



PROGRAMME & ABSTRACTS

3RD INTERNATIONAL SYMPOSIUM ON CAGE AQUACULTURE IN ASIA 2011 (CAA3)

“Securing the Future”

16-19 NOVEMBER 2011
KUALA LUMPUR, MALAYSIA

In conjunction with:



Malaysia International Seafood Exposition 2011

Hosted by:



Gold Sponsor:



Organised by:



In collaboration with:





TABLE OF CONTENTS

	<u>Pages</u>
Conference Organisation	3
Messages	4 - 8
Members of National Organising Committee (NOC)	9
Members of Programme Committee (POC)	10
Scientific Programme	11 - 19
Plenary Lecture I	
- Bionote of Dr. Michael A. Rimmer	20
- Abstract	21 - 22
Plenary Lecture II	
- Bionote of Dato' Ahamad Sabki Mahmood	23
- Abstract	24 - 25
List of Posters	26 - 29
Abstracts for Oral Presentation	31 - 99
Abstracts for Poster Presentation	101 - 132
R&D Fisheries Product Seminar	134 - 150

ORGANISERS

- **Asian Fisheries Society (AFS)**
- **Malaysian Fisheries Society (MFS)**
- **Department of Fisheries Malaysia (DoF)**
- **Fisheries Development Authority of Malaysia (LKIM)**
- **Universiti Putra Malaysia (UPM)**

CAA3 GOLD SPONSOR

- **Uni-President Vietnam Co., Ltd.**

CO-SPONSORS

- **Ambang Prospek Sdn Bhd**
- **Dindings Soya & Multifeeds Sdn Bhd**
- **Fisheries Development Authority of Malaysia**
- **Gagnar Engineering Sdn Bhd**
- **Hydroaxys Sdn Bhd**
- **Majuikan Sdn Bhd**
- **Recirculating Aquaculture Systems Sdn Bhd**
- **Star Feedmills (M) Sdn Bhd**
- **Super Artemia Sdn Bhd**

SUPPORTING ORGANISATIONS

- **Universiti Sains Malaysia (USM)**
- **Universiti Malaysia Terengganu (UMT)**
- **Universiti Malaysia Sabah (UMS)**
- **Universiti Malaya (UM)**
- **The Indonesia-Malaysia-Thailand Growth Triangle (IMT-GT)**
- **Food and Agriculture Organisation of the United Nations (FAO)**

Welcome and Selamat Datang

On behalf of the Department of Fisheries, Malaysia, I wish to welcome all exhibitors, visitors and delegates to Malaysia.

Malaysia is hosting its 2nd Malaysia International Seafood Exposition 2011 and concurrently Malaysia is also hosting the 3rd International Symposium on Cage Aquaculture in Asia 2011. We are proud to be able to organise both events under one roof. I would also like to extend my sincere appreciation to the Asian Fisheries Society and the Malaysian Fisheries Society for choosing Malaysia to organise this remarkable event.



The seafood industry has steadily progressed over the past decade and today it is an important contributor to the Malaysian export earnings. Malaysian seafood products are well accepted in more than 45 countries worldwide and it is enjoying healthy growth.

This year's Malaysia International Seafood Exposition is set to be bigger than the previous one encompassing more than 150 booths consisting of Malaysia's best seafood. This entails an increase in the number of exhibitors not only from Malaysia but also from overseas. The show has also lined up business matching programs, talks and cooking demonstrations. The Department of Fisheries is confident that this year's show will be an exciting one which will be mutually beneficial to both visitors and exhibitors.

I hope exhibitors, visitors and delegates will take the opportunity to gain knowledge from both events and achieve their objectives here.

I wish all parties a rewarding sessions.

Thank you

Y. H. Dato' Ahamad Sabki bin Mahmood
Director General of Fisheries Malaysia

AFS *President's Message*



On the occasion of the 3rd International Symposium on Cage Culture in Asia (CAA3), the Asian Fisheries Society (AFS) welcomes distinguished plenary and keynote speakers, symposium participants, exhibitors and visitors to the Malaysia International Seafood Exposition 2011 (MISE 2011).

The AFS is very proud to be a partner in these endeavours. It has been involved in organizing two earlier cage culture symposia – 1999 in Taiwan and 2006 in China. Since the first symposium, it has witnessed the growth and sophistication of cage culture in Asia and the innovative approaches taken to overcome the constraints of restricted space, vulnerability to weather such as typhoons, environmental pollution and use of fresh trash fish as a feed. The more recent shift to offshore cage culture and large scale hatcheries for fry production is an exciting development that brings with it its own set of challenges, especially in finding the balance between small-scale fish farming that provides livelihoods for both coastal and inland communities and the development of large-scale farming operated by major companies. In Asia, there are many lessons to be learnt from countries such as China P.R. that introduced offshore culture in the late 1990s, and others such as Thailand and Indonesia where it is still in an experimental stage. CAA3 will provide an opportunity to examine these and other recent advances and trends in cage culture and to communicate the challenges and solutions to decision makers.

The Asian Fisheries Society (AFS) was founded in 1984 by fishery professionals in Asia. It aims to provide a platform for improving fisheries and aquaculture research and the dissemination of the results by promoting networking and co-operation between scientists, technicians and all stakeholders involved in fisheries and aquaculture production, research and development in Asia. An exciting new project for AFS is “AsiaPacific-FishWatch” that will give users access to direct, authoritative online information about Asia-Pacific fisheries has just begun.

As the new President of the AFS my vision is to make the Society more relevant and useful to its members, especially its younger members – the scientists of tomorrow. The Society started with a large number of members and considerable enthusiasm but in recent times the interaction and cooperation has declined along with the number of active members. As the new President I will be seeking active feedback on how we can improve this situation, and look forward to welcoming more new members into the AFS family.

Check us out on www.asianfisheriessociety.org/

Dr. Derek J. Staples
President
Asian Fisheries Society

MFS *President's Message*

On behalf of the Malaysian Fisheries Society, it is my great pleasure to welcome all participants to Kuala Lumpur, Malaysia and to this 3rd International Symposium on Cage Aquaculture in Asia 2011 (CAA3) organised by the Malaysian Fisheries Society and Asian Fisheries Society in conjunction with the Malaysian International Seafood Exhibition 2011 (MISE) organised by the Department of Fisheries Malaysia.



The society has an important role in promoting fisheries and aquaculture in Malaysia. It is an honour for Malaysian Fisheries Society to be selected as the local organisation of this symposium series which started in Taiwan in 1999. This symposium will provide a platform for exchange of information and ideas, and disseminate updates on the development of cage aquaculture, not only within the Asia Pacific region but also globally.

With the world population reaching 7 billion in 2011, the task ahead is to find ways to increase fish production to meet current and future global demands. The most sustainable alternative to depleting catches from capture fishery is fish farming which includes pond and cage aquaculture. Asia's water resources, marine and freshwater, provide the opportunity for the expansion of cage aquaculture practices.

Over the next three days, we deliberate on the research in cage aquaculture and related areas like feed, health management and seed production with the hope to further push the development of industrial cage aquaculture. At the same time, industry needs to learn to be market-driven rather than production driven and seek to be sustainable and meet environment and social norms in food production.

I would like to thank all our plenary and keynote speakers, and presenters who have come to share their valuable knowledge and findings in this symposium. Last but not least, I would like to thank our Gold Sponsor, Uni-President Vietnam and the Department of Fisheries Malaysia for hosting this event and for their financial support. I also congratulate members of the organising committee and others who have helped to make this event a success.

