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MASTER OF SCIENCE

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**THE EFFICACY OF MARINE MICROALGAE
WITH HIGH ANTIOXIDANT ACTIVITY ON
GROWTH, SURVIVAL AND OXIDATIVE
STRESS OF *Litopenaeus vannamei* POSTLARVAE**

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ANTIOXIDANT ACTIVITY ON GROWTH, SURVIVAL AND OXIDATIVE
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NORAZIRA ABDU RAHMAN

**Thesis Submitted in Fulfillment of the Requirement for the Degree of
Master of Science in the School of Fisheries and Aquaculture Sciences
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2016

DEDICATION

To my parents: Abdu Rahman Talib and Asnaiyah Khamis
to my brothers and sister.

Abstract of the thesis presented to the senate of University Malaysia Terengganu in fulfillment of the requirement for the degree of Master of Science

THE EFFICACY OF MARINE MICROALGAE WITH HIGH ANTIOXIDANT ACTIVITY ON GROWTH, SURVIVAL AND OXIDATIVE STRESS OF *Litopenaeus vannamei* POSTLARVAE

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Main supervisor : Helena Khatoon, PhD

Co-supervisor : Norhayati Yusuf, PhD

Institute : School of Fisheries and Aquaculture Sciences

The efficacy of high antioxidant microalgae on oxidative stress biomarkers were examined in *Litopenaeus vannamei* postlarvae. The selection of microalgae with high antioxidant activity in three species of marine microalgae, *Tetraselmis chuii*, *Nannochloropsis maculate* and *Chaetoceros calcitrans* was carried out by a screening test using five antioxidant chemical assays (Antioxidant activity, scavenging effect on superoxide radical and DPPH radical, ferric reducing antioxidant potential (FRAP) and total phenolic content). Highest antioxidant activity, free radical scavenging activities and total phenolic content was found in *T. chuii*. The *T. chuii* with high antioxidant activity was further evaluated for its effect on survival, growth parameters and oxidative stress biomarkers of the *L. vannamei* postlarvae (PLs). The experimental diets were supplemented at 25% (T25), 50% (T50), 75% (T75) and 100% (T100) of *T. chuii* and were performed with PLs for 12

days in triplicates for each treatment. Commercial shrimp feed without *T. chuii* served as control. All data obtained were analyzed using one way analysis of variance (ANOVA).

Shrimp reared on diets supplemented with 50% and above of *T. chuii* showed significantly higher survival (75.4% - 97.6%) than those without *T. chuii* ($48.8 \pm 0.8\%$). In addition, tanks with the inclusion of 50% *T. chuii* had lower mean TAN ($0.339 \pm 0.06 \text{ mg L}^{-1}$) compared to tanks with control ($1.426 \pm 0.01 \text{ mg L}^{-1}$). Similarly, $\text{NO}_2\text{-N}$ ($0.004 \pm 0.00 \text{ mg L}^{-1}$) and $\text{PO}_4\text{-P}$ ($0.658 \pm 0.02 \text{ mg L}^{-1}$) concentrations were significantly ($p < 0.05$) lower in the shrimp culture tanks fed with T50 than the control ($0.018 \pm 0.00 \text{ mg L}^{-1}$ and $0.097 \pm 0.05 \text{ mg L}^{-1}$ respectively).

Lower hydrogen peroxide content and electrolyte leakage was also found in PLs raised on diets supplemented with 50% - 100% *T. chuii*. In addition, the shrimp PLs also showed high resistance to reverse salinity stress test (76.7% - 100 %) compared to control (43.3%) and T25 (50.0%). However, no changes were found in the growth and lipid peroxidation of PLs fed with inclusion of *T. chuii* into the feed. Due to the nutritional and antioxidant activity properties of *T. chuii* and the positive effect on oxidative stress status, survival and water quality, the feeding of *L. vannamei* PLs with the diet containing at least 50% (T50) is recommended as natural source of antioxidant for PLs.

