

A STUDY ON HEAVY METAL CONTENT IN SEaweEDS
FROM PENINSULAR MALAYSIA

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I would like to extend my sincere appreciation and gratitude to my supervisors, Dr Noor Azhar bin Mohd Shauki and Dr Siti Aishah Abukhalaf for their guidance, advice, comments, patience and time throughout this project.

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ABSTRACT

Seaweed and seawater samples were collected from thirteen locations along the beaches of Peninsular Malaysia. A total of 8 species of Chlorophyta, 6 species of Rhodophyta, 4 species of Phaeophyta and 1 species of Cyanophyta were then analyzed for five metals namely Cu, Cd, Cr, Fe and Zn by atomic absorption spectrophotometry. The seawater samples were analyzed for Cu, Cd, Pb and Zn.

Total concentrations (μg metal/g dry weight seaweed) of metals in *Padina australis* ranged from 10.30-188.88 μg Zn/g, 2.69-10.57 μg Cu/g, 465.30-4946.15 μg Fe/g, 1.66-15.90 μg Cr/g and 0.030-2.691 μg Cd/g. In *Amphiroa foliacea* metals levels ranged from 2.99-27.19 μg Zn/g, 0.47-3.46 μg Cu/g, 138.63-763.33 μg Fe/g, 0.71-4.98 μg Cr/g and 0.018-0.159 μg Cd/g. Total concentration in *Sargassum sp* were 14.9-177.16 μg Zn/g, 2.04-31.00 μg Cu/g, 256.11-3565.12 μg Fe/g, 3.01-7.29 μg Cr/g and 0.187 -6.972 μg Cd/g. In *Gracilaria sp* total concentration were 7.60-67.22 μg Zn/g, 1.57-8.30 μg Cu/g, 941.69-1445.59 μg Fe/g, 3.04-5.86 μg Cr/g and 0.143-0.635 μg Cd/g. Total concentration of metals in *Enteromorpha sp* ranged from 26.91-90.49 μg Zn/g, 3.45-13.02 μg Cu/g, 2268.62-7066.66 μg Fe/g, 7.41-19.03 μg Cr/g and 0.139-0.695 μg Cd/g. In *Laurencia sp* metal level were 11.29-60.18 μg Zn/g, 4.13-13.97 μg Cu/g, 755.25-2917.34 μg Fe/g, 2.36-14.05 μg Cr/g and 0.112-0.934 μg Cd/g. Total concentration in *Cladophora prolifera* were 14.28-66.10 μg Zn/g, 2.33-14.98 μg Cu/g, 2156.43-4875.03 μg Fe/g, 8.16-19.11 μg Cr/g and 0.143-0.247 μg Cd/g.

The highest heavy metals content in seaweeds can be found from Tanjung Kling, Tanjung Bidara, Port Dickson and Telaga Simpul, which are either heavily industrialised areas or tourism areas. The results also showed that local seaweed species have the potential to be used as biological indicators of heavy metals. Seaweeds that can be used to monitor metal pollution are *Enteromorpha sp* for iron, *Padina australis* for zinc, *Sargassum sp* for copper, *Cladophora prolifera* for chromium and *Padina minor* for cadmium.

Kepekatan keseluruhan (μg logam/g berat kering) dalam spesies yang dominan seperti *Padina australis* adalah berjalat dari 10.30-128.88 $\mu\text{g Zn/g}$, 2.69-10.37 $\mu\text{g Cu/g}$, 465.30-4946.15 $\mu\text{g Fe/g}$, 1.66-15.90 $\mu\text{g Cr/g}$ dan 0.030-2.691 $\mu\text{g Cd/g}$. Bagi *Amphiroa foliacea* pula adalah berjalat antara 2.99-27.19 $\mu\text{g Zn/g}$, 0.47-3.46 $\mu\text{g Cu/g}$, 138.53-763.33 $\mu\text{g Fe/g}$, 0.71-4.94 $\mu\text{g Cr/g}$ dan 0.018-0.159 $\mu\text{g Cd/g}$. Kepekatan-logam dalam *Sargassum sp* adalah berjalat 14.9-177.16 $\mu\text{g Zn/g}$, 2.04-31.00 $\mu\text{g Cu/g}$, 256.11-3565.12 $\mu\text{g Fe/g}$, 3.01-7.29 $\mu\text{g Cr/g}$ dan 0.187-6.972 $\mu\text{g Cd/g}$. Bagi *Cracilaria sp* pula adalah berjalat antara 7.60-67.22 $\mu\text{g Zn/g}$, 1.37-8.30 $\mu\text{g Cu/g}$, 941.69-1445.50 $\mu\text{g Fe/g}$, 3.04-3.86 $\mu\text{g Cr/g}$ dan 0.143-0.635 $\mu\text{g Cd/g}$. Kepekatan logam dalam *Enteromorpha sp* adalah berjalat antara 25.91-50.49 $\mu\text{g Zn/g}$, 3.45-13.02 $\mu\text{g Cu/g}$, 2268.62-7056.66 $\mu\text{g Fe/g}$, 7.41-19.03 $\mu\text{g Cr/g}$ dan 0.139-0.695 $\mu\text{g Cd/g}$. Bagi *Laurencia sp* pula, kepekatan logam berjalat antara 11.29-60.13 $\mu\text{g Zn/g}$, 4.13-13.97 $\mu\text{g Cu/g}$, 755.25-2917.34 $\mu\text{g Fe/g}$, 3.36-14.05 $\mu\text{g Cr/g}$ dan 0.112-0.934 $\mu\text{g Cd/g}$.

