UNIVERSITI PUTRA MALAYSIA

PERFORMANCE OF PENAEUSINDICUS, CULTURED UNDER THREE SALINITIES WITH DIET CONTAINING VARYING ENERGY LEVELS AND KILKA, CLUPEONELLA DELICATULA, OIL SUPPLEMENTATION IN THE NORTH OF PERSIAN GULF, I.R. IRAN

ABDUL HAMID YAZDANI JAHROMI

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BY

ABDUL HAMID YAZDANI JAHROMI

Thesis Submitted in Fulfilment of the Requirements for the Degree of Doctor of Philosophy in the Institute of Bioscience Universiti Putra Malaysia

May 2001

To my parents

for their true love, constant trust and principles that guide my life

To my wife

for her devotion, understanding and support during all difficulties

To my children

for making everything worthwhile

and

to many people whose works hard to improve the knowledge of human for peaceful living

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Doctor of Phylosophy

PERFORMANCE OF *PENAEUS INDICUS*, CULTURED UNDER THREE SALINITIES WITH DIET CONTAINING VARYING ENERGY LEVELS AND KILKA, *CLUPEONELLA DELICATULA*, OIL SUPPLEMENTATION IN THE NORTH OF PERSIAN GULF, I.R. IRAN

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May 2001

Chairman: Che Roos Saad, Ph.D

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The effects of varying energy and kilka oil levels on the performances of Indian prawn *Penaeus indicus* were evaluated in a 35 day experimental period in three water salinities (25, 35 and 45 ppt). For each salinity, four experimental diets with energy levels of 3500, 3800,4100 and 4400kcal/kg, each containing three kilka *(Clupeonella delicatula)* oil levels of 2, 4, 6% (totaling 12 experimental diets) were formulated using Lindo softwear program. All diets were isonitrogenous (40% protein) and fed at 8 percent of body weight to 36 groups of 200 juvenile shrimps (*P. indicus*) in each level of salinity. The results showed that under 25 ppt salinity, the diet containing 4100 kcal/ kg with 4% kilka oil showed the best results. For 35 ppt, 3800 kcal/ kg with kilka oil level of 6 % was the suitable energy level. At 45 ppt,

the best result was observed for the shrimp fed with 3500 kcal/ kg at 6% kilka oil level. It thus appeared that energy requirement vary with salinity. It also revealed that the energy to protein ratio of 110-118 kcal/ g proteins was the most suitable ratio for the growth of the shrimp under different salinities. The incorporation of kilka oil in the diet as a source of energy and essential fatty acids showed a satisfactory growth performance of the prawn. The n-3 fatty acid of shrimp body tissue increased with the increasing the dietary n-3 fatty acid levels.

Abstrak tesis dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi syarat untuk mendapatkan Ijazah Doktor Falsafah.

PENAMPILAN *PENAEUS INDICUS* YANG DIKULTUR DALAM AIR MENGANDUNGI TIGA SALINITI BERLAINAN DENGAN DIET MENGANDUNGI PELBAGAI TINGKAT TENAGA DAN MINYAK KILKA, *CLUPEONELLA DELICATULA*, DI UTARA TELUK PARSI, I.R. IRAN

Oleh

ABDULHAMID YAZDANI JAHROMI

May 2001

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Kesan perbedaan tenaga dan peringkat minyak ikan kilka (*Clupeonella delicatula*) yang berbeda terhadap penampilan udang India *Panaeus indicus* yang dipelihara selama 35 hari di dalam air yang mempunyai tiga saliniti (25, 35 dan 45 ppt) telah dinilaikan. Untuk setiap peringkat saliniti, empat diet ujian yang mengandungi 3500, 3800, 4100 dan 4400 kcal/kg tenaga, di mana setiap peringkat tenaga pula mengandungi tiga peringkat minyak 2, 4, dan 6% (keseluruhan berjumlah 12 diet ujian) telah disediakan dengan penggunaan program perisian LINDO. Kesemua diet adalah isonitrogenus (40% protein) dan telah diberi makan sebanyak 8 peratus dari berat badan kepada 36 kumpulan yang setiap kumpulan terdiri dari 200 juwana udang *P. indicus* bagi setiap tahap saliniti. Untuk udang yang dipelihara dalam air ber saliniti 25ppt., diet yang mengandungi 4100 kcal/kg dan 4% minyak ikan kilka telah memberikan hasil yang terbaik. Bagi udang yang dipelihara dalam air