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

KEBERKESANAN MIKROALGA MARIN DENGAN AKTIVITI ANTIOKSIDAN TINGGI TERHADAP TUMBESARAN, KEMANDIRIAN DAN TEGASAN OKSIDATIF PASCALARVA *Litopenaeus vannamei*

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Keberkesanan mikroalga yang mempunyai kandungan aktiviti antioksidan yang tinggi dikaji pada pascalarva *Litopenaeus vannamei*. Pemilihan mikroalga yang mempunyai kandungan aktiviti antioksian yang tinggi dibuat antara tiga spesies mikroalga marin, *Tetraselmis chunii*, *Nannochloropsis maculate* and *Chaetoceros calcitrans* dibuat menggunakan ujian saringan yang melibatkan aktiviti antioksidan, kesan pemerangkapan radikal superoksida dan DPPH, potensi antioksidan melalui pengurangan ion ferik dan jumlah kandungan fenolik. *T. chunii* didapati mempunyai aktiviti antioksidan, kesan pemerangkapan terhadap radikal dan potensi antioksidan melalui pengurangan ion ferik yang tertinggi berbanding spesies lain yang dikaji.

Keberkesanan *T. chunii* dengan aktiviti antioksidan yang tinggi kemudiannya dikaji terhadap tumbesaran, kadar kemandirian dan penanda bio tegasan oksidatif

pascalarva *L. vannamei*. Makanan udang yang telah ditambah dengan 25% (T25), 50% (T50), 75% (T75), 100% (T100) *T. chuii* diberi makan kepada PLs selama 12 hari dalam jumlah tiga replikasi bagi setiap rawatan. Makanan udang komersial tanpa *T. chuii* digunakan sebagai kawalan, kesemua data yang diperolehi adalah dianalisis menggunakan analisis varians satu-hala (ANOVA). Udang yang dipelihara dengan diet yang disertakan dengan 50% atau lebih *T. chuii* menunjukkan kadar kemandirian yang tinggi (75.4% - 97.6%) berbanding udang tanpa sebarang tambahan *T. chuii* (37%). Tambahan pula, tangki udang yang diberi makan dengan penambahan 50% *T. chuii* juga mempunyai nilai min yang rendah bagi TAN ($0.339 \pm 0.06 \text{ mg L}^{-1}$) berbanding tangki kawalan ($1.426 \pm 0.01 \text{ mg L}^{-1}$). Selain itu, kepekatan $\text{NO}_2\text{-N}$ ($0.004 \pm 0.00 \text{ mg L}^{-1}$) dan $\text{PO}_4\text{-P}$ ($0.658 \pm 0.02 \text{ mg L}^{-1}$) adalah lebih rendah dengan signifikan ($p < 0.05$) dalam tangki udang yang diberi makan T50 berbanding tangki kawalan (masing-masing $0.018 \pm 0.00 \text{ mg L}^{-1}$ dan $0.097 \pm 0.05 \text{ mg L}^{-1}$).

Kandungan hidrogen peroksida dan kebocoran elektrolit yang rendah juga ditemui pada PLs yang diberi makan diet yang diberi makan diet yang ditambah dengan 50% - 100% *T. chuii*. Malahan, pascalarva udang tersebut juga menunjukkan daya ketahanan yang tinggi terhadap ujian tekanan salinity terbalik (76.7% - 100%) berbanding kawalan (43.3%) dan T25 (50.0%). Walau bagaimanapun, tiada perubahan ditemui dari segi tumbesaran dan kesan pengoksidaan ke atas lipid. Berdasarkan kepada kandungan nilai nutrisi dan antioksidan *T. chuii* yang bagus dan kesannya yang positif terhadap tegasan oksidatif, kelangsungan hidup dan kualiti air, PLs yang diberi makan dengan diet yang mengandungi sekurang-kurangnya 50% (T50) adalah disyorkan sebagai sumber antioksidan semula jadi.