UNIVERSITI PUTRA MALAYSIA

MOINA MICRURA (KURZ) AS A LIVE FOOD SUBSTITUTE FOR *ARTEMIA SALINA* (L.) IN LARVAL REARING OF *MACROBRACHIUM ROSENBERGII* (DE MAN)

MD. JAHANGIR ALAM

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DOCTOR OF PHILOSOPHY
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By

MD. JAHANGIR ALAM

Thesis Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy in the Faculty of Fisheries and Marine Science, Universiti Pertanian Malaysia

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To the sacred memory of my baby daughter

NISHITHA

who left us for ever when I was here
on my study

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MOINA MICRURA (KURZ) AS A LIVE FOOD SUBSTITUTE FOR *ARTEMIA SALINA* (L.) IN LARVAL REARING OF *MACROBRACHIUM ROSENBERGII* (DE MAN)

By

MD. JAHANGIR ALAM

Chairman: Professor Ang Kok Jee, Ph.D

Faculty : Fisheries and Marine Science

Four main experiments *viz*., (i) use of *A. salina* and *Moina micrura*, either solely or in combinations, (ii) ingestion rates of *Artemia* and *M. micrura*, (iii) replacement of *Artemia* with *M. micrura*, either abruptly or gradually, and (iv) effects of cod liver oil (CLO) enriched egg custard, were conducted to evaluate the use of *M. micrura* as an overnight live food substitute for *Artemia* in rearing of *Macrobrachium rosenbergii* larvae.

M. rosenbergii larvae fed a mixed diet of *Artemia* and *Moina* and larvae weaned from *Artemia* to *Moina* had either a similar or significantly higher yield of post larvae compared to that fed *Artemia* alone. However, a 50:50 mixture and gradual weaning

with *Artemia* cut off at stage VIII or X resulted in the highest ($p < 0.05$) yield ranging from 16.81 ± 1.82 to 19.21 ± 1.54 PL/l. The production rates of 9.23 ± 1.22 to 11.26 ± 1.33 PL/l for larvae fed *Moina* alone were significantly lower ($p < 0.05$) than that for larvae fed *Artemia* alone (13.21 ± 0.90 and 14.27 ± 1.64 PL/l). The post larval yield for larvae fed *Moina* cultured on poultry manure (Mpm) was slightly higher than that for larvae fed *Moina* cultured on *Chlorella* and yeast (Mcy). The maximum mortality and significantly lower development in larvae fed *Moina* alone were observed during the first half of rearing period. However, in the later period, larval development and growth of post larvae fed the *Moina* equalled that of larvae fed other diets.

Compared to the individual ingestion rates (IIR) of *Artemia*, a 7 - 4 folds lower IIR of *Moina* were observed for up to stage V larvae. Thereafter, IIR of *Moina* increased and either equalled or surpassed that of *Artemia* in terms of dry mass ingestion and calorie intake. From a 50:50 mixture of *Artemia* and *Moina*, the IIR of *Artemia* was ≥ 80% up to stage V, but decreased thereafter and that of *Moina* increased steadily.

While n-3 HUFA content was higher in Mpm (8.68%) than that in *Artemia* (6.96%), it was only 0.97% in Mcy. Despite using Mcy as the overnight food, the production rates of 11.27 ± 1.35, 13.02 ± 1.70 and 12.13 ± 1.35 PL/l, respectively, for 1, 3 and

5% CLO enriched egg custard were significantly higher ($p < 0.05$) than that of 7.83 ± 1.58 PL/l for egg custard without CLO. However, there was no significant difference in production among the CLO enriched dietary treatments.

In larval rearing of *M. rosenbergii*, *M. micrura* may successfully be used as a supplement with *Artemia* throughout the rearing period or as a substitute for *Artemia* from larval stage VI-VII without any undue reduction in post larval yield.

Abstrak tesis ini dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah.

MOINA MICRURA (KURZ) SEBAGAI MAKANAN HIDUP PENGGANTI BAGI _ARTEMIA SALINA_ (L.) DALAM PENTERNAKAN LARVA _MACROBRACHIUM ROSENBERGII_ (DE MAN)

Oleh

MD. JAHANGIR ALAM

Pengerusi: Professor Ang Kok Jee, Ph.D

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Sebanyak empat eksperimen utama iaitu (i) penggunaan *A. salina* dan *Moina micrura*, sama ada secara tunggal atau gabungan, (ii) kadar penelanan *Artemia* dan *M. micrura*, (iii) penggantian *Artemia* dengan *M. micrura* sama ada secara mendadak atau secara beransur-ansur, (iv) kesan minyak limpa ikan kod (CLO) yang diperkaya dengan kastard telur, telah dijalankan untuk menilai penggunaan *M. micrura* sebagai makanan hidup yang digunakan pada waktu malam bagi menggantikan *Artemia* dalam penternakan larva *Macrobrachium rosenbergii*.

