NOR JUNETA BINTI ABU SEMAN

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SYNERGIES BETWEEN MOULTING CYCLES, CANNIBALISM, AND BIOCHEMICAL COMPOUND CUES RELEASED BY GIANT FRESHWATER PRAWN, *Macrobrachium rosenbergii* (de Man, 1879) DURING ECDYSIS

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Thesis Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy in the Institute of Tropical Aquaculture and Fisheries Research Universiti Malaysia Terengganu

2019

Dedicated this thesis to:

My family (husband – Mohd. Hisham Mustaffa b. Anua & daughter– Adriana Shafiqa), my beloved parent (Abu Seman b. Abdullah & Junaidah bt. Yusoff) and parent in-law (late Anua b. Rusdi & Hamidah bt. Abd Hamid) for all their dedication, sacrifice and endless love,

and

for my late supervisor, Associate Professor Dr. Safiah bt. Jasmani, (1962-2017) who never got to read this thesis. You are the determination in every page…

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu in fulfilment of the requirement for the Degree of Doctor of Philosophy

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Main Supervisor : **Professor Mhd Ikhwanuddin Abdullah, Ph.D**
Co–supervisors : **Noordiyana bt. Mat Noordin, Ph.D**
: **In memory of Associate Professor Safiah bt. Jasmani, Ph.D**
Institute : **Institute of Tropical Aquaculture and Fisheries Research (AKUATROP)**

Ecdysis is a common phenomenon that happen throughout the life phase of giant fresh water prawn, *Macrobrachium rosenbergii*. During ecdysis, biochemical compound fluctuates and produces a variety of chemical cues that indirectly promotes cannibalism. This study characterized the ecdysis or moulting stages based on setagenesis and determined the complete moulting duration of *M. rosenbergii*. The level of glucose, lipid, and protein within the haemolymph at various moulting stages were measured using phenol-sulfuric acids, sulfo-phospho-vanillin following Bradford's method respectively, while amino acids (total amino acid and free amino acid) levels in tissue muscle, exoskeleton and sample water of culture medium from moulting (Stage E) and non-moulting (Stage C) were investigated using HPLC analysis. The results showed that mean duration day to complete one moulting cycles was 33.27 ± 0.22 days, with no significant difference (two-sample t-test) between male and female individuals. The results from this study supported the hypothesis that cannibalism mortality rate are affected by moulting stages. Maximal level of glucose, lipid, and protein were 1.08 ± 0.04 mg mL^{-1}, 5.76 ± 0.33 mg mL^{-1} and 113.67 ± 3.92 mg mL^{-1}, respectively, during pre-moult stages while minimal levels of glucose, lipid and protein at 0.23 ± 0.02 mg mL^{-1}, 1.04 ± 0.04 mg mL^{-1} and

35.43 ± 2.41 mg mL^{-1} were observed during post-moulting stages. Significant differences (one-way ANOVA, $P < 0.05$) were found between the glucose, lipid and protein levels within haemolymph with respect to the moult cycle stages of *M. rosenbergii*. Comparison study between moulting and non-moulting prawn revealed that among the total amino acid compounds, proline and sarcosine of tissues from moulting prawn,were found at the highest levels of 17.39 ± 0.67 mg 100 g^{-1} and 8.64 ± 0.68 mg 100 g^{-1}, respectively. Meanwhile, the level of free amino acid from water that contain moulting prawns (Stage E) were dominated by tryptophan and proline with values of 9.57 ± 0.53 mg 100 mL^{-1} and 9.54 ± 0.25 mg 100 mL^{-1}, respectively. In conclusion, significant values obtained in the present study showed that these amino acids compounds act as a chemical cue to promote cannibalism in *M. rosenbergii* during ecdysis.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

SINERGI DIANTARA KITARAN BERSALIN KULIT, KANIBALISMA, DAN PETUNJUK SEBATIAN BIOKIMIA YANG DIREMBESKAN OLEH UDANG GALAH, *Macrobrachium rosenbergii* (de Man, 1879) SEMASA EKDISIS

NOR JUNETA BINTI ABU SEMAN

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Ekdisis adalah fenomena biasa yang berlaku sepanjang fasa hidup udang galah, *Macrobrachium rosenbergii.* Semasa ekdisis, perubahan tahap sebatian biokimia mengalami naik turun dan menghasilkan pelbagai petunjuk kimia yang secara tidak langsung menyebabkan kanibalisma. Kajian ini mencirikan ekdisis atau peringkat penyalinan kulit berdasarkan setagenesis dan juga menentukan tempoh lengkap bagi proses penyalinan kulit *M. Rosenbergii.* Tahap glukosa, lipid, dan protein dalam darah di pelbagai peringkat bersalin kulit diukur menggunakan kaedah asid fenol-sulfur, sulfon-phospho-vanilin dan bradford, sementara asid amino (jumlah asid amino dan asid amino bebas) dalam otot tisu, kulit dan sampel kultur air daripada udang yang bersalin kulit (Peringkat E) dan tidak bersalin kulit (Peringkat C) telah dikaji dengan menggunakan analisa HPLC. Keputusan menunjukkan purata jangka masa yang diambil untuk melengkapkan satu kitaran bersalin kulit adalah 33.27 ± 0.22 hari, tetapi tiada perbezaan yang ketara (ujian-t dua-sampel) di antara individu jantan dan betina. Keputusan kajian ini menyokong hipotesis yang menyatakan kadar kematian yang disebabkan oleh kanibalisma adalah dipengaruhi oleh peringkat bersalin kulit. Tahap maksimal glukosa, lipid, dan protein adalah 1.08 ± 0.04 mg mL^{-1}, 5.76 ± 0.33 mg mL^{-1} dan 113.67 ± 3.92 mg mL^{-1}, semasa peringkat prasalin kulit manakala paras minimum glukosa, lipid dan protein pada 0.23 ± 0.02 mg mL^{-1},

1.04 ± 0.04 mg mL^{-1} dan 35.43 ± 2.41 mg mL^{-1} diperhatikan semasa peringkat selepas bersalin kulit. Perbezaan yang ketara ($P < 0.05$) adalah didapati antara paras glukosa, lipid dan protein dalam darah untuk setiap peringkat kitaran bersalin kulit *M. rosenbergii*. Kajian perbandingan antara udang yang bersalin kulit dan udang yang tidak bersalin kulit mendedahkan bahawa jumlah sebatian asid amino, prolina dan sarkosina adalah pada tahap tertinggi bagi tisu udang yang bersalin kulit, iaitu 17.39 ± 0.67 mg 100 g^{-1} dan 8.64 ± 0.68 mg 100 g^{-1}. Sementara itu, tahap asid amino bebas daripada air yang mengandungi udang yang telah bersalin kulit (Peringkat E) adalah didominasikan oleh triptofan dan prolina pada 9.57 ± 0.53 mg 100 mL^{-1} dan 9.54 ± 0.25 mg 100 mL^{-1}. Kesimpulannya, perbezaan nilai yang diperolehi dalam kajian ini menunjukkan bahawa sebatian asid amino ini bertindak sebagai petunjuk kimia yang mempengaruhi kanibalisma pada *M. rosenbergii* semasa ekdisis.