

TOXICOLOGICAL RESPONSE CHARACTERISTICS OF TINFOIL
BARB (*Barbonymus schwanenfeldii*)
TOWARDS CADMIUM, LEAD AND ZINC

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Toxicological response characteristic of tin foil barb (*Barbonyx schwanenfeldii*) towards cadmium, lead and zinc / Noraifaa Abdullah Sani.

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(*Barbonymus schwanenfeldii*) TOWARDS CADMIUM, LEAD AND ZINC**

NORAIFAA ABDULLAH SANI

**Thesis submitted in fulfillment of the requirement for the
Degree of Master of Science in the Institute of Oceanography**

**UNIVERSITI MALAYSIA TERENGGANU
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DEDICATION

This thesis is dedicated to both my parents, siblings, colleagues and friends who had faith in me and without complaining the hours spent for the project

Parents and family,

My mentors and my biggest fans,

Who's guided me the best they can

Lent me a patient ear and also helped to dry my tears

Abstract of thesis presented to the Senate Universiti Malaysia Terengganu in fulfillment of the requirement for the degree of Master of Science

**TOXICOLOGICAL RESPONSE CHARACTERISTICS OF TINFOIL BARB
(*Barbonymus schwanefeldii*) TOWARDS CADMIUM, LEAD AND ZINC**

By

NORAIFAA ABDULLAH SANI

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Members : Associate Professor Dr. Mohd Effendy Abdul Wahid
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Faculty : Institute of Oceanography

The toxicological response of tinfoil barb, *Barbonymus schwanefeldii* towards cadmium, lead and zinc were determined in acute 96 hr of LC₅₀ tests and in sublethal exposure tests at 0.10, 0.25 and 0.5 of the 96 hr LC₅₀ values for 21 days duration. Both acute and sublethal tests were conducted using a continuous flow system and data on blood parameters, amount of metals accumulated and histopathological effects were studied in fish sampled each week, for three weeks. The 96 hr LC₅₀ values were 0.63 mg Cd/L, 1.52 mg Zn/L and 28.0 mg Pb/L. After exposure to heavy metals, the juveniles of *B. schwanefeldii* showed rapid movement, loss of equilibrium in water and showed sideways movement during swimming. Hemorrhage in the eyes and gills were observed when exposure to 0.76 mg Zn/L, 0.063 mg Cd/L, 0.158 mg Cd/L and 0.315 mg Cd/L while eventual spinal curvatures were notice after exposure to all lead concentration. The general bioaccumulation order of heavy metals from the sublethal exposure experiments at concentrations of 10%, 25% and 50 % values of the 96 hr LC₅₀ for 21 days duration

was Cd < Pb < Zn. In general, the results showed that the amount of metals bioaccumulated in whole body increased as the concentration of metal exposure and exposure duration increased. Through scanning electron microscopy (SEM) and light microscopic studies, the control gill presented developed secondary lamellae with the microridges observed to cover the primary and secondary lamella epithelial cells. Large numbers of chloride cells were located in the primary lamella mainly on the afferent region while the secondary lamella projected a smooth surface. The summary of severity scores of heavy metals exposure effects on gill were in the order of Cd (5.38) > Pb (5.09) > Zn (4.57). Following the exposure, the histopathological examination was carried out on the primary lamella (PL) and secondary lamella (SL) in response towards different concentrations of Cd, Pb and Zn. The gill exhibited rapid alterations that include sloughing off of the epithelium mucosa of PL and SL, extensive hemorrhage and lead to extensive hyperplasia of the PL and SL. The normal hematology baseline values for tinfoil barb juvenile was documented with the leukocyte percentage composition in order of lymphocyte > trombocyte > neutrophil > eosinophil > basophil. Finally, significant findings ($P < 0.05$) were observed after day 7 in fish exposed to 50% of the 96 hr of LC_{50} value of zinc (0.76 mg/L), 25% of the 96 hr LC_{50} value of Cd (0.158 mg/L) and 10% of the 96 hr LC_{50} value of Pb (2.8 mg/L). Intense lymphocytopenia and neutrophilia were also observed which was accompanied by the distortion of RBC morphology such as anisocytosis (erythrocyte size variation), poikilocytosis (shape variation) and also dividing erythrocytes. The changes in the RBC numbers suggested a compulsory response to respiratory surface reduction of gills (tissue damage and cell proliferation) in order to maintain oxygen transfer from water to the tissue. In conclusion, the toxicology

response towards heavy metals exposure on *B. schwanenfeldii* is significantly presented through histopathology and hematology examination.