Dr. Annie Christianus
President
Malaysian Fisheries Society

Selamat Datang and Welcome to CAAT3...



It is with great pleasure that I welcome all participants from all across Asia and other parts of the world to Malaysia. We are pleased that you have chosen to be part of this leading event – **3rd International Symposium on Cage Aquaculture in Asia 2011 (CAA3)**.

Malaysian plays a significant role in the region's aquaculture industry. With the advancement of technologies and technical expertise, aquaculture has become one of the major contributors to the Malaysian economy, in particular the shrimp, tilapia and ornamental fish industry. The theme "**Securing the Future**" will mark another milestone when scientists, policy makers and industry stakeholders from 15 participating countries meet to contemplate and highlight current and future research and development for the technical, socio-economic well-being of the Asian cage aquaculture industry. With nearly 100 abstracts, we are happy that the symposium is well received. It is expected to draw more than 300 participants.

The symposium features seven technical sessions including a special session on "Seafood Trade and Certification" focusing on issues pertaining to markets and the supply chain. Other sessions range in aspects from Policy and Socio-Economics; Site Selection and Environmental Management; Production, Technology and Systems; Species Selection and Seed Production; Biosecurity and Health Management; to Feeds and Feeding for the marine and freshwater finfish.

Of major significance to the industry in Malaysia will be the Farmer's Day to be held on 18th November with technical presentations from international experts, successful farmers, and other professionals in English and with simultaneous translations in Mandarin and Malay. This session is open to farmers and other stakeholders involved in cage aquaculture. There will be a post conference tour to private cage culture farms located on the west coast of Peninsular Malaysia which should not be missed.

I am indeed grateful to the members of the organising committee for their tireless and excellent contribution and support, to make this special and memorable event a great success. To all sponsors thank you for your great contributions and never ending support.

Best wishes and thank you.

Siti Shapor Siraj (PhD)

Professor in Fish Genetics and Breeding
Faculty of Agriculture, Universiti Putra Malaysia
National Organising Committee – Chair

PREFACE

Cage aquaculture contributes significantly to the production of freshwater and marine finfish in Asia. In the face of declining fish catch, there is a growing expectation on aquaculture to fill the gap in global fish supply. As land based aquaculture is squeezed by competitive use of water and land resources by other economic forces, the pressure will be on cage aquaculture to meet the rapidly growing demand for quality fish from an increasingly discerning consumer base.



Cage aquaculture is widely practiced in many parts of Asia but is largely on a small scale. The future will call for cage aquaculture to be carried out at an industrial scale so that it would have the necessary economies of scale. At the same time, production methods would need to be sustainable and environmentally friendly. Food safety considerations are expected to be paramount as consumers become more sophisticated and educated on the health impacts of their choices.

The 2nd Symposium on Cage Culture in Asia or CAA2 was successfully held in Hangzhou, China in 2006 and the aquaculture community is now meeting again in Kuala Lumpur city, Malaysia to discuss the recent advances, potentials, challenges and problems of cage aquaculture in Asia. Similar to its predecessor held five years ago, it will continue to look at the rapid commercialization of both marine and freshwater cage aquaculture in Asia.

The CAA3 symposium and the booth trade show will be co-located with the Malaysia International Seafood Exposition (MISE) which is Malaysia's premier seafood event held biennially. There will be six concurrent sessions and each session will begin with a keynote address from prominent experts in their respective fields.

We thank all the speakers and poster presenters for their participation in this symposium. Our thanks and appreciation also goes to the Department of Fisheries Malaysia for hosting this collaborative effort on MISE and CAA3. To all the sponsoring agencies and companies, our appreciation and gratitude for your kind contributions.

Fatimah Md. Yusoff (PhD)

Professor in Limnology and Aquatic Ecology
Institute of Bioscience, Universiti Putra Malaysia
Programme Committee – Chair

MEMBERS OF NATIONAL ORGANISING COMMITTEE (NOC)
THIRD INTERNATIONAL SYMPOSIUM ON CAGE AQUACULTURE IN ASIA 2011 (CAA3)

Chairperson: Prof. Dr. Siti Shapor Siraj
(UPM/MFS)

Members: Dr. Annie Christianus
Mr. Perumal Kuppan
Assoc. Prof. Dr. Hassan Hj. Mohd Daud
Mr. Ng Chee Kiat
Malaysian Fisheries Society (MFS)

Dr. Zuridah Merican
Prof. Dr. Fatimah Md Yusoff
Assoc. Prof. Dr. Aziz Arshad
Asian Fisheries Society (AFS)

Assoc. Prof. Dr. Mohd Salleh Kamarudin
Mr. Abdullah Abd Rahim
Universiti Putra Malaysia (UPM)

Dr. Mazuki Hashim
Mr. Hj. Munir Hj. Mohd Nawi
Ms. Azimah Jumatli
Ms. Azura Markus
Mr. Johari Tim
Department of Fisheries, Malaysia (DOF)

Mr. Hj. Mohari Mohd Tamin
Fisheries Development Authority of Malaysia (LKIM)

Prof. Dr. Sharr Azni Harmin
Universiti Selangor (UNISEL)

Secretariat: Ms. Mariati Tiansin (AFS)
Ms. Fadzillah Abd Razak (UPM)
Ms. Maisirah Amran (UPM)
Ms. Nurhafiza Mohd Nasir (UPM)
Ms. Jocyntha Joseph (AFS)

MEMBERS OF PROGRAMME COMMITTEE
THIRD INTERNATIONAL SYMPOSIUM ON CAGE AQUACULTURE IN ASIA 2011 (CAA3)

Chairperson: Prof. Dr. Fatimah Md Yusoff
(UPM/AFS)

Members: Dr. Derek J. Staples
Prof. Dato' Dr. Mohamed Shariff Mohamed Din
Asian Fisheries Society (AFS)

Dr. Annie Christianus
Prof. Dr. Siti Shapor Siraj
Dr. Zuridah Merican
Malaysian Fisheries Society (MFS)

Prof. Dr. Mariana Nor Shamsudin
Assoc. Prof. Dr. Mohd Salleh Kamarudin
Dr. Ismail Abd Latif
Dr. Sanjoy Banerjee
Universiti Putra Malaysia (UPM)

Dr. Siti Zahrah Abdullah
Mr. Ismail Ishak
Mr. Hj. Munir Hj. Mohd Nawi
Department of Fisheries, Malaysia (DOF)

Dr. Wee Kok Leong
Temasek Polytechnic, Singapore

Prof. Dr. Ridzwan Abdul Rahman
Prof. Dr. Saleem Mustafa
Dr. Rossita Shapawi
Universiti Malaysia Sabah (UMS)

Prof. Dr. Faizah Shaharom
Assoc. Prof. Dr. Anuar Hassan
Universiti Malaysia Terengganu (UMT)

Prof. Dr. Roshada Hashim
Universiti Sains Malaysia (USM)

Prof. Dr. Sharr Azni Harmin
Universiti Selangor (UNISEL)

Mr. Gopinath Nagaraj



Fanli Marine and Consultancy Sdn. Bhd.
**3RD INTERNATIONAL SYMPOSIUM ON
CAGE AQUACULTURE IN ASIA (CAA3 2011)**
16 - 18 November 2011
PWTC, Kuala Lumpur, Malaysia

