

**FEED NUTRITIONAL VALUE OF ENRICHED CYCLOPOID
COPEPODS (*Oithona* sp.) AS A POTENTIAL LIVE FEED IN
LARVAL REARING OF THE MUD CRAB (*Scylla olivacea*)**

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**Thesis Submitted in Fulfilment of the Requirements for the
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DEDICATION

I dedicate this thesis to:

My supervisor, Ts. Wan Nurul Nadiah Wan Rasdi, Ph.D., and co-supervisor, Prof.

Mhd. Ikhwanuddin @ Polity bin Abdullah, Ph.D.

My family and my friends for their dedication, sacrifice, and endless love.

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THE MUD CRAB (*Scylla olivacea*)**

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Faculty : Faculty of Fisheries and Food Science

The copepod *Oithona* sp. can be used as a natural feed in rearing larvae of the mud crab *Scylla olivacea*. However, copepod is not readily obtainable due to their characteristics as seasonal zooplankton, causing limitation of using copepods. Different dietary additives for *Oithona* sp. such as swiftlet waste, soybean meal, rice bran, and *Nannochloropsis* sp. were compared. The objectives of this study were to analyse the growth and productivity (hatching time, hatching rate, generation time, lifespan, spawning and, offspring production) of *Oithona* sp. in different dietary enrichment, to compare the protein, lipid and fatty acid analysis of enriched *Oithona* sp., unenriched with *Artemia*, and to evaluate the nutrient transfer of enriched *Oithona* sp. in improving the growth development and survival of early-stage mud crab (*Scylla olivacea*). The effects of different feeding regimes on the survival and development of *S. olivacea* larvae were studied in two phases of the crab larval development: Phase 1 (zoea 1 to zoea 2 stage) and Phase 2 (zoea 5 to megalopa stage). The feeding regimes were T1: *Oithona* sp. enriched with rice bran, T2: *Oithona* sp. enriched with *Nannochloropsis* sp., T3: *Oithona* sp. enriched with a mixture of rice bran and *Nannochloropsis* sp., and T4: *Artemia*. The results showed

that rice bran and *Nannochloropsis* sp. additives produced the best outcomes in terms of specific growth rate ($0.109 \pm 0.002 \text{ day}^{-1}$ and $0.104 \pm 0.001 \text{ day}^{-1}$) of *Oithona* sp., protein content ($66.83 \pm 2.25\%$ and $72.08 \pm 2.02\%$), and lipid content ($21.98 \pm 1.41\%$ and $18.09 \pm 1.18\%$) respectively. A mixture of rice bran and *Nannochloropsis* sp. (41.62%) as dietary additives also improved the polyunsaturated fatty acids (PUFAs) content of *Oithona* sp. as compared with mono diet applied such as rice bran (28.16%) and *Nannochloropsis* sp. (31.35%). The average survival rate of *S. olivacea* from zoea 1 until megalopa shows that, T3 ($20.20 \pm 1.97\%$) was higher than T1 ($13.87 \pm 0.90\%$), T2 ($12.47 \pm 1.14\%$) or T4 ($3.13 \pm 1.29\%$). In conclusion, improving the survival rate of crab larvae in commercial hatcheries by using precise early-stage foods is fundamental to enhance seed production technology of mud crabs.

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**NILAI NUTRISI MAKANAN BAGI KOPEPOD CYCLOPOID YANG
DIPERKAYA (*Oithona* sp.) SEBAGAI MAKANAN HIDUP YANG
BERPOTENSI DALAM PENTERNAKAN KETAM NIPAH (*Scylla olivacea*).**

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Kopepod *Oithona* sp. boleh digunakan sebagai makanan semulajadi untuk penternakan larva ketam bakau *Scylla olivacea*. Walau bagaimanapun, kopepod tidak senantiasa boleh didapati kerana ciri-cirinya sebagai zooplankton bermusim. Makanan tambahan yang berbeza untuk *Oithona* sp. seperti najis burung walit, makanan kacang soya, dedak padi dan *Nannochloropsis* sp. telah dibandingkan. Objektif kajian ini adalah untuk menganalisis pertumbuhan dan produktiviti (masa penetasan, kadar penetasan, tempoh generasi, jangka hayat, penghasilan telur dan anak) *Oithona* sp. di dalam pengkayaan yang berbeza, untuk membandingkan kadar analisis protein, lipid dan asid lemak *Oithona* sp. yang diperkaya dengan yang tidak diperkaya dan *Artemia*, dan untuk menilai pemindahan nutrisi *Oithona* sp. yang diperkaya dalam meningkatkan kadar pertumbuhan dan kemandirian peringkat awal ketam bakau (*Scylla olivacea*). Kesan perbezaan rejim pemakanan terhadap kemandirian dan perkembangan larva *S. olivacea* dikaji di dalam dua fasa kajian perkembangan larva ketam: Fasa 1 (zoea 1 sehingga zoea 2) dan Fasa 2 (zoea 5 sehingga megalopa). Rejim pemakanan adalah T1: *Oithona* sp. yang diperkaya dengan dedak padi, T2: *Oithona* sp. yang diperkaya dengan *Nannochloropsis* sp., T3:

Oithona sp. yang diperkaya dengan campuran dedak padi dan *Nannochloropsis* sp. dan T4: *Artemia*. Keputusan menunjukkan makanan tambahan seperti dedak padi dan *Nannochloropsis* sp. menghasilkan dapatan kajian yang terbaik terhadap kadar tumbesaran spesifik (0.109 ± 0.002 hari⁻¹ dan 0.104 ± 0.001 hari⁻¹) *Oithona* sp., nilai protein ($66.83 \pm 2.25\%$ dan $72.08 \pm 2.02\%$) dan nilai lipid ($21.98 \pm 1.41\%$ dan $18.09 \pm 1.18\%$). Campuran dedak padi dan *Nannochloropsis* sp. (41.62%) sebagai makanan tambahan telah meningkatkan kadar asid lemak politaktepu (PUFAs) di dalam *Oithona* sp. berbanding dengan penggunaan makanan secara mono sahaja seperti dedak padi (28.16%) dan *Nannochloropsis* sp. (31.35%). Purata kadar kemandirian *S. olivacea* daripada zoea 1 sehingga megalopa menunjukkan, T3 ($20.20 \pm 1.97\%$) adalah lebih tinggi berbanding dengan T1 ($13.87 \pm 0.90\%$), T2 ($12.47 \pm 1.14\%$) dan T4 ($3.13 \pm 1.29\%$). Kesimpulannya, peningkatan kadar kemandirian larva ketam secara komersial di hatceri dengan menggunakan makanan yang betul di awal pertumbuhan adalah merupakan asas utama yang penting untuk meningkatkan teknologi penghasilan benih ketam bakau.