UNIVERSITI PUTRA MALAYSIA

EVALUATION OF FREE-LIVING NEMATODE PANAGRELLUS REDIVIVUS AS A LIVE FOOD ORGANISM FOR SILVER BARB BARBODES GONIONOTUS LARVAE

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By

ABDOLSAMAD JAHANGARD

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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DEDICATION

To my most beloved wife, Ladan,

for all her understanding, patience and support during all difficulties and for her technical help during my study

To my father and mother,

for their support, principle guide and encouragement since my childhood

To all scientists and researchers,
who have contributed directly and indirectly in the quest of knowledge

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairman: **Associate Professor Dr. Mohd. Salleh Kamarudin**

Faculty: **Agriculture**

A series of experiments were conducted to develop mass production and improve nutritional quality of free-living nematode *Panagrellus redivivus*. The performance of nematodes *P. redivivus* produced on different culture media on growth and survival of silver barb *Barbodes gonionotus* larvae were also studied.

Prior to evaluation of *P. redivivus* as a larval live food organism, a study was conducted on the optimal stocking density of *B. gonionotus* larvae. Best larval growth and survival were obtained at 10 larvae L^{-1} for a 16-days rearing period. However, a range of 34-65 larvae L^{-1} was recommended for its commercial hatchery production.

A comparative study on performance of nematode, rotifer, *Moina* and *Artemia* was carried out. *B. gonionotus* larvae fed with *Artemia* and

nematode exhibited significantly ($P<0.05$) highest growth followed by those fed with rotifer and *Moina* respectively. *P. redivivus* was found to be a suitable food for *B. gonionotus*. A following study indicated that 20 nematodes mL^{-1} was the optimal feeding density for silver barb *B. gonionotus* stocked at 10 larvae L^{-1} for a 16-days culture period.

The study also revealed that 8% starch is the optimal level for the maximum production of *P. redivivus*. Nematodes produced at 8% starch also gave the best growth and survival of silver barb larvae. A following study showed that the total production of free-living nematode *P. redivivus* was significantly affected by the source of starch in culture medium. Potato starch was the best starch for culture of *P. redivivus.* Starch sources, however, did not have any significant ($P>0.05$) effect on the biochemical composition and nutritional value of *P. redivivus* for silver barb *P. gonionotus* larvae. Another study was conducted to determine the effect of lipid enrichment on the production of *P. redivivus*.

The results showed that the best lipid enrichment level for the maximum production of *P. redivivus* was 3.43%. The extremely low production of *P. redivivus* in unenriched medium suggested that lipid has an important role in reproduction, metabolism and as the main energy source. The results of a feeding trial showed that nematodes grown in media enriched with > 2.6% oil level were unsuitable for silver barb *B. gonionotus* larvae.

Finally, this study demonstrated that lipid source has an enormous effect on production and fatty acid composition of *P. redivivus*. The highest production

was achieved when nematodes were grown on sunflower oil enriched medium, followed by those grown in corn, linseed, fish, bleached palm kernel and bleached palm oil enriched respectively. The fish feeding trial, however, demonstrated that silver barb *B. gonionotus* larvae had a high capability to utilize a wide range of lipid source and dietary fatty acids without any negative effect on its growth and survival.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PENILAIAN NEMATOD *PANAGRELLUS REDIVIVUS* SEBAGAI MAKANAN LARVA LAMPAM JAWA, *BARBODES GONIONOTUS*

Oleh

ABDOLSAMAD JAHANGARD

Mac 2003

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Fakulti: Pertanian

Beberapa eksperimen telah dilakukan bagi membangunkan pengeluaran dan peningkatan mutu pemakanan nematod *Panagrellus redivivus* secara besar-besaran. Prestasi pengeluaran nematod *P. redivivus* menggunakan media kultur yang berlainan terhadap pertumbuhan dan kemandirian larva lampam Jawa *Barbodes gonionotus* juga telah dikaji.

Sebelum kajian penilaian *P. redivivus* dijalankan, satu kajian telah dilakukan untuk menentukan kadar perlepasan optimum larva *B. gonionotus.* Kadar perlepasan 10 larva L^{-1} telah memberi pertumbuhan dan kemandirian tertinggi dalam tempoh 16 hari pengkulturan. Kadar perlepasan 34-65 larva L^{-1} bagaimanapun telah disarankan untuk pengeluaran benih lampam Jawa secara komersial.

Satu kajian perbandingan prestasi nematod, rotifer, *Moina* dan *Artemia*. telah dilakukan. Larva lampam Jawa yang diberi Artemia dan nematod menunjukkan pertumbuhan tertinggi ($P<0.05$), diikuti oleh rotifer dan *Moina*. Nematod didapati sesuai sebagai makanan larva lampam Jawa. Kajian selanjutnya menunjukkan 20 nematod mL^{-1} adalah kadar pemberian makanan optimum bagi larva lampam Jawa pada kadar perlepasan 10 larva L-1 dalam tempoh 16 hari pengkulturan.