SCIENTIFIC PROGRAMME

SPECIAL SESSION: SEAFOOD TRADE AND CERTIFICATION

16th Nov. 2011 (Wednesday) 0900 – 1240 Tun Hussein Onn Hall

[Chairperson: Mr. Ahmad Hazizi Aziz]

- 0900 STC1 Trends in the Global Seafood Trade
Helga M. Josupeit
- 0940 STC2 Seafood Market Trends in Japan
Goichi Sakita
- 1020 **Refreshment**
- 1040 STC3 China Seafood: Where will be the New Value Added
Flows?
Jean-Yves Chow
- 1120 STC4 Seafood Trade in Asia: Trends in Supply and Demand with
Special Reference to Malaysia
Fatima Ferdouse
- 1200 STC5 Market Access and Certification for Cage Aquaculture
Products
Ahmad Hazizi Aziz
- 1240 **Lunch Break (Mawar Room)**

SESSION 1: POLICY AND REGULATORY DRIVERS IN THE SOCIO- ECONOMICS OF CAGE AQUACULTURE

16th Nov. 2011 (Wednesday) 1400 – 1740 Tun Hussein Onn Hall

[Chairperson: Mr. Gopinath Nagaraj]

- 1400 KA01 Contemporary Trends in Fish Consumption and their
Socio-Economic Impact on Traditional Cage Operators
M.C. Nandeesh

- 1440 KA02 Promoting Aquatic Biosecurity as a Policy Instrument to ensure Production and Market Sustainability in the Asia Pacific – Role of NACA
Chadag V. Mohan, Eduardo Leano, and Ambekar E. Eknath
- 1520 OP01 The Contribution of Full Time and Part Time Cage Culture Fisheries to Farm Household Income
Jariah M., Tengku Aizan Hamid, Zumilah Z., Ismail L. and Shariff M.
- 1540 **Refreshment**
Session 1: (continue)
[Chairpersons: Mr. Ismail Ishak/ Prof. M.C. Nandeesh]
- 1600 OP02 Developing Community-Based Ecotourism of Mangrove Ecosystems to Enhance Rural Livelihoods and Conservation of Resources: The Case of Kota Marudu, Sabah, Malaysia
Awang Noor Abd. Ghani, Abdullah Mohd, Faridah Hanum Ibrahim, Mohamed Zakaria Hussin, Kamziah Abdul Kudus and Yip Hin Wai
- 1620 OP03 Cage Aquaculture: A Sustainable Business Model
Azmi Abdul Hamid, Indra Devi Rajamanoharan and Rozainun Hj Abdul Aziz
- 1640 OP04 Implications of Juvenile Fishery Policies and Regulations on the Feasibility of Siganid Culture in Alaminos and Bolinao, Pangasinan, Philippines
Paul Joseph B. Ramirez
- 1700 OP05 Impact of Salinity Fluctuations of Rambangan River (Borneo Island) on Cage Aquaculture and its Economic Implications
Norzaihan Hashim and Sandy Lim
- 1720 OP06 Empowerment of Namibian Youth Group through the Uis Fish Farming Eco-Tourism Enterprise: A Case Study
Mugiho Ataka and Md. Ghulam Kibria

PLENARY LECTURES

17th Nov. 2011 (Thursday) 0940 – 1100 Tun Hussein Onn Hall

[Chairperson: Dr. Derek J. Staples]

- 0940 PL01 Securing the Future for Marine Finfish Aquaculture in Asia
Michael A. Rimmer
- 1020 PL02 Cage Aquaculture in Malaysia – Towards Realizing New Key Economic Areas
Ahamad Sabki Mahmood, K. Subramaniam and Munir Mohd Nawi
- 1100 **Refreshment**

SESSION 2: SITE SELECTION & ENVIRONMENTAL MANAGEMENT

17th Nov. 2011 (Thursday) 1120-1300/1400-1500 Perhentian Room(L3)

[Chairpersons: Prof. Dr. Ridzwan Abdul Rahman/ Dr. Rossita Shapawi]

- 1120 KA03 Cage Culture of Marine Finfish: Site Selection and Adaptation to Climate Change
Saleem Mustafa, Rossita Shapawi, Abentin Estim and Ridzwan Abdul Rahman
- 1200 OP07 Milkfish Culture in Marine Cages in the Philippines
Crispino A. Saclauso
- 1220 OP08 Influence of Tilapia Cage Culture on Water Quality and Plankton Composition in Lam Pao Reservoir, Thailand
Praneet Ngamsnae and Piangpen Chaycharoen
- 1240 OP09 Status of Cage Culture of Fish in Nepal
Madhav K. Shrestha and Jay D. Bista
- 1300 **Lunch Break (Mawar Room)**
Session 2: (continue)
[Chairperson: Prof. Dr. Saleem Mustafa]
- 1400 OP10 Climate Change Effects on Fisheries and Aquaculture in the Philippines: Implications on Environmental Management
Len R. Garces

- 1420 OP11 Site Selection and Production Performance of Red Tilapia, *Oreochromis niloticus* Cage Culture Operations: The Batang Ai Hydroelectric Dam Reservoir, Sarawak, Malaysia Experience
Mhd Ikhwanuddin Abdullah, Hariffin A.B. and Abol Munafi Ambok Bolong
- 1440 OP12 Marine Cage Culture in the Mariculture Parks of the Philippines
Gil A. Adora and Arnil C. Emata

SESSION 3: PRODUCTION, TECHNOLOGY AND SYSTEMS

17th Nov. 2011 (Thursday) 1120-1300/1400-1520 Tun Hussein Onn Hall

[Chairpersons: Prof. Dr. Fatimah Md. Yusoff/ Dr. Sanjoy Banerjee]

- 1120 KA04 Large Scale Sustainable Tilapia Farming in Malaysia - Using Modern Cage Technology
Olav Jamtøy, Lai Sead Ping and Alejandro Tola Alvarez
- 1200 OP13 ARDA (Association for the Development of Aquaculture in Reunion Island): The Marine Aquaculture Centre and its Innovative Cage Farming System
Jérôme Bosmans and Nicolas Macé
- 1220 OP14 Mariculture Park in the Philippines: A Model for Developing Sustainable Aquaculture Development
Hermogenes S. Tambalque III
- 1240 OP15 Numerical Simulation Model for Cage Aquaculture Systems in the Open Sea
Chai-Cheng Huang, Chien-Ning Su and Chun-Ho Chan
- 1300 **Lunch Break (Mawar Room)**
Session 3: (continue)
**[Chairpersons: Dr. Michael A. Rimmer/
Mr. Haji Munir Mohd Naw]**
- 1400 OP16 Technical Efficiency Analysis of Fish Cage Culture in Peninsular Malaysia: An Application of Stochastic Frontier Production Function Approach
Gazi Md. Nurul Islam, Tai Shzee Yew and Kusairi Mohd Noh
- 1420 OP17 Semi-submersible Cage Technology in Malaysia: Pulau Layang Layang Experience
Mohammed Mohidin, Abdul Razak Abdul Rahman, Albert Chuan Gambang and Imelda Riti Rantty

