

DEDICATION

The work in this thesis is dedicated to my dearest parents

Mohamad Bin Mohd. Zin & Rafeah Binti Jusoh

and

my beloved husband

Awangku Shahrir Naquiddin Awang Subaili

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu
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**THE USE OF FISH PARASITES IN INDIAN MACKEREL (*Rastrelliger
kanagurta*) AND LONG TAIL TUNA (*Thunnus tonggol*) FROM COASTAL
TERENGGANU AS SENSITIVE INDICATORS OF HEAVY METALS
BIOACCUMULATION**

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Two systems of host-parasites were evaluated in order to examine the parasites as potential sensitive indicator of heavy metal bioaccumulation in ninety *Rastrelliger kanagurta*, Indian mackerel and nineteen *Thunnus tonggol*, long tail tuna from coastal Terengganu. The digenetic trematodes *Lecithocladium* sp. were collected from intestine and stomach of mackerel while the acanthocephalans *Echinorhynchus* sp. were collected in the liver of long tail tuna. All samples including muscle, intestine, liver and kidney of both fish collected were acid-digested followed by inductively coupled plasma mass spectrometry (ICP-MS) measurements in order to obtain the levels of Cr, Fe, Ni, Zn, Se, Pb, Al, Mn, Cd, Co, Cu, As and Hg in each sample. *Echinorhynchus* sp. recorded highest concentrations of six elements (Cr, Ni, Al, Zn, Pb and Mn) out

of 13 elements assessed compared to its host tissues. *Lecithocladium* sp. were found to be the highest only in Pb and Co compared to their host tissues. Bioconcentration factors were evaluated to observe the ability of parasites to absorb metals from fish organs. *Echinorhynchus* sp. recorded highest BCF values for Pb (392.13) in muscle of tuna whereas BCF values in *Lecithocladium* sp. was 10.47 (Cd). Then, Discrimination factors (DFs) values were calculated to allow one to know the affinity of parasites to accumulate one metal compared to the other metals. (DFs) values of *Echinorhynchus* sp. demonstrated high ability to accumulate Pb, Ni, Hg, Cr and Zn. *Lecithocladium* sp. showed that it can accumulate well Pb and Ni and possibly Cd as the average values of DF are greater than 1.0. Difference values between these parasites could be due to the characteristics of parasites, parasites development stage, location of parasite in host and the metal. Feeding habits of fish could be the factor that influence the differences on the concentrations of these elements. Overall, comparison of metal concentrations with maximum permissible limits of toxic metals in food indicated the values were well within safety levels. Ultimately, the present study has revealed *Echinorhynchus* sp. is potential as sentinel of metal bioaccumulation since *Echinorhynchus* sp. has high ability to accumulate Pb, Ni, Hg, Cr and Zn.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk ijazah Master Sains.

**PENGGUNAAN PARASIT IKAN DALAM KEMBONG (*Rastrelliger kanagurta*)
DAN TONGKOL (*Thunnus tonggol*) DARI PERAIRAN TERENGGANU
SEBAGAI INDIKATOR DARI BIOAKUMULASI LOGAM BERAT**

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Dua sistem perumah-parasit telah dinilai untuk mengkaji parasit sebagai potensi penunjuk sensitif bioakumulasi logam berat dalam 90 *Rastrelliger kanagurta* dan 19 *Thunnus tonggol* dari perairan Terengganu. Trematode digenea, *Lecithocladium* sp. (Yamaguti, 1953) telah dikumpulkan dari usus dan perut daripada kembong manakala Acanthocephala, *Echinorhynchus* sp. dikumpulkan dari dalam hati perumah mereka, tongkol. Kesemua sampel termasuk otot, usus, hati dan buah pinggang yang telah dikumpulkan dari kedua-dua ikan dihadamkan dengan asid diikuti pengukuran ICP-MS (*Inductively Coupled Plasma Mass Spectrometry*) untuk mendapatkan tahap kepekatan Cr, Fe, Ni, Zn, Se, Pb, Al, Mn, Cd, Co, Cu, As dan Hg bagi setiap sampel. *Echinorhynchus* sp. merekodkan kepekatan tertinggi bagi enam logam (Cr, Ni, Al, Zn, Pb and Mn) dari 13 logam yang dianalisa berbanding dengan tisu

perumahnya. *Lecithocladium* sp. didapati hanya tertinggi bagi logam Pb dan Co berbanding tisu perumahnya. Faktor Biopemekatan (BCFs) dinilai untuk melihat keupayaan parasit menyerap logam dari organ tempat mereka hidup. *Echinorhynchus* sp. direkodkan tertinggi nilai BCFs bagi Pb (392.13) dalam otot manakala nilai BCFs dalam *Lecithocladium* ialah 10.47 (Cd). Kemudian, faktor Diskriminasi (DFs) dikira untuk mengetahui kecenderungan parasit mengumpul sesuatu logam berbanding logam lain. Nilai DFs bagi *Echinorhynchus* sp. menunjukkan ia berkeupayaan tinggi untuk mengumpul kepekatan logam Pb, Ni, Hg, Cr dan Zn. Sebaliknya, *Lecithocladium* sp. menunjukkan bahawa ia boleh mengumpul dengan baik logam Pb, Ni dan Cd kerana nilai purata DF didapati lebih besar daripada 1.0. Perbezaan pengumpulan kepekatan logam antara parasit ini mungkin disebabkan oleh ciri-ciri tertentu parasit, tahap perkembangan parasit, logam, lokasi parasit dalam perumah, dan perumah. Cara pemakanan ikan mungkin antara faktor yang mempengaruhi perbezaan kepekatan logam antara ikan dalam kajian ini. Secara keseluruhannya, nilai logam dalam tisu ikan adalah dalam tahap selamat apabila dibandingkan dengan pengukuran had logam dalam makanan yang telah ditetapkan. Akhirnya, kajian ini telah mendedahkan *Echinorhynchus* sp. adalah berpotensi sebagai indikator logam kerana *Echinorhynchus* sp. mempunyai keupayaan yang tinggi untuk mengumpul Pb, Ni, Hg, Cr dan Zn.