rumput laut (As, B, Cd, Cr, Fe, Hg, Ni, Pb dan S), sedimen (As, B, Cd, Cu, Cr, Na, Hg, Ni, Pb dan S) dan air pori (As, B, Cd, Cr, Na, Hg, Ni, Pb dan S) telah ditentukan. Lapan spesies rumput laut; *Enhalus acoroides*, *Thalassia hemprichii*, *Halophila ovalis* berdaun besar, *Halophila ovalis* berdaun kecil, *Halophila spinulosa*, *Cymodocea serrulata*, *Halodule uninervis* berdaun tirus dan *Halodule uninervis* berdaun lebar telah dikumpul di beting Merambong, Johor semasa air surut selama 5 bulan dari April hingga Ogos. Sampel segar telah dikeringkan dan dikisar. Rumput laut kering dan sedimen tanah tertakluk kepada kaedah penghadaman basah manakala air pori telah diturunkan pH kurang daripada dua (2) sebelum dianalisis menggunakan Perkin Elmer Optima 8300 ICP-OES. Kepekatan sulfur adalah yang tertinggi untuk rumput laut di antara 5920.30-9507.30 ppm diikuti oleh kepekatan besi (1242.60-7819.00 ppm) manakala yang terendah adalah kepekatan arsenik diantara 0.17-2.67 ppm. Unsur raksa tidak dikesan dalam semua spesies rumput laut. Sedimen tanah adalah kepekatan tertinggi bagi natrium dengan 2950.20-8270.00 ppm manakala kepekatan arsenik adalah paling rendah (0.13-1.07 ppm). Unsur raksa dan boron tidak dikesan dalam sedimen tanah. Dalam air pori, kepekatan sulfur adalah yang tertinggi (598.73-873.61 ppm) diikuti dengan boron (2.221-3.489 ppm). Kepekatan unsur surih secara relatifnya lebih rendah berbanding daripada kajian-kajian lain.

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LIST OF ABBREVIATIONS/ SYMBOLS

As	Arsenic
B	Boron
Cd	Cadmium
Cr	Chromium
Fe	Iron
Hg	Mercury
Ni	Nickel
Pb	Lead
S	Sulfur
Cu	Copper
pH	power of hydrogen
ppm	parts per million
ml	milliliter
μm	micrometer
$^{\circ}\text{C}$	degree Celsius
N	normality
μM	micromoles
mV	millivolt
am	Ante Meridian
HNO_3	Nitri acid
H_2O_2	Hydrogen peroxide
HClO_4	Perchloric acid
HCL	Hydrochloric acid

CHAPTER 1

INTRODUCTION

The life of all living things are maintained through various important processes such as growth, metabolism, homeostasis, nucleic acid metabolism and protein synthesis. The trace element plays an important role as enzyme and cofactor to facilitate these processes. The effects of the trace element control over the life processes can be reflected in human health, shifts of the equilibrium in ecological competition between organism and also the success of agriculture activity in a certain region. For instance, a 10 g of molybdenum when applied to one hectare which consist of 5-6 million individual plants, may increase the crop yield of legumes by 30-40% while sometimes by 200% (Shkolnik, 1984). Human and some animals obtain these essential trace element, raw materials and energy through plant. It is the ability of green plant to transform these inorganic nutrient into vital raw materials including starch, amino acids, fatty acids, vitamins and fibres that plants are indispensable in the daily diet. This make plants an important component for human health and consumption.

In plant science, the essential elements considered to be required in plant physiology is carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), calcium (Ca), magnesium (Mg), potassium (K), sulphur (S), manganese (Mn), copper (Cu), zinc (Zn), molybdenum (Mo), boron (B), chlorine (Cl), sodium (Na), silicon (Si), cobalt (Co) and iron (Fe) (Arnon and Stout, 1939). One problem may occur such as toxicity or inhibition in growth when the concentration of the

element is too high. At such instance, these elements may be termed as heavy metal to define its toxicity in plants. According to Duffus (2002), heavy metals are termed according to size and density greater than a certain amount. But a consistent amount was never established to completely define the term heavy metal, therefor making the term loosely defined, meaningless and misleading. These elements in the periodic table can also be termed as alkali metal, alkali earth metal, transition metal, metalloid, non-metals and halogen. The word trace element used to define the elements required by plants.

From a geochemical view point, the trace elements are generally viewed as those other than the eight abundant rock-forming elements found in nature which are the oxygen (O), Silicon (Si), aluminum (Al), iron (Fe), calcium (Ca), sodium (Na), potassium (K) and magnesium (Mg). Earth scientist defined trace elements as elements which present in the earth crust that have a concentration that are lower than 1000 mg kg^{-1} while from biochemical view point, it is considered to be those found in plants or animal tissue that are lower than 100 mg kg^{-1} of organism dry matter (Blum *et al.*, 2013). The trace elements are introduced into the natural ecosystem through either natural process such as weathering of rocks or tectonic activities as well as from anthropogenic activities. Human activities such as industrialization, motor vehicles, power plants and agriculture are some of the main contributors of trace elements into the ecosystem.

In the aquatic system, most of the trace elements interact with the suspended particulate matter through adsorption and get deposited in the sediment through

flocculation and sediment process. The sediments act as a potential sink and substrate for these elements which influence their fate in the environment (Fernandes *et al.*, 2011). These trace element may be mobilized or immobilized and become available for organisms uptake in the sediments. These elements may be associated with the surface functional groups such as hydroxide, carbonate or sulphide minerals (in amorphous or crystalline forms) or organic matter in the sediment (Driscoll *et al.*, 1994).

The mobilization of elements to the interstitial water and their chemical speciation are controlled by major sediment components such as organic compound and oxides of iron. Transformation of metals as in methylation of some metals and the competition of the metals in the sediment for the uptake site of the organism also affects the metal speciation in the environment. Bioturbation, salinity, pH or redox also affect the behavior of the elements (Bryan and Langston, 1991). They form complexes with a range of ligands in the aqueous environment. These include water (aquo complexes), OH⁻ (hydroxo complexes), other inorganic ligands (e.g., Cl⁻, SO₄²⁻, HCO₃⁻, F^{T-}) and organic ligands (Driscoll *et al.*, 1994).

Seagrass or marine macrophytes are plants that have roots in the sediments on the sea bottom while have their shoots grow above the substrate. They live in the marine environment and like higher plants, require trace element to perform various metabolic process to sustain itself. Seagrass obtain the trace elements from both the sediments and also directly from seawater itself. The mechanisms

of absorbing the trace element from the surrounding making the seagrass a unique and interesting subject to research on compared to terrestrial plant.

Interaction of organisms with the trace elements in their surrounding is of particular interest due to potential nutrient deficiencies and toxicity. But the understanding of such a topic is only available in a few system. The mechanisms of trace element bioavailability for the organisms vary from organism to organism and element to element (Driscoll *et al.*, 1994). The environment in which the element are present also influence the bioavailability for organisms to uptake.

Therefore the aim of this study is to understand on the interaction of the trace element with the seagrass and sediment as well as pore water. The specific of this study are:

- to determine the trace elements content in seagrass.
- to investigate the trace element content in the sediment and pore water.

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