- 1440 OP18 Comparative Growth Account of Mixed-Sex and Monosex Nile Tilapia at Various Stocking Densities during Cage Culture
Suman B. Chakraborty and Samir Banerjee
- 1500 OP19 Production Potential of Herbivorous Fish Grass Carp (*Ctenopharyngodon idella*) in Floating Net Cages in Lake Phewa, Nepal
Jay D. Bista, Surendra P. Sah and Madhav K. Shrestha

SESSION 4: SPECIES SELECTION AND SEED PRODUCTION

17th Nov. 2011 (Thursday) 1120-1300/1400-1520 Johor/Kedah Room

[Chairpersons: Dr. Annie Christianus/ Prof. Hisashi Kurokura]

- 1120 KA05 Advances in Seed Production of Marine Finfish in Malaysia
Hussin Mat Ali and Mazuki Hashim
- 1200 OP20 Seed Production Techniques of Marble Goby *Oxyeleotris marmoratus* and some Groupers
Shigeharu Senoo and Ridzwan A. Rahman
- 1240 OP21 Species Selection and Seed Production for Cage Culture in Malaysia
Abol Munafi Ambok Bolong, Awang-Alim A.K., Ariffin A.B., Daud A.O., Norazmi-Lokman N.H. and Abduh M.Y.
- 1300 **Lunch Break (Mawar Room)**
Session 4: (continue)
**[Chairperson: Prof. Dr. Sharr Azni Harmin/
Prof Dr. Siti Shapor Siraj]**
- 1400 OP22 Production of Hybrid Groupers: Spotted Grouper *Epinephelus polyphekadion* × Tiger Grouper *E. fuscoguttatus* and Coral Grouper *E. corallicola* × Tiger Grouper *E. fuscoguttatus*
Mohd Addin Aazif Mokhtar and Shigeharu Senoo
- 1420 OP23 Oyster Seed Production for Cage Culture in Malaysia in Relation to other ASEAN Countries
Aileen Tan Shau-Hwai and Zulfigar Yasin
- 1440 OP24 Gonadotropin Releasing Hormone Analogue in Enhancing Reproductive Performance of River Catfish *Hemibagrus nemurus* (Valenciennes, 1840) in Captivity
Fatimat A. Adebij, Siti Shapor Siraj, Sharr Azni Harmin and Annie Christianus

- 1500 OP25 Production of Carp Fingerling in Nursery Cages in the Lakes of Pokhara Valley
Jay D. Bista, Ram K. Shrestha and Suresh K. Wagle

SESSION 5: BIOSECURITY AND HEALTH MANAGEMENT

18th Nov. 2011 (Friday) 0900 – 1700 Tun Hussein Onn Hall A

**[Chairpersons: Prof. Dr. Faizah Shaharom/
Prof. Dr. Mariana Nor Shamsudin]**

- 0900 KA06 Finfish Culture and Parasitic Diseases in China
Tingbao Yang
- 0940 OP26 Effect of Climate Change on Fish Disease
Faizah Shaharom-Harrison
- 1020 **Refreshment**
- 1040 OP27 Seasonal Infestation and Pathology of Capsalid Monogeneans on Cultured Red Snapper, *Lutjanus erythropterus* in Penang, Malaysia
Leong Tak Seng
- 1100 OP28 Epidemiological Study of Streptococcosis in Red Tilapia Cultured in Different Water Bodies in Malaysia
Siti-Zahrah A., Zulkafli A.R., Zamri-Saad M., Amal A.M.N., Nur-Nazifah M., Firdaus-Nawi M., Ramley B., Fahmi S. and Shahidan H.
- 1120 OP29 Environmental Factors Related to the Outbreaks of Cryptocaryoniasis in Marine Fishes in Cage Aquaculture in Japan
Tomoyoshi Yoshinaga
- 1140 OP30 Control Strategy for Viral Diseases of Salmonid Fish and Flounders at Hatchery or Seed Production Facility, and Net-Pen or Tank in Japan
Mamoru Yoshimizu and Hisae Kasai
- 1200 OP31 Caligidae Infestation in Asian Seabass, *Lates calcarifer*, Bloch 1790 Cultured at Different Salinity in Malaysia
Muhd-Faizul H.A.H, Kua Beng Chu and Leaw Yoon Yau
- 1220 OP32 Photobacteriosis in Hatchery-Cultured Asian Seabass (*Lates calcarifer*) Juvenile in Sabah
Chong Yen Thing, Julian Ransangan and Lu Kein Chee

- 1240 **Lunch Break (*Mawar Room*)**
Session 5: (*continue*)
**[Chairpersons: Prof. Yang Tingbao/
Dr. Siti Zahrah Abdullah]**
- 1440 OP33 Health Promoting Effects of *Excoecaria agallocha* Extract on *Elizabethkingia meningoseptica* Infected Catfish (*Clarias gariepinus*)
Laith Abdulrazzak and Najiah Musa
- 1500 OP34 The Effect of Thermal Bar on Distribution of Monogenean Gill Parasite on Cage-Cultured Red Hybrid Tilapia (*Oreochromis* sp) at Kenyir Lake
Faizah Shaharom-Harrison, Anil Chatterji and Surzanne Mohd Agos
- 1520 OP35 Disastrous Impacts of Isopod Infestation in Caged Culture Tilapia at Durian Tunggal Dam: Malaysian Experience
Muhammad Zudaidy Jaafar, Siti Zahrah Abdullah, Kua Beng Chu, Rosly Hassan and Zulkafli Abd Rashid
- 1540 OP36 Mass Mortality Associated with a *Streptococcus agalactiae* Infection in Nile Tilapia *Oreochromis niloticus* (L.) Juveniles Cultured in Lake in Malaysia
Hassan Mohd Daud, Milud Alsaïd, Yasser M. Abdelhadi and Ali Abuseliana
- 1600 OP37 Differences in Haematological Parameters in Normal and Immunized Fingerlings of Red Tilapia (*Oreochromis mossambicus* X *Oreochromis niloticus*)
Ali Muhammad Mastoi, Mithun Sukumaran, Khanit Suwanno, Anuar Hassan, Faizah Shaharom and Anil Chatterji
- 1620 OP38 Streptococcosis and Tilapia Cage Culture
Yasser Mohamed Abdelhadi
- 1640 OP39 *Dactylogyrus macrolepidoti* (Dactylogyridae) as Bioindicator of Water Quality: Evidence from Field Survey
Bako Mallam Modu, M. Saiful, Zaleha Kasim, Marina Hassan and Faizah M. Shaharom-Harrison

SESSION 6: FEEDS AND FEEDING

18th Nov. 2011 (Friday) 0900 – 1720 Tun Hussein Onn Hall B

[Chairpersons: Assoc. Prof. Dr. Mohd Salleh Kamarudin/
Dr. Wee Kok Leong]