CIRI-TINDAK BALAS TOKSIKOLOGI KE ATAS IKAN LAMPAK
STINGGAI (*Burhanipoma schwanenfeldii*) TERHADAP KADMIUM, PLOMBUM
DAN ZINK

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Kajian dilakukan keatas tindakbalas toksikologi *Burhanipoma schwanenfeldii* terhadap kadmium, plumbum dan zink melalui ujian ketoksikan akut 96 jam LC50 dan ujian dos-dosis sub-akut pada 0.1, 0.25 dan 0.5 daripada 96 jam LC50. Kadar-dosis ujian akut dan sub-akut ini ditandakan menggunakan sistem pengaliran berturutan dan data mengenai peredaran darah, jumlah sel-sel berakut terlampau dan faedah histopatologi terhadap ikan rujuk dengan ujian kawalan selama 21 hari. Nilai akut 96 jam LC50 bagi kadmium (0.63 mg/L), zink (1.62 mg/L) dan plumbum (28.0 mg/L). Selepas ditandakan kepada ujian akut, jantan *B. schwanenfeldii* menunjukkan purgeman, lelu, menguning dan hilang kesuburan. Ujian sub-akut menunjukkan pada masa dan faedah: masa kesuburan apabila ikan tersebut ditandakan kepada 0.16 mg Zn/L, 0.003 mg Cd/L, 0.138 mg Pb/L dan 0.015 mg Cd/L. Selaku itu, faedah faedah yang ditunjukkan adalah pemangkakan jumlah sel-sel apabila ditandakan kepada semua kadmium, plumbum. Secara umum,

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

CIRI - CIRI TINDAKBALAS TOKSIKOLOGI KE ATAS IKAN LAMPAM SUNGAI (*Barbonymus schwanenfeldii*) TERHADAP KADMIUM, PLUMBUM DAN ZINK

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Kajian dilakukan keatas tindakbalas toksikologi *Barbonymus schwanenfeldii* terhadap kadmium, plumbum dan zink melalui ujian ketoksikan akut 96 jam LC₅₀ dan ujian dedahan sub-maut pada 0.1, 0.25 dan 0.5 daripada 96 jam LC₅₀. Kedua-dua ujian akut dan sub-maut ini dijalankan menggunakan sistem pengaliran berterusan dan data melalui parameter darah, jumlah logam berat terkumpul dan kesan histopatologi terhadap ikan yang dikaji setiap minggu selama 21 hari. Nilai akut 96 jam LC₅₀ bagi kadmium (0.63 mg/L), zink (1.52 mg/L) dan plumbum (28.0 mg/L). Selepas didedahkan kepada logam berat, juvenil *B. schwanenfeldii* menunjukkan pergerakan laju, mengiring dan hilang keseimbangan dalam air. Pendarahan pada mata dan insang turut diperhatikan apabila ikan tersebut didedahkan kepada 0.76 mg Zn/L, 0.063 mg Cd/L, 0.158 mg Cd/L dan 0.315 mg Cd/L. Selain itu, kesan terakhir yang diperhatikan adalah pembengkokkan tulang spinal apabila didedahkan kepada semua kepekatan plumbum. Secara amnya,

turunan nilai logam berat yang diakumulasi dalam ujian dedahan sub-maut pada 10%, 25% dan 50% daripada nilai 96 jam LC₅₀ untuk jangkamasa 21 hari adalah Cd < Pb < Zn. Secara keseluruhannya, keputusan menunjukkan jumlah logam berat terkumpul dalam keseluruhan badan meningkat sejajar dengan peningkatan kepekatan dan masa dedahan. Melalui kajian Mikroskopi Imbasan Elektron (SEM) dan mikroskopi cahaya, insang pada ikan kawalan menunjukkan pembentukan sempurna mikrorabung pada lamela sekunder daripada apik ke dasar. Mikrorabung kelihatan jelas meliputi permukaan sel epitelia lamela primer dan sekunder. Jumlah sel klorid yang banyak diperhatikan pada lamela utama terutama di kawasan aferon, sementara lamela sekunder memaparkan permukaan yang licin. Ringkasan keputusan kemudahan terhadap kesan dedahan logam berat ke atas insang mengikut turutan ialah Cd (5.38) > Pb (5.09) > Zn (4.57). Berdasarkan kepada kesan dedahan tersebut, pemeriksaan histopatologi dijalankan ke atas lamela primer (PL) dan lamela sekunder (SL) dalam menentukan perbezaan tindakbalas terhadap kepekatan Cd, Pb, Zn. Insang menunjukkan perubahan ketara iaitu pengelupasan epitelium mukosa dan pendarahan akut yang menjurus kepada hiperplasia ekstensif di PL dan SL. Nilai hematologi normal bagi lampam sungai telah didokumenkan dengan menggunakan komposisi peratusan leukosit didalam turutan limfosit > trombosit > neutrofil > eosinofil > basofil. Nilai signifikan didapati selepas 7 hari ikan didedahkan kepada 50% Zn (0.76mg/L), 25% Cd (0.158mg/L) dan 10% Pb (2.8mg/L) daripada 96 jam LC₅₀. Limfositopenia dan neutrofilia juga turut diperhatikan disamping perubahan morfologi sel darah merah seperti anisositis (variasi saiz), poikilositosis (variasi bentuk) dan eritrosit terbahagi. Perubahan bilangan sel darah merah disebabkan oleh kesan terhadap pengurangan permukaan insang sekunder (kerosakan tisu dan pembahagian sel)

dalam mengekalkan pemindahan oksigen dari air ke tisu. Kesimpulan kajian ini menunjukkan kesan toksikologi terhadap pendedahan logam berat ke atas *B. schwanefeldii* dapat dilihat secara signifikan melalui pemeriksaan hitopatologi dan ujian hematologi.