Larva *M. rosenbergii* yang diberikan diet campuran *Artemia* dan *Moina* dan larva yang diberikan *Artemia* serta diikuti dengan *Moina* telah memberikan hasil sama ada sama atau lebih tinggi

dibandingkan dengan pasca larva yang telah diberi makanan *Artemia* sahaja. Bagaimanapun campuran 50:50 dan perubahan diet beransur-ansur dengan *Artemia* diberhentikan pada peringkat VII atau X memberikan hasil yang paling tinggi ($P < 0.05$) berjulat dari 16.81 ± 1.82 hingga 19.21 ± 1.5 PL/l. Kadar pengeluaran larva yang diberi makan *Moina* sahaja ialah 9.23 ± 1.22 hingga 11.26 ± 1.33 PL/l nyata lebih rendah ($p < 0.05$) dibandingkan dengan larva yang diberi makan *Artemia* sahaja (13.21 ± 0.90 dan 14.27 ± 1.64 PL/l). Penghasilan pasca larva yang diberi makanan *Moina* yang dikultur menggunakan baja ayam ternakan (Mpm) didapati tinggi sedikit daripada larva yang diberi makanan *Moina* yang dikultur dalam *Chlorella* dan ragi (Mcy). Mortaliti maksimum dan perkembangan yang lebih rendah nyata pada larva yang diberi makanan *Moina* sahaja, dan ini telah diperhatikan semasa peringkat pertama awal jangkamasa pemeliharaan. Walau bagaimanapun, dalam jangkamasa penghujung terakhir, perkembangan dan pertumbuhan pasca larva yang diberi makan diet *Moina* didapati sama dengan larva yang diberi makanan diet lain.

Dibandingkan dengan kadar penelanan individu (IIR) *Artemia*, IIR *Moina* diperhatikan 7 - 4 kali ganda lebih rendah sehingga ke peringkat ke V. Selepas itu, IIR *Moina* meningkat sama ada sama atau melebihi *Artemia* dalam konteks penelanan jirim dan pengambilan kalori. Daripada campuran 50:50 *Artemia* dan

Moina, *Artemia* IIR adalah > 80% hingga ke peringkat V, tetapi menurun selepas itu dan *Moina* meningkat secara tetap.

Kandungan n-3 HUFA adalah lebih tinggi dalam Mpm (8.68%) daripada dalam *Artemia* (6.96%), sementara dalam Mcy ianya hanya 0.97%. Walaupun dengan menggunakan Mcy sebagai makanan pada waktu malam, kadar pengeluaran bagi 1, 3 dan 5% CLO yang diperkaya dengan kastard telur masing-masing ialah 11.27 ± 1.35, 13.02 ± 1.70 dan 12.13 ± 1.35 PL/l, nyata lebih tinggi ($p < 0.05$) dibandingkan dengan CLO tanpa kastard telur iaitu 7.85 ± 1.57 PL/l. Bagaimanapun, tiada perbezaan bererti dalam pengeluaran di antara percubaan menggunakan diet CLO yang diperkaya.

Dalam penternakan larva *M. rosenbergii*, *M. micrura* mungkin boleh digunakan dengan jayanya sebagai pengganti *Artemia* sepanjang tempoh penternakan atau sebagai pengganti bagi *Artemia* dari peringkat larva VI - VII tanpa sebarang penurunan ketara dalam penghasilan pasca larva.

CHAPTER I

INTRODUCTION

Background of the Study

Macrobrachium rosenbergii (de Man), a decapod caridean crustacean which is apparently evolving "out of the sea" (Johnson, 1960), is native to fresh and brackishwaters throughout South and Southeast Asia, Northern Oceania and Western Pacific Islands (New and Singholka, 1985).

In the coastal areas of Indo-Pacific region, catches of *M. rosenbergii* have been supporting small local fisheries for hundreds of years (Holthuis, 1980; Rabanal, 1982). The traditional trapping-holding-growing culture operations characterized by collecting juvenile prawns from the wild and on-growing them into impoundments have, however, been practised from time immemorial in some Asian countries, especially in Thailand (Sidhimunka and Choapaknam, 1966), Bangladesh and India (Ling and Costello, 1979). The true aquaculture of *M. rosenbergii* began to be developed since the elucidation of life cycle of the species by Ling (1962) and subsequent establishment of mass larval rearing techniques by Fujimura (1966), Ling (1969a), Fujimura and Okamoto (1970, 1972), and AQUACOP (1977).