bersaliniti 35 ppt pula, diet mengandungi 3800kcal/kg bersama 6% minyak ikan adalah paling sesuai. Sementara udang yang dipelihara dalam air bersaliniti 45 ppt pula, diet yang sesuai ialah yang mengandungi 3500 kcal/kg dan 6% minyak ikan. Kajian ini telah menunjukkan keperluan tenaga adalah berbeda bagi udang yang dipelihara dalam air bersalainan salinity. Kajian ini juga menunjukkan nisbah tenaga kepada protein 110-118 kcal/g adalah yang paling sesuai untuk pertumbuhan udang dalam saliniti yang berbeda. Pertambahan minyak ikan kilka dalam diet sebagai sumber tenaga dan asid lemak yang penting, telah memberikan prestasi pertumbuhan udang yang memuaskan. Kadar n-3 asid lemak dalam daging udang meningkat dengan meningkatnya kadar n-3 asid lemak dalam pemakanan.

ACKNOWLEDGEMENT

Words are not enough to express my sincere appreciation for the people who were involved in my training towards obtaining this degree. I am very grateful to Iranian Fisheries Company and Iranian Fisheries Research Centre for giving me an opportunity and financing this research project which leads to my Ph. D study. First and formost I am very thankful to my supervisor, Dr Che Roos Saad for his guidance, objective discussions and criticisms, encouragement and support throughout the course of the study. I am also indebted to the members of my supervisory committee, Dr. Razak bin Alimon, Prof Dr. Ali Nikkhah for providing guidance and constructive suggestions.

I would like to thank Mr. Jalali, Mr. Lahijanian, Dr. Salehi, , Mr. Yasaei Dr, Shafiepour, Dr. Riezvani, Dr. Masomiyan, Mr. Karimi, Mr. Abdolhi, Dr. Hossinzadeh and Dr. Matinfard.

Thanks are extended to Dr. Pyman Rostaeian for providing guidance and analyzing fatty acids of the samples during early stages of this study. I am also thankful to technical staff of Kolahi Hatchery at Bandar Abbas, Hormozgan Province, I.R, Iran, especially Mr. Mahdavi, Mr. Ataei and Mr. Furozan who are my technical advisors, Mr. Massandani, Mr.Amirnegad, and last but not least is Dr. Banadarakhshan other staffs involved direct or indirectly in this project.

I am also very thankful to the staff of Kilka Company especially Mr. Abdullahi, Mr. Fahim, Mr. Solehi and also the Director General of Shilat Trade Company, Mr. Hosseini and Mr. Shakori with whose help I could continue my study in Malaysia.

I certify that an Examination Committee met on 16th April 2001 to conduct the final examination of Abdulhamid Yazdani Jahromi on his Doctor of Philosophy thesis entitled " Performance of *Penaeus Indicus,* Cultured Under Three Salinities with Diet Containing Varying Energy Leveis and Kilka, *Clupeonella Delicatula,* Oil Supplementation in the North of Persian Gulf, I.R. Iran" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. The Committee Members for the candidate are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