Kajian ini juga menunjukkan 8% adalah paras optimum kanji dalam media bagi pengeluaran maksimum *P. redivivus*. Larva lampam Jawa yang diberi nematod yang dikultur menggunakan media 8% kanji juga menunjukkan pertumbuhan dan kemandirian yang tertinggi.

Kajian selanjutnya menunjukkan sumber kanji dalam media mempengaruhi pengeluaran keseluruhan nematod *P. redivivus*. Kanji kentang merupakan sumber yang terbaik pagi pengeluaran nematod. Bagaimanapun sumber kanji didapati tidak mempengaruhi komposisi kimia dan nilai pemakanan *P. redivivus* terhadap larva lampam Jawa, *B. gonionotus*.

Kajian selanjutnya telah dilakukan bagi menentukan kesan paras pengkayaan lipid dalam media terhadap pengeluaran *P. redivivus*. Keputusan menunjukkan paras pengkayaan lipid maksimum bagi pengeluaran *P. redivivus* adalah 3.43%. Pengeluaran yang amat rendah dalam media tanpa lipid menunjukkkan lipid berperanan penting dalam pembiakan, metabolisme dan sebagai sumber utama tenaga bagi nematod. Kajian juga menunjukkan nematod yang dikultur dalam media yang

diperkaya dengan lipid melebihi >2.6% didapati tidak sesuai untuk larva *B. gonionotus*.

Kajian juga menunjukkan sumber lipid mempunyai kesan penting terhadap pengeluaran dan komposisi asid lemak *P. redivivus*. Pengeluaran nematod tertinggi didapati apabila ia dikultur dalam media diperkaya dengan minyak bunga matahari, disusuli oleh minyak jagung, minyak bijan, ikan, isirong kelapa sawit diluntur dan kelapa sawit yang diluntur. Keputusan kajian pemberian makanan menunjukkan larva *B. gonionotus* memiliki keupayaan untuk menggunakan ranj sumber lipid dan asid lemak dietari yang luas tanpa sebarang kesan pada kemandirian dan pertumbuhannya.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
AOAC	Association of Official Analytical Chemist
BW	Body weight
BSA	Bovine Serum Albumin
CHCl3	Chloroform
CH3OH	Methanol
CRD	Complete Randomised Design
DHA	Decosahexanoeic acid
DMRT	Duncan Multiple Range Test
DW	Dry weight
DO	Dissolved oxygen
EFA	Essential fatty acid
Expt.	Experiment
FAME	Fatty acid methyl esters
HCL	Hydrochloric acid
H2SO4	Sulphuric acid
HUFA	Highly unsaturated fatty acid
M.F.	Multiplication factor
MSA	Methanol sulphuric acid
MUFA	Mono unsaturated fatty acid
N	Normality
NaCl	Sodium chloride
NaOH	Sodium hydroxide

NPK	Nitrogen Potassium Phosphorous
NPU	Net protein utilization
RGR	Relative growth rate
RPM	Revolution per minute
SAS	Statistical analysis system
SEAFDEC	Southeast Asian Fisheries Development Centre
SFA	Saturated fatty acid
SGR	Specific growth rate
SEM	Standard error of mean
TRT	Treatment
µm	Microgram
UPM	Universiti Putra Malaysia
UV	Ultra Violet
YSI	Yellow spring instrument

CHAPTER I

INTRODUCTION

Background of the Study

Asia has the world's highest production and consumption of aquaculture products (Liao, 1991). Similar to other Asian developing nations, seafood is also one of the major sources of dietary protein for Malaysians. Fish culture was introduced to Malaysia with the immigration of Chinese workers to Malaya. However, the industrial farming of several species of fish and shellfish in this country has recently and rapidly expanded due to technology advancement, government support, tropical condition and sufficient water sources (Endinkeau and Kiew, 1993). Despite of rapid development in culture techniques, inadequate fry supply coupled with relatively high feed prices limits Malaysian aquaculture production (Ang, 1993). Most of fish and shellfish hatcheries in Malaysia are very dependent on imported expensive *Artemia* cysts (USD 50-80kg^{-1}) as a main larval food source, which could cost up to 80% of the total production cost *per se* (Sorgeloos, 1980). However, *Artemia* may not always be the best larval food for all species (Jones *et al.*, 1993). Therefore, cheaper alternative live food should be explored.

Free-living nematode *Panagrellus redivivus* with its suitable wide size range, ease of culture, high nutritional value and low cost production (Fontaine *et al.*, 1982; Kahan and Appel, 1975; Kahan *et al.*, 1980) has been found to be