UNIVERSITI PUTRA MALAYSIA

HEAVY METAL CONCENTRATION LEVEL IN FIDDLER CRAB (*UCA ANNULIPES*) AND SOLDIER CRAB (*DOTILLA MYCTIROIDES*) IN INTERTIDAL AREAS OF THE WEST COAST, PENINSULAR MALAYSIA

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MOHD IKRAM BIN MOHAMMAD

**Thesis Submitted to the School of Graduate Studies,
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Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

HEAVY METAL CONCENTRATION LEVEL IN FIDDLER CRAB (*UCA ANNULIPES*) AND SOLDIER CRAB (*DOTILLA MYCTIROIDES*) IN INTERTIDAL AREAS OF THE WEST COAST, PENINSULAR MALAYSIA

By

MOHD IKRAM BIN MOHAMMAD

March 2010

Chairman : Professor Dr. Ahmad Ismail, PhD

Faculty : Science

The study investigated the distribution concentration levels of heavy metals Zn, Cu, Cd and Pb in *Uca annulipes* and *Dotilla myctiroides* crabs with addition to sediment samples that were collected from the intertidal areas of Selangor (5 sites) and Negeri Sembilan (3 sites), west coast of Peninsular Malaysia. The particle size distribution (clay, silt and sand fraction) and organic matter content in sediment samples collected were also determined because these factors can play important roles in influencing the heavy metals concentration level in crabs.

The mean heavy metals concentration level (μg/g dry weight) in whole body of *U. annulipes* and *D. myctiroides* were found to range from 69.94 – 77.20, 45.81 – 104.93, 1.65 – 2.40 and 21.35 – 30.32 for Zn, Cu, Cd and Pb, respectively. The patterns of heavy metals distribution in both crab species of the different sampling stations were found to be {Cu > Zn} or {Zn > Cu} > Pb > Cd, where the highest were usually found for Zn and Cu which were not consistent in their order, and the lowest were found for Cd and Pb. This was explained due to the different function of

heavy metals in crabs such as for essential purpose, sequestration and even to be excreted. As for sediments, the mean heavy metals concentration level (µg/g dry weight) were found to range from 7.26 – 47.59, 1.51 – 15.19, 0.11 – 0.37 and 5.83 – 47.59 for Zn, Cu, Cd and Pb, respectively. The present levels of heavy metals in sediments of the different sampling stations were found to be low when compared to few sediment quality guideline and background level, indicating the relatively uncontaminated metal pollution conditions in which crabs inhabited.

A higher heavy metals concentration level was generally recorded in *U. annulipes* when compared to those of *D. myctiroides*. This difference was related to the particle size distribution and organic matter percentages (%) of the crab microhabitat sediment settings. Results showed that a significantly ($p < 0.05$) higher distribution of the fine particles (clay and silt) and organic matter content were found in sediments inhabited by *U. annulipes* when compared to those sediments inhabited by *D. myctiroides* which had significantly ($p < 0.05$) lower distribution. The fact that fine particles and organic matter of sediments have capability to bind heavy metals and crabs feed by scraping of surface sediments, hence the crabs potential to bioaccumulate heavy metals bonded onto fine particles and organic matter of sediments can assume to be higher for *U. annulipes* when compared to *D. myctiroides*. This therefore might explain the differences in heavy metals concentration level observed in *U. annulipes* and *D. myctiroides* which is much related to crabs preferences for different microhabitat sediment settings and daily crab activity of feeding. This ability of *U. annulipes* and *D. myctiroides* to bioaccumulate heavy metals from sediments may also be important in order to facilitate them as potential biomonitor organism for the monitoring of heavy metal pollution in the intertidal area of west Peninsular Malaysia.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

ARAS KEPEKATAN LOGAM BERAT DALAM KETAM FIDDLER (*UCA ANNULIPES*) DAN KETAM SOLDIER (*DOTILLA MYCTIROIDES*) DI KAWASAN PASANG SURUT PERSISIRAN PANTAI BARAT, SEMENANJUNG MALAYSIA

Oleh

MOHD IKRAM BIN MOHAMMAD

March 2010

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Fakulti : Sains

Kajian ini menyiasat aras kepekatan distribusi logam berat Zn, Cu, Cd and Pb dalam ketam *Uca annulipes* dan *Dotilla myctiroides* seiringan sampel sedimen yang dikumpulkan daripada kawasan pasang surut Selangor (5 kawasan) dan Negeri Sembilan (3 kawasan), persisiran pantai barat Semenanjung Malaysia. Distribusi saiz partikel (bahagian liat, kelodak dan pasir) dan kandungan bahan organik dalam sampel sedimen yang dikumpulkan itu turut juga diukur kerana faktor ini boleh memainkan peranan penting dalam mempengaruhi aras kepekatan logam berat dalam ketam.