Abdul Hamid Yazdani Jahromi
15 May 2001

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LIST OF ABBREVIATIONS

A/E = Essential amino acid ratio

ANOVA = Analysis of variance

CGAF = Calories per gram ash-free dry weight

CLO = Cod liver oil

DW = Dry weight

EPL= Early postlarvae

FAME = Fatty acid methyl esters

HUFA = Highly unsaturated fatty acids

LL= Late larvae

LSD = Least significant difference

MBW= Mean body weight

MDS = Mean developmental stage

MUFA = Monounsaturated fatty acids

PL = Postlarval

ppm = Part per million

ppt = Part per thousand

PUFA = Polyunsaturated fatty acids

sd = Standard deviation

SFA = Saturated fatty acids

SGR= specific growth rate

SVR= Survival rate

CHAPTER I

INTRODUCTION

Background of the Study

From modest beginnings more than thirty years ago, cultured shrimp from commercial aquaculture operations now contributes at least 25% to the world's total supply of shrimp. Shrimp farming continues to be one of the fastest growing sectors of the entire aquaculture industry. The 1980's and 1990's have been a period of particularly explosive growth. Over the last decade (1985-1995), the contribution from farm-raised shrimp to the total world supply of shrimp has grown by approximately 400%(Rosenberry, 2000).

The major cultured shrimp producing countries at the present time are Thailand, Ecuador, Indonesia, Philippines and India. Worldwide, there are approximately 50,000 farms that occupy almost 1.2 million hectares of land (approx. 3 million acres). The Eastern hemisphere accounts for 75% of the total production while the Western Hemisphere accounts for 25% of the production. Total revenues generated from the production of farm-raised shrimp worldwide was recently estimated at US$5-6 billion annually (Fish Farming 2000).

Today's world market for farm-raised shrimp continues to be characterized by strong product demand and all signs point towards the continuing expansion of the shrimp

farming industry. Many seafood buyers worldwide recognize that the farm-raised product is superior to the wild product in many instances.

This is due to the farmers ability to freeze shrimp on-site within hours of the harvest, locking in the freshness. In light of this, tremendous marketing opportunities exist for premium quality farm-raised shrimp. The three major markets for farm-raised shrimp are the United States, Europe and Japan. However, a number of new and developing markets throughout the world are now demanding higher and higher levels of this fine and easily accessible product (Fish Farming 2000).

Long southern coastline (2000 km) of the Islamic Republic of Iran along the coastal waters of Northern Persian Gulf and Oman Sea offers a tremendous culture potential for both marine fish and shrimp. This culture potential was first realized by Shilat (Iranian Fisheries Company) in mid 80, (1984-1986). Consequently in 1989, the first feasibility study and development project was funded jointly by United Nations Development Program (UNDP) and Shilat, and was carried out with the help of Asian experts contracted through the UN Food & Agriculture Organization (FAO). Construction began in 1991 on a national shrimp culture development center in Kolahi, near Bandar Abbas. Preliminary studies were conducted on banana shrimp, *Penaeus merguiensis*, the tiger green prawn, *P. semisulcatus*, and the Indian white shrimp, *P. indicus*, which are indigenous to the coastal waters of Persian Gulf and Oman Sea. The results of these early trials revealed that *P. indicus* has greater

potential in terms of production under Iranian conditions compared to *P. semisulcatus* and *P. merguiensis*. Yields of up to 2250 kg/ha were obtained for *P. indicus* at Kolahi Fisheries Station (Shilat, 1991). Based on the results of these trials, Shilat financially encouraged development of marine shrimp farming using Asian technologies adapted by the Institute of Fisheries Research (IFRTO). The development of shrimp culture industry in terms of area under shrimp culture and production at Iranian southern provinces from 1991 until now. Presently, there are approximately 30 hatcheries and more than 4200 hectares in production Table 1.1 and Table 1.2 respectively. Increasing trend can be seen in total shrimp production during the last decade in I.R. Iran. It is important to mention that due to temperature limitation, the shrimp culture is practiced from April to October in Iran. The growth of shrimp culture has provided new perspectives and horizons in the economics of the areas which are not suitable for agriculture Nash (1997).

In order to materialize the aquaculture aims of 3rd five-year economic development plan of Iranian Government which forecasted the annual production of 30,000 mt of shrimp by end of 2005, information on various aspects of shrimp culture including broodstock management and rearing, larvae production, nutrition, disease, pollution, environmental impacts, processing should be provided.