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**MASTER OF SCIENCE**

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**PATHOLOGICAL ASSESSMENT OF  
CLIMBING PERCH, *Anabas testudineus*  
EXPOSED TO 1,1-DIMETHYL-4,4-  
BIPYRIDINIUM DICHLORIDE  
(PARAQUAT)**

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**NOR AZRI SHAH BIN NORHAN**

**Thesis Submitted in Fulfilment of the Requirement for the  
Degree of Master of Science in the Institute of Tropical Aquaculture  
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## **DEDICATION**

This thesis is dedicated to my family members; for their endless prayers, encouragement and support until today. To my supervisors; for their endless patience, guidance, time and expertise, thank you for taking me under your wing. To my friends; without them my study would not fill with cherish moments. Lastly, don't be know-it-all, be a learn-it-all.

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

## **ABSTRACT**

### **PATHOLOGICAL ASSESSMENT OF CLIMBING PERCH, *Anabas testudineus* EXPOSED TO 1,1-DIMETHYL-4,4-BIPYRIDINIUM DICHLORIDE (PARAQUAT)**

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**Institute : Institute of Tropical Aquaculture**

Paraquat is one of the most widely used herbicide in agricultural activities. Uncontrolled usage will lead to chemical runoff that runs directly into aquatic ecosystem. The toxicant exposure is a common situation which has considerable impact on the aquatic organism, namely fish. This study provides significant evidences that paraquat does negatively impacted *Anabas testudineus* health status. The research focuses on four different biomarkers; fish behavioural changes, haematological parameters evaluation, histopathological assessment and paraquat residual in fish muscle. The 96h median lethal concentration (96hLC<sub>50</sub>) of paraquat was 16.81 mgL<sup>-1</sup>. The effects of sub lethal concentrations of paraquat on behaviour, haematology and tissues were subsequently study by exposing fish to 2, 5, 12 and 15 mgL<sup>-1</sup> paraquat. In behavioural study, exposed fish exhibited significant changes (P<0.05) in frequent surface to bottom

movement, erratic swimming, opercula movement, air gulping, excessive mucous secretion, sluggish and swirling movement compared to control. The erythrocyte indices (total erythrocyte count, haematocrit, haemoglobin, mean corpuscular value and mean corpuscular haemoglobin) and leukocyte indices (total leukocyte count) were determined in paraquat exposed fish. The total erythrocyte count, haematocrit, haemoglobin and total leukocyte count were significantly different ( $P < 0.05$ ) from controls. However, mean corpuscular value and mean corpuscular haemoglobin was not significantly different ( $P \geq 0.05$ ). In histopathological study, gill, liver and kidney tissue changes were analysed. Paraquat exposure induced lamellar epithelial lifting, lamellar epithelial hyperplasia, lamellar fusion and oedema in *A. testudineus* gill. As for liver and kidney, histological alterations such as hydropic degeneration in hepatocyte and renal tubular epithelial cells were observed in exposed fish. A lesion score analysis indicated that severity of tissue alterations was progressively developed towards higher concentration. Residue study showed paraquat was not retained in *A. testudineus* muscle within a short term exposure. Considering there were significant changes in *A. testudineus* behaviours, haematological indices and tissue alterations, short term paraquat exposure does promotes adverse effect on *A. testudineus* health status. Therefore, it is advisable that paraquat usage in field must be monitored and documented due to their toxicity affects.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai syarat memenuhi keperluan Ijazah Master Sains

## **ABSTRAK**

### **PENILIAN PATOLOGI TERHADAP IKAN PUYU, *Anabas testudineus* YANG DIDEHAHKAN DENGAN 1,1-DIMETHYL-4,4-BIPYRIDINIUM DICHLORIDE (PARAQUAT)**

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Paraquat adalah salah satu racun rumpai yang digunakan secara meluas dalam aktiviti pertanian. Penggunaan yang tidak terkawal akan menyebabkan lebihan racun rumpai tersebut menyusup masuk ke dalam ekosistem akuatik. Pendedahan bahan toksik ini merupakan situasi yang biasa di mana boleh memberi kesan yang besar kepada organisma akuatik, terutamanya ikan. Kajian ini memberi bukti yang signifikan bahawa pendedahan paraquat memang memberi kesan yang negatif terhadap status kesihatan *Anabas testudineus*. Kajian ini berfokus kepada empat jenis penanda bio; perubahan perilaku ikan, penilaian parameter hematologi, penilaian histopatologi dan sisa paraquat dalam isi ikan. Nilai 96h median dos maut (96hLC<sub>50</sub>) bagi paraquat adalah 16.81 mgL<sup>-1</sup>. Kesan separa dos maut paraquat terhadap perilaku ikan, hematologi dan tisu telah kemudiannya dikaji dengan mendedahkan ikan pada paraquat yang

berkepekatan 2, 5, 12 dan 15 mgL<sup>-1</sup>. Dalam kajian perubahan perilaku ikan, ikan yang terdedah menunjukkan perubahan yang signifikan ( $P < 0.05$ ) dari segi kekerapan pergerakan dari permukaan ke dasar air, renangan yang tidak menentu, pergerakan operkulum, pernafasan di permukaan udara, rembesan mukus yang berlebihan, pergerakan yang lembap dan berpusing berbanding dengan kawalan. Indeks sel darah merah (jumlah kiraan sel darah merah, hematokrit, hemoglobin, min nilai korpuskel dan min korpuskel hemoglobin) dan indeks sel darah putih (jumlah kiraan sel darah putih) telah ditentukan oleh ikan yang terdedah dengan paraquat. Jumlah kiraan sel darah merah, hematokrit, hemoglobin dan jumlah kiraan sel darah putih menunjukkan perbezaan yang signifikan ( $P < 0.05$ ) berbanding kawalan. Walau bagaimanapun, min nilai korpuskel dan min korpuskel hemoglobin tiada signifikansi ( $P \geq 0.05$ ). Dalam kajian histopatologi, perubahan tisu insang, hati dan buah pinggang telah dianalisa. Pendedahan paraquat telah menyebabkan *lamellar epithelial lifting*, *lamellar epithelial hyperplasia*, *lamellar fusion* dan *oedema* pada insang *A. testudineus* tersebut. Pada tisu hati dan buah pinggang, perubahan histologi seperti *hydropic degeneration* di tisu hepatik dan *renal tubular epithelial cells* telah diperhatikan pada ikan yang terdedah. Analisa pemarkahan luka menunjukkan keterukan perubahan tisu berkembang secara progresif ke arah kepekatan yang tinggi. Kajian residu menunjukkan paraquat tidak boleh tersimpan dalam isi *A. testudineus* dalam pendedahan jangka masa pendek. Memandangkan adanya perubahan yang signifikan terhadap perilaku ikan, indeks hematologi dan perubahan tisu *A. testudineus*, pendedahan paraquat jangka masa pendek telah menggalakkan kesan yang buruk kepada status kesihatan *A.*



*testudineus*. Oleh yang demikian, disarankan agar penggunaan paraquat di lapangan mestilah dipantau dan didokumenkan disebabkan oleh kesan ketoksikannya.