CHAPTER 6

CONCLUSION

6.0 Conclusion

This study revealed five patterns of heavy metal accumulation in the Malaysian seaweed species, tested;

Pattern 1 : An initial rapid uptake, followed by a gradual accumulation till 24 h.

Pattern 2 : A continuous gradual accumulation pattern for the entire 24h.

Pattern 3 : An initial rapid uptake, followed by a re lease-uptake pattern before a steady state concentration or gradual accumulation contin ued till 24 h.

Pattern 4 : An initial net accumulative pattern, followed by a continuous regulatory discharge till 24 h.

Pattern 5 : An alternating uptake-release pattern through out the 24 h.

Patterns 1, 2 and 3 are grouped as net accumulative patterns on the whole, while patterns 4 and 5 are indication of regulatory processes.

Based on the following criteria for the use of seaweeds as potential bioaccumulative indicators of metal : i) seaweeds should possess net accumulation pattern; ii) seaweeds should have strong positive correlation between metal accumulated in tissues and time of exposure; iii)

seaweeds should have strong positive correlation between metal accumulated in tissues and available metal concentration in seawater, the following seaweeds are potential bioaccumulative indicators of the corresponding heavy metals :

Bioaccumulative Indicator	Metal
Chaetomorpha linum	Cu, Zn and Mn
Padina tetrastomatica	Cu, Zn, Mn and Cd
Sargassum siliquosum	Cu, Zn, Mn and Cd
Sargassum baccularia	Cu, Zn, Mn and Cd
Gracilaria edulis	Cd
Gracilaria salicornia	Zn and Cd

The occurrence of metal regulation in seaweeds after 24 h of metal exposure, in this study is summarised below :

Seaweed	Regulated metal
C. linum	Cd
G. changii	Cu, Zn, Mn and Cd
G. edulis	Cu, Zn and Mn
G. salicornia	Cu and Mn

Decreasing salinity levels correlated ($p<0.05$) with increased accumulation of metals in seaweeds in the 2 h metal exposure study, except in *C. linum* exposed to Cd concentration.

No definite trend was seen for the effect of pH on metal accumulation in seaweeds for 2 h in the study. However, seaweeds exposed to pH ranging from 5-8, showed significantly

($p<0.05$) higher accumulation of metal than at pH 4.

Toxicity studies of heavy metals showed that IC_{50} values can vary greatly, depending on the incubation time used. *G. changii* was the most sensitive species to Cd exposure, with 50% inhibition of dry weight after 96 hours in the range finding test. Toxicity results for Cd exposure in 96 h definitive test conducted on *G. changii* : IC_{50} = 31.071 $mgCdL^{-1}$; LOEC = 15 $mgCdL^{-1}$; NOEC < 15 $mgCdL^{-1}$). In contrast, exposure *C. linum* and *S. baccularia* to Cd in 96 h range finding test did not produce 50% inhibition in chlorophyll-a content and dry weight respectively. Further exposure to Cd for 7 and 10 days in the definitive tests showed that *G. changii* was still the most sensitive species. However, the inhibitory concentrations decreased with the incubation time used. The order of decreasing sensitivity to Cd exposure according to species is as follows : *G. changii* > *S. baccularia* > *C. linum*.