- 0900 KA07 Cage Culture in Asia – Feed and Feeding Perspective
Wee Kok Leong
- 0940 OP40 Improving Feed and Feeding Practices in Cage Culture in Asia towards Environmental Integrity and Sustainability
Weimin Miao, Mohammad R. Hasan and Simon Funge-Smith
- 1020 **Refreshment**
- 1040 OP41 Feed Management in Coastal Aquaculture in Southeast Asia – An Update on the Latest Developments
Brett D. Glencross
- 1120 OP42 Linking Physiology, Nutrition and Environment Research to Potential Impacts of Climate Change: Case-Study on Tasmanian Atlantic Salmon Aquaculture
Chris G. Carter, Robin S. Katersky, Catriona Macleod, Harry R. King and Stephen C. Battaglene
- 1200 OP43 Effects of Stocking Density on Growth Parameters of Great Sturgeon (*Huso huso*) in Net Cages
Mahmoud Shakourian, Pourkazemi M., Yazdani Sadati M.A., Peykaran N., Pourali H.R. and Arshad U.
- 1220 **Lunch Break (Mawar Room)**
Session 6: (continue)
**[Chairpersons: Dr. Brett D. Glencross/
Dr. Wee Kok Leong]**
- 1440 OP44 Experimental Study on Different Levels of Trash Fish Feeds for Cultured Grouper (*Epinephelus* sp) in Floating Net Cages at the Coastal Waters of Cebu State College of Science and Technology – Fishery and Industrial College San Francisco, Cebu
Dominador G. Surbano and Bonifacio S. Villanueva
- 1500 OP45 The Effects of Varying Protein and Lipid Levels in the Diets on Growth, Feed Utilization and Body Proximate Composition of Tiger Grouper, *Epinephelus fuscoguttatus*
Isabella Ebi, Annita Yong and Rossita Shapawi

- 1520 OP46 Feed and Feeding in Freshwater Cage Aquaculture in Indonesia
Gede S. Sumiarsa and Lukas Manomaitis
- 1600 OP47 The Effects of Dietary Protein Levels on Growth Performance and Muscle Composition of Young Mekong Giant Catfish (*Pangasianodon gigas*), Raised in Cages
Suthus Phaukgeen and Praneet Ngamsnae

FARMER'S DAY

18th Nov. 2011 (Friday) 0900 – 1240 Tun Dr Ismail Hall

[Chairperson: Mr. Haji Ismail Abu Hassan]

- 0800 **Registration**
- 0845 **Welcoming Remarks by Dept. of Fisheries**
- 0900 FD01 Perspective in the Successful Cage Farming of Marine Fish: Pompano, *Trachinotus blochii* Experience
Misai Tsai
- 0940 FD02 Vaccine Focused Biosecurity Programs in Open-Water Cage Farms
Neil Wendover and Yuli Pancawati
- 1020 **Refreshment**
- 1040 FD03 History and Present States of Net Cage Culture for Aquaculture Industry in Japan: From 1950s Yellow Tail to 2010s Blue Fin Tuna
Shigeharu Senoo, Okada T. and Miyashita S.
- 1120 FD04 Experiences and Key Challenges in Cage Aquaculture Business in Malaysia
Goh Cheng Liang
- 1200 **Question & Answer Session**
- 1220 **Lunch Break (Mawar Room)**

PLENARY LECTURE

DR. MICHAEL A. RIMMER

Mike Rimmer has been involved in the development of aquaculture and stock enhancement techniques for Australian native marine and freshwater fishes for over 25 years. From 1987 to 2006 he worked for the Queensland Department of Primary Industries, based at Northern Fisheries Centre in Cairns. In this position he was instrumental in the development of practical aquaculture technology for barramundi (*Lates calcarifer*), which is now the principal aquacultured finfish in northern Australia. More recently, Mike has been involved in developing aquaculture technology for high-value marine finfish such as snappers (Lutjanidae) and groupers (Serranidae). He has undertaken numerous collaborative studies with laboratories in the US, Taiwan, Indonesia, the Philippines, Vietnam, India, and several Pacific Island countries, and has lead two ACIAR projects to improve hatchery and grow-out technology for grouper and other high-value marine finfish. From 2004 to 2005 Mike was the President of the World Aquaculture Society's Asian-Pacific Chapter. Since 2006 he has been based in Indonesia, managing Australian projects on post-tsunami reconstruction in Aceh and aquaculture development. He is currently working for the University of Sydney on a project to develop diversification options for brackishwater pond farmers in Indonesia, and on improving fish health to increase productivity in marine cage culture.



PL01

Securing the Future for Marine Finfish Aquaculture in Asia

MICHAEL A. RIMMER*

University of Sydney/
ACIAR Field Support Office, Makassar, South Sulawesi, Indonesia

*Corresponding author's e-mail: mike.rimmer@sydney.edu.au

Abstract

Global demand for fish products is increasing in line with population growth, increasing affluence in developing countries and growing per capita consumption of fish. It is well accepted that capture fisheries are fully or over-exploited and that supply will increasingly come from aquaculture production. Based on demographic and economic projections for fish demand, most of this future demand is likely to come from developing countries, particularly China and India. Asia will remain the main supply source for increasing aquaculture production for the foreseeable future.

Because aquaculture will play a vital role in human nutrition globally, cage aquaculture will have to develop technologies and production systems similar to those seen in other intensive animal production industries, including selective breeding programs, improved seed production technologies, and more cost-effective grow-out systems. However, in contrast to terrestrial agriculture, and even temperate aquaculture, tropical aquaculture is disadvantaged because of the high diversity of species cultured, and the frequent shifts in production trends between various species. Consequently, a focussed effort on developing advanced technologies for a limited range of species is difficult. Despite this, there is a clear need for improved technologies, particularly in regards to compounded feeds and fish health management.

In general, cage aquaculture in Asia is dominated by smallholder farmers. Small-scale farmers tend to be driven by cost issues, often at the expense of quality. This makes large-scale technological adoption difficult, and contributes to variations in product quality that are not acceptable to some markets.

The continued development of cage aquaculture in Asia is likely to be dualistic. On the one hand, large-scale or 'industrial' scale farms that focus on a limited range of species that are amenable to large-scale culture (e.g. barramundi, pompano, cobia) will increasingly be significant providers of

aquaculture products, particularly for the global ‘white fish’ market. In contrast, small-scale farmers will continue to be a major feature of Asian cage aquaculture. Increasingly, small-scale farms will need to focus on species that do not compete for the ‘white fish’ market that can be more efficiently produced by large-scale farms (e.g. groupers and snappers).

Most governments focus on large-scale producers because they contribute more effectively to national productivity (and in many cases to foreign earnings through exports) and they also contribute to national pride, providing examples of modern production technology. Despite the need for such operations, it is essential that the needs of small-scale farmers are considered and their livelihoods as aquaculture producers are secured. ‘Securing the Future’ for cage aquaculture in Asia means developing and supporting a diversified production base that provide opportunities for a range of scales of production, and access to the diversified market opportunities that will only expand as demand for fisheries products increases.

PLENARY LECTURE

DATO' AHAMAD SABKI MAHMOOD

Dato' Ahamad Sabki Mahmood assumed the position as Director-General of Fisheries Malaysia in August 2010. He began his distinguished career as an officer in the Department of Fisheries (DoF) immediately after graduating with B.A. (Hons) in Socio-Economic Science from Universiti Sains Malaysia in 1978. He subsequently obtained his Master of Science (Agricultural Extension Studies) from the University of Queensland, Australia in 1987.



In his 33-year career with Department, Dato' Ahamad Sabki has held a number of major positions. He was the Director of Fisheries, Penang State from 1988-1992, following which he headed various sections within the Department's headquarters covering marine extension, communications and planning. Over the 1998-2003 period, he headed three departmental directorates i.e on extension and education, resource management and protection as well as planning and development. He was appointed the Deputy Director-General of Fisheries Malaysia in March 2003 before he was entrusted to lead the Department as its Director-General starting from 7th August 2010.