Aras kepekatan (µg/g berat kering) purata logam berat dalam keseluruhan badan *U. annulipes* dan *D. Myctiroides* adalah berada dalam lingkungan 69.94 – 77.20, 45.81 – 104.93, 1.65 – 2.40 dan 21.35 – 30.32 untuk Zn, Cu, Cd dan Pb. Corak distribusi logam berat dalam kedua spesis ketam yang dikaji daripada setiap lokasi kajian didapati sebagai {Cu > Zn} or {Zn > Cu} > Pb > Cd, di mana Zn dan Cu adalah

tidak konsisten coraknya iaitu berubah-ubah serta mempunayi nilai kepekatan paling tinggi, manakala Cd dan Pb mempunyai nilai kepekatan rendah. Ini diterangkan melalui perbezaan fungsi logam berat di dalam ketam iaitu sama ada digunakan untuk tujuan kemandirian, diasingkan dan juga perlu disingkirkan. Bagi sedimen, aras kepekatan (µg/g berat kering) purata logam berat adalah berada dalam lingkungan 7.26 – 47.59, 1.51 – 15.19, 0.11 – 0.37 dan 5.83 – 47.59 untuk Zn, Cu, Cd dan Pb. Aras kepekatan logam berat dalam sedimen daripada setiap lokasi kajian didapti masih di tahap rendah berbanding dengan beberapa tahap garis panduan kualiti sedimen dan juga aras latar belakang logam berat tersedia ada, dan seterusnya menandakan tahap pencemaran logam berat dalam sedimen yang didiami ketam masih tidak tercemar.

Aras kepekatan logam berat secara umumnya direkodkan lebih tinggi dalam *U. annulipes* berbanding dalam *D. myctiroides*. Perbezaan ini dikaitkan dengan peratusan (%) distribusi saiz partikel dan kandungan bahan organik yang terdapat di dalam sedimen persekitaran mikro ketam. Keputusan kajian telah mendapati distribusi saiz partikel sedimen yang kecil (liat dan kelodak) serta kandungan bahan organik adalah paling tinggi dan signifikan ($p < 0.05$) nilai peratusannya dalam sedimen yang didiami oleh *U. annulipes* berbanding sedimen yang didiami *D. myctiroides* yang rendah dan signifikan ($p < 0.05$) distribusinya. Oleh kerana saiz partikel sedimen yang kecil dan bahan organik mempunyai keupayaan untuk mengikat logam berat serta tabiat ketam yang memakan secara mengambil cebisan permukaan sedimen, maka potensi untuk *U. annulipes* mengambil logam berat yang mengikat kepada saiz partikel sedimen yang kecil dan bahan organik boleh dianggap tinggi berbanding dengan *D. myctiroides*. Ini secara tidak langsung menerangkan perbezaan dalam aras kepekatan logam berat yang didapati dalam *U. annulipes* dan *D. myctiroides* yang sangat berkisar terhadap pemilihan sedimen oleh ketam dalam persekitaran mikro mereka, dan aktiviti seharian ketam iaitu memakan sedimen. Keupayaan *U. annulipes* dan *D. myctiroides* untuk memakan dan mengambil logam berat yang mengikat kepada sedimen juga penting dalam menentukankan potensi ketam sebagai agen penunjuk biologi bagi pencemaran logam berat di kawasan pasang surut persisiran pantai barat Semenanjung Malaysia.

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I certify that a Thesis Examination Committee has met on 4 March 2010 to conduct the final examination of Mohd Ikram Bin Mohammad on his thesis entitled "Heavy Metal Concentration Level in Fiddler Crab (*Uca annulipes*) and Soldier Crab (*Dotilla myctiroides*) in Intertidal Areas of the West Coast, Peninsular Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

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Date : 24 June 2010

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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Date : 15 July 2010

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Putra Malaysia or other institutions.

MOHD IKRAM BIN MOHAMMAD

Date : 27 May 2010

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LIST OF ABBREVIATIONS

µm	micrometre
mm	millimetre
cm	centimetre
m	metre
ml	millilitre
mg/L	milligram per litre
µg/L	microgram per litre
µg/g	microgram per gram
ppm	parts per million
M	molar volume
g	gram
%	percentage
°C	degree Celsius
$HClO_4$	perchloric acid
HCl	hydrochloric acid
HNO_3	nitric acid
H_3PO_4	phosphoric acid
H_2O_2	hydrogen peroxide
H_2O	water
Na_2CO_3	natrium carbonate
$NaOH$	natrium hydroxide
NH_4CH_3COO	ammonium acetate
$NH_2OH.HCl_2$	hydroxyl ammonium chloride