ABSTRAK

Sampel rumput laut dan air laut telah dikutip dari tiga belas stesen di sepanjang pantai Semenanjung Malaysia. Sebanyak 8 spesies rumput laut hijau (Chlorophyta), 6 spesies rumput laut merah (Rhodophyta), 4 spesies rumput laut perang (Phaeophyta) dan satu spesies rumput laut biru-hijau (Cyanophyta) telah diukur kandungan logam beratnya bagi lima jenis logam seperti Zn, Cu, Fe, Cr and Cd dengan menggunakan alat spektrofotometri penyerapan atom. Sementara itu, kandungan Zn, Pb, Cu dan Cd di dalam sampel air laut juga diukur.

Kepekatan keseluruhan (μg logam/g berat kering) dalam spesies yang dominan seperti *Padina australis* adalah berjulat dari 10.30-188.88 $\mu\text{g Zn/g}$, 2.69-10.57 $\mu\text{gCu/g}$, 465.30-4946.15 $\mu\text{gFe/g}$, 1.66-15.90 $\mu\text{gCr/g}$ dan 0.030-2.691 $\mu\text{gCd/g}$. Bagi *Amphiroa foliacea* pula adalah berjulat antara 2.99-27.19 $\mu\text{gZn/g}$, 0.47-3.46 $\mu\text{gCu/g}$, 138.63-763.33 $\mu\text{gFe/g}$, 0.71-4.98 $\mu\text{gCr/g}$ dan 0.018-0.159 $\mu\text{gCd/g}$. Kepekatan logam dalam *Sargassum sp* adalah berjulat 14.9-177.16 $\mu\text{gZn/g}$, 2.04-31.00 $\mu\text{gCu/g}$, 256.11-3565.12 $\mu\text{gFe/g}$, 3.01-7.29 $\mu\text{gCr/g}$ dan 0.187-6.972 $\mu\text{gCd/g}$. Bagi *Gracilaria sp* pula adalah berjulat antara 7.60-67.22 $\mu\text{gZn/g}$, 1.57-8.30 $\mu\text{gCu/g}$, 941.69-1445.59 $\mu\text{gFe/g}$, 3.04-5.86 $\mu\text{gCr/g}$ dan 0.143-0.635 $\mu\text{gCd/g}$. Kepekatan logam dalam *Enteromorpha sp* adalah berjulat antara 26.91-90.49 $\mu\text{gZn/g}$, 3.45-13.02 $\mu\text{gCu/g}$, 2268.62-7066.66 $\mu\text{gFe/g}$, 7.41-19.03 $\mu\text{gCr/g}$ dan 0.139-0.695 $\mu\text{gCd/g}$. Bagi *Laurencia sp* pula, kepekatan logam berjulat antara 11.29-60.18 $\mu\text{gZn/g}$, 4.13-13.97 $\mu\text{gCu/g}$, 755.25-2917.34 $\mu\text{gFe/g}$, 2.36-14.05 $\mu\text{gCr/g}$ dan 0.112-0.934 $\mu\text{gCd/g}$.

Kepekatan logam dalam *Cladophora prolifera* berjulat dari 14.28-66.10 $\mu\text{gZn/g}$, 2.33-14.98 $\mu\text{gCu/g}$, 2156.43-4875.03 $\mu\text{gFe/g}$, 8.16-19.11 $\mu\text{gCr/g}$ dan 0.143-0.247 $\mu\text{gCd/g}$.

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