As Director-General, Dato' Ahamad Sabki has been actively involved on the planning and implementation of a number of major initiatives where the development of the fishing community is concerned. These include the Fisheries Enterprise Adoption and Development Programme, Integrated Fisheries Extension System, Fisheries Ecosystem Management Group Programme and the Skippers' Development Programme.

He has always been passionate about the importance of entrepreneurship in the development of the fishing industry and shared his ideas on the subject on many occasions, including during keynote speeches delivered at various workshops and conferences, nationally and internationally.

Apart from his service with the Department of Fisheries, Dato' Ahamad Sabki is the Council Director of Malaysia for the Southeast Asian Fisheries Development Centre (from 2010 till present). He was also member of the Fisheries Development Board (from 2000 – 2006), and member of World Fish Centre (WFC) Board of Trustees (from 2008 until present). Given his extensive experience in fisheries related activities, he has also been appointed as a Permanent Member of the ASEAN Fisheries Consultative Forum Body (AFCFB).

Dato' Ahamad Sabki has received numerous accolades and awards for his contributions to the Malaysian fisheries and aquaculture industry. He was awarded the prestigious Darjah Indra Mahkota Pahang (DIMP) award from the State Government of Pahang in 2007, which carries the title 'Dato'. Other decorations include the Paduka Setia Mahkota Kelantan in 2005 from the State Government of Kelantan and Excellent Performance Award, DoF Malaysia in 2002.

PL02

Cage Aquaculture in Malaysia – Towards Realizing New Key Economic Areas

AHAMAD SABKI MAHMOOD*, K. SUBRAMANIAM AND MUNIR MOHD NAWI

Department of Fisheries Malaysia, WISMATANI, Putrajaya, Malaysia

*Corresponding author's e-mail: ahamadsabki@dof.gov.my

Abstract

Cage aquaculture in Malaysia is a fast developing sub-sector and is being promoted continuously by Department of Fisheries Malaysia under the Fourth National Agriculture Policy (NAP 4). This policy is aimed at turning the agro-food sector into a competitive and sustainable industry to ensure sufficient food supply that is safe for human consumption.

Over the last 3 consecutive years, cage aquaculture production in Malaysia recorded a double digit growth and in 2010, the production was 34,154 tonnes. The industry is expected to maintain this encouraging growth and contribute significantly towards meeting the increasing demand for fish protein by adopting a new approach called the Entry Point Projects (EPP) for integrated cage aquaculture (i-CAGE) development.

As such, cage aquaculture in Malaysia has gained importance by being one of the 16 different EPP in the agriculture sector under the New Key Economic Areas (NKEA) in Economic Transformation Programme (ETP). This sub-sector is expected to assist the nation in job creation, achieve a positive balance of food trade and contribute towards the increase in Gross National Income.

Large water bodies, mainly man-made lakes and reservoirs are used for freshwater cage aquaculture, concentrating on species like tilapia and riverine catfish. While sheltered coastal areas and large river mouth areas are the sites of choice for marine cage aquaculture with seabass, grouper and snappers as most important culture species. There are 3,000 ha of fresh water and 500 ha of marine or brackish water bodies available in the country for cage aquaculture development.

Though traditional cage aquaculture technologies have improved with good aquaculture practices, modern cage aquaculture techniques have been

adopted well in Temenggor Lake in collaboration with a Norwegian company. It is a vertically integrated system for eco friendly farming, producing fish that are safe, sustainable, with 100% traceability, using DNA technology for genetic marking. A containment system and waste management system is also incorporated to retrieve dead fish, uneaten feed and fecal materials to maintain the pristine condition of the lake by minimizing impact on the environment. Technology transfer is ensured through training and capacity building to unemployed graduates via synergy farming; while small scale farmers are encouraged to adopt contract farming with commercial operators in meeting social and economic challenges.

The current trend in marine cage aquaculture in Malaysia is to move away from traditional small scale system to large business models. This is possible with the involvement of technocrats and corporate sector using integrated approach to reduce dependence on imported seed stock and aiming for premium market having high demand for good quality fish. Some farmers have moved their operation further offshore using large cages, either semi-submerged or fully submerged, to take advantage of the better water quality.

Despite the availability of commercially produced dry feed, trash fish remain the major options among traditional cage operators. The government is committed in promoting the use of dry pellets for sustainable culture operation. Disease is a major concern but the use of efficient and effective vaccine in tilapia culture operation has ensured healthy and wholesome aquaculture. Such practices are still at an early stage in marine cage aquaculture. Hence Research and Development in cage aquaculture is placing its concerted effort on producing cheaper and efficient formulated feed, fish genetic and vaccine development.

Premium grade fish are produced in cage aquaculture system in Malaysia. Live fish are exported to Singapore, Hong Kong and China to take advantage of good market value, followed by local retail outlets and restaurant markets. Downstream activities are also being developed to produce value added products such as fresh and frozen fish fillet and fish fingers.

There is a greater potential for cage aquaculture development in Malaysia especially with its favourable climatic condition and investment opportunities. Hence the industry is envisaged to grow steadily to increase marine finfish production in the country and ensure food security via government incentives provided in EPP under NKEA.

LIST OF POSTERS FOR CAA3 SYMPOSIUM

Venue: Tun Razak Exhibition Hall 3, Level 3, PWTC

POSTER NO.

TITLES & AUTHORS

Policy and Regulatory Drivers in the Socio-Economics of Cage Aquaculture

- PP01 Poverty Reduction and Food Security through Cage Aquaculture Development in Uis, Erongo Region: A Case Study from Namibia
Johan van der Westhuizen, Louis van der Westhuizen and Md. Ghulam Kibria

Site Selection and Environmental Management

- PP02 Spatial Modelling for Freshwater Cage Aquaculture Site Selection in Batur Lake, Bali, Indonesia
I Nyoman Radiarta, Achmad Sudradjat and I Nyoman Adiasmara Giri
- PP03 Preliminary Research Findings on Tilapia Production in Cage Culture – Batang Ai Reservoir, Sarawak
Philip Wong
- PP04 Total Sulfide Concentrations at Batang Ai Reservoir and Implications for Aquaculture
Ling Teck Yee, Debbie, D.P., L. Nyanti, Norhadi, I. and Justin, J.J.E.
- PP05 Impact of Cage Culture on Water Quality in Batang Ai Hydroelectric Dam Reservoir, Sarawak, Malaysia
Lee Nyanti, Hii, K.M., Norhadi, I. and Ling, T.Y.
- PP06 Cage Culture of Asian Sea Bass (*Lates calcarifer*) in Persian Gulf and its Constraints
Mehdi Soltani, Ghanadian, B., Mirzaee and Yavari, H.
- PP07 Suitable Weight for Release Process and Marine Culture of *Rutilus frisii kutum* Fingerlings in South Caspian Sea
Seyedali Hosseini, Che Roos Saad, Annie Christianus, Mohammad Sayyad Bourani, Hassan Mohd Daud, Sharr Azni Harmin and Hadi Zokaei Far

Production, Technology and Systems

- PP08 Estuarine Fish and Oyster Integrated Cage Culture: An Environment Friendly Innovation
Westly R. Rosario, Raquel A. Ferrer, Reivin T. Vinarao, Angelito C. Dela Cruz, Nova Marie O. Pesebre, Annabelle Tenorio, Medel M. Espinosa, Criseldo Bautista, Rodel Bautista and Joselito Rantayo

- PP09 Bangus Culture in Cages at Cebu Technological University San Francisco Campus: Proposed Extension Training
Angelo B. Dalaguit, Mary Ann L. Dalaguit Dominador G. Surbano and Bonifacio S. Villanueva
- PP10 Catching Effectiveness of the Four Shallow Water Artificial Fish Shelters (Miracle Hole) using Indigenous Materials at the Coastal Waters of the Northern Poblacion, San Francisco, Cebu: Basis for Technology Guide
Dominador G. Surbano and Bonifacio S. Villanueva

Species Selection and Seed Production

- PP11 The Growth and Gonadal Development of Tank Cultured *Probarbus jullieni*
Mohd Fariq Ahmat and Annie Christianus
- PP12 Egg Development and Hatching in Freshwater and 10 psu Water on Marble Goby, *Oxyeleotris marmoratus* Caught in a River in Sabah, Malaysia
Nguang Siew-Ing, Yoshizumi Nakagawa, Keitaro Kato, Osamu Murata, Kenji Takii, Shigeru Miyashita and Shigeharu Senoo
- PP13 Effects of Timing of First Feeding for Nutrition Transition Period on Marble Goby, *Oxyeleotris marmoratus* Larvae
Siti Fairus Mohamed Yusoff, Ching Fui Fui and Shigeharu Senoo
- PP14 Vitellogenin in Boosting up Reproductive Performance of *Lates calcarifer* in Captivity
Noor Fazielawanie Mohd Rashid, Siti Shapor Siraj, Ina Salwany Md Yasin, Sharr Azni Harmin and Nik Daud Nik Sin
- PP15 Feeding Activity of White-Leg Shrimp, *Litopenaeus vannamei* Post Larva under Different Environmental Conditions
Audrey Daning Tuzan, Annita Yong Seok Kian and Kiu Hie Yung
- PP16 Physiological Performance of White Shrimp, *Litopenaeus vannamei* Cultured in Freshwater Medium by Potassium Application
Aan Fibro Widodo, Brata Pantjara, Noor Bimo Adhiyudanto and Rachman Syah
- PP17 Quality Improvement of Broodstock, Larvae and Juvenile of Abalone *Haliotis squamata* (Reeve, 1846) through Environmental Management
Ibnu Rusdi, Bambang Susanto, Riani Rahmawati and I Nyoman A. Giri

- PP18 Maternal Inheritance of Yellowfin Tuna (*Thunnus albacares*) in Captivity
Gusti Ngurah Permana, Jhon Harianto Hutapea, Sari Budi Moria and Haryanti

Biosecurity and Health Management

- PP19 Infection Susceptibility of Adult *Caligus rotundigenitalis* on Six Marine Finfish Cultured in Cages in Penang, Malaysia
Leaw Yoon Yau, Anil Chatterji, Beng Chu Kua and Faizah Shaharom
- PP20 Antibiotic Sensitivity Study of *Aeromonas hydrophila* Isolated from Clinically Infected Freshwater Fishes (*Oreochromis mossambicus*, *Puntius gonionotus*, *Leptobarbus hoevenii*, *Pangasius pangasius*, *Anabas testudineus*, *Clarias gariepinus* and *Cichlasoma* sp.) in Malaysia
Hassan Mohd Daud, Ruhil Hayati Hamdan, Nur Hidayahanum Hamid and Mohd Fuad Matori
- PP21 Isolation, Identification and Pathogenicity of *Aeromonas hydrophila* from MAS (Motile Aeromonas Septicemia) like Disease in Juvenile Tilapia, *Oreochromis niloticus*
Hassan Mohd Daud, Nur Hidayahanum Hamid and Ruhil Hayati Hamdan
- PP22 Significance of Immunity in Disease Management of Caged Grouper
Catherine Chieng Cheng Yun, Mariana Nor Shamsudin, Fatimah Mohd Yusoff and Maha Abdullah
- PP23 Development of Monoclonal Antibodies against Phagocytic Leukocytes of Brown-Marbled Grouper, *Epinephelus fuscoguttatus*
Chong Chou Min, Mariana Nor Shamsudin, Than L.T.L., Fatimah Md Yusoff and Maha Abdullah
- PP24 Site-Specificity Study of Monogenean Gill Parasite in Pond Cultured Patin Buah (*Pangasius nasutus*) at Aquaculture Extension Centre, Perlok, Jerantut, Pahang
Surzanne Mohd Agos and Faizah Shaharom-Harisson
- PP25 Preliminary Studies of Aquatic Fungi in Malaysian Water Bodies
Hassan Mohd Daud and Seyedeh Fatemeh Afzali
- PP26 Effect of *Cinnamomum camphora* and *Thymus* as Antimicrobial on the *Petrophyllum scalare* Fish
Tara Etemadi, Amir Abbas Esmailzadeh, Maral Dara, Mohammad Hossein Bazghandi and Farbod Hajobashi

Feeds and Feeding

- PP27 Effects of Different Feeding Regimes on Growth of Nile Tilapia
(*Oreochromis niloticus*)
Jeong-Yeol Lee and Yang Gao
- PP28 Palm Oil Based-Diet Enhances Growth Performance of Asian
Seabass (*Lates calcarifer*, Centropomidae) Juveniles
Rossita Shapawi, Muhammad Aizat Mohd Zain and Shigeharu Senoo
- PP29 Vegetable Oils Based - Feed for Grow Out Culture of *E.*
fuscoguttatus
Norfazreena Mohd Faudzi, Rossita Shapawi and Shigeharu Senoo
- PP30 Growth Performance of Juvenile Marble Goby, *Oxyeleotris*
marmoratus Fed with Different Dietary Protein Levels
Ooi Shing Yau, Rossita Shapawi and Annita Yong Seok Kian
- PP31 Feeding Biology and Diet Composition of the Freshwater Fish,
Sardinella tawilis in Taal Lake (Batangas) in Southern Luzon,
Philippines
Richard M. Magsino

**ABSTRACTS FOR
ORAL PRESENTATION**

STC1

Trends in the Global Seafood Trade

HELGA JOSUPEIT*

Fishery Industry Officer,
Products, Trade and Marketing Service (FIPM),
Fisheries and Aquaculture Department,
Food and Agriculture Organisation of the United Nations (FAO),
Viale delle Terme di Caracalla
00153 Rome, Italy

*Corresponding author's e-mail: Helga.Josupeit@fao.org

Abstract

Demand for seafood is growing worldwide. Both developed and developing countries are interested in consuming seafood. As a result, seafood products are one of the most traded products in the world, with about 37% of the production entering international trade. In recent years, the composition of fish production has changed, with more aquaculture products being produced, while wild capture fisheries stay stable. As a result, today about half of the world fish and seafood consumption is coming from aquaculture. FAO estimates that by the year 2015, more farmed fish than wild fish will be consumed. However, there are challenges for seafood trade. One is the limit to production, which is already reached for capture fish production. For aquaculture, the limits are set by limited of areas where seafood can be grown and by limits to amount of feed produced suitable for fish and shellfish aquaculture, especially the limits to world fishmeal production. In addition, tariffs and non tariff barriers create problems to international seafood trade. In international negotiations, some tariffs for seafood have been reduced; however, non tariff barriers are becoming more important. These include sanitary controls, enforcements of measure to reduce IUU (illegal, unregulated and unreported fisheries) fishing and measures on reduction of by-catch, to mention just a few. In addition to these official measures by importing countries, seafood trade is experiencing a growing number of certification schemes, trying to evaluate the sustainability of a fisheries or a fish farming system.

STC2

Seafood Market Trends in Japan

GOICHI SAKITA*

Texchem Food Sdn. Bhd.
Level 18, Menara Boustead Penang
39, Jalan Sultan Ahmad Shah
10050 Penang, Malaysia

*Corresponding author's e-mail: sakita@texchemfood.com

Abstract

After the tsunami on 11 March 2011, the situation in Japan has changed significantly. Important issues affecting the seafood industry are radioactive contamination, the strong Yen, damaged fishing ports, etc. The radioactive contamination has decimated Japan's fish exports to other countries and a reduction in the sales at Japanese restaurants. This has changed the Japanese mindset and encouraged the population to consume more imported food. China today produces and supplies high valued-added products for the Japanese market, such as fish preserved by miso, grilled salmon, dry capelin, etc. Due to the destruction of the fishing ports, one of Japan's most popular fish, saury called 'sanma' in Japanese is no longer available. As a replacement, Japan is importing a lot of 'sanma' from Taiwan this year.

This presentation will describe the recent trend in Japanese seafood in the world and the seafood market in Japan post March 11.

STC3

China Seafood: Where will be the New Value Added Flows?

JEAN-YVES CHOW*

Senior Industry Analyst - North East Asia,
Rabobank International, Hong Kong Branch,
Food & Agribusiness Research and Advisory,
10/F York House, The Landmark, 15 Queens Road Central
Hong Kong

*Corresponding author's e-mail: JeanYves.Chow@rabobank.com

Abstract

China seafood industry likewise other major commodity will probably be the major swing factor in the supply and demand equation and thus trade. The specificity of China seafood sector is the rapid change to simplistic model from "factory of the world" to a balance in "China value added" model integrating domestic growth and new trade flows. Emergence of new organized sales channel (retail and food industry) and the double edged sword of China rising income and thus labour cost will reshuffle China seafood industry. In such a changing environment, China trade relationships with its neighbourhood countries definitely create new trade dynamics.

STC4

Seafood Trade in Asia: Trends in Supply and Demand with Special Reference to Malaysia

FATIMA FERDOUSE*

INFOFISH

Level 2, Menara Olympia

No 8, Jln Raja Chulan

50200 Kuala Lumpur, Malaysia

*Corresponding author's e-mail: info@infofish.org, infish@tm.net.my

Abstract

The post-recession recovery in the international fishery trade started in 2010 and persisted through the first quarter of this year. Out of the top fourteen markets that posted positive growths seven (7) were from the Asia/ Pacific region.

By the third quarter of the year, seafood demand in the western markets was being affected by the growing economic uncertainty among consumers, but many Asian markets maintained their 2-digit growth rates.

With more than 90% share in global aquaculture production, Asia continues to support rising seafood demand in domestic and export trade. China, Thailand and Vietnam are among the top five seafood exporters.

Fish consumption in SE Asia is much higher than the global average. Supported by the rising income of the people, strong regional currencies and good domestic prices, more fish now days are being sold to local and regional markets. Supply gaps are often met through imports, largely dominated by Asian exporters.

The trend is similar in Malaysia where per capita fish consumption is one of the highest in the world. As such, it is also an important market for seafood. In recent years, domestic production in the county has increased, particularly through freshwater aquaculture - reducing dependency on quantitative imports. Consumers in Malaysia are willing to pay premium price for high quality live and fresh fish. Retail price for such products increased by 40-50% over the last 3-4 year.

The fishery export trade has also been positive, supported by the aquaculture sector including mariculture. In recent years, market diversification has also been obvious in Malaysia's seafood export trade. There has been more focus, particularly towards Asia/Pacific market.

STC5

Market Access and Certification for Cage Aquaculture Products

AHMAD HAZIZI AZIZ*

Director, Fisheries Biosecurity Division,
Level 3, Podium 2, Wisma Tani, Lot 4G2, Presint 4,
Federal Government Administrative Centre,
62628 Putrajaya. Malaysia

*Corresponding author's e-mail: ziziawaameen@yahoo.com

Abstract

Certification is identified as one of the tools for better market access for products because it meets the applicable safety and performance standards required by regulatory authorities. The certification for cage aquaculture products is implemented to measure the level of compliance of the operators towards Good Aquaculture Practices. In 2009, the production from cage culture has contributed 30, 421 m.t. and with the value of RM489,268.00 from overall aquaculture production which involves *Oreochromis* sp., *Pengasius* sp., *Lates* sp., *Epinephalus* sp. and *Lutjanus* sp. and mainly cultured in Perak, Pulau Pinang, Selangor, Johor, Pahang and Terengganu. The Department of Fisheries Malaysia has introduced Malaysian Aquaculture Farm Certification Scheme (SPLAM) and Good Aquaculture Practice Certificate (SAAB) certification scheme in 2004 and the Department has also introduced Fish Quality Certificate (FQC) for fisheries based establishments that comply with EU requirements in 2009. In order to obtain SAAB, SPLAM and FQC certificates, the cage culture operators will be audited and monitored frequently, participate in the government sampling programs and conduct self-testing on certain parameters pertaining to food safety. However, the number of certified cage culture establishments is still small due to the lack of awareness on the importance of certification scheme among the operators. As a measure to ensure the safety and quality of aquaculture products for human consumption, the government will impose new requirement by 2013 whereby only certified aquaculture products will be allowed to penetrate into local and international market.

KA01

Contemporary Trends in Fish Consumption and their Socio-Economic Impact on Traditional Cage Operators

M.C. NANDEESHA*

Fisheries College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Tuticorin-628008, India

*Corresponding author's e-mail: mcnrāju@gmail.com

Abstract

World population is now 7 billion and most increases in the population would continue to occur in Asia. Interestingly, fish consumption is also on the increase in most countries and the demand for fish is expected to increase rapidly in Asia with the growth in economy and change in food habits. Increasing research evidences that prove the health benefits of fish is also on the increase and as a result, the demand for fish is expected to increase in all parts of the world, but major increase is anticipated in Asia. To meet the growing demand for fish, new technologies and systems of fish culture are evolving. With the long history of cage culture in Asia, cage farming is expected to increase in its scope and area of operation, with the increasing technical cooperation between different countries and also the participation of private sector. Cage culture introduction in new areas and its expansion in existing areas would become success and sustainable, if the technology is environmentally friendly, socially acceptable and economically remunerative.

Cage culture in Asia has been largely synonymous with the culture of high value species and that too by feeding fish that have good value as human food. As a result, such focus on high value species and heavy dependence on small fish to feed these high value species has caused much public debate and even banning of cage culture of some species in some countries of Asia. However, technological progress in developing quality diets that can be used for the culture of these high value species is gradually accepted by farmers and recently, FAO has completed a TCP project demonstrating the viability of culture of high value species by using pellet feed in five Asian countries. Further, intensive research efforts to grow high value species on low fish meal or no fish meal diet is expected to provide new stimulus for the expansion of aquaculture and allow more fish to become available for human consumption. In freshwater, fish like carps have been cultured in cages by harnessing the natural food from the reservoirs and such low cost systems have been providing livelihood to fishers and high quality protein to people. The success of tilapia

culture in cages and its ability to improve the livelihoods of people has also greatly helped to create good image of the system.

Food quality and safety, no longer remain as concerns of products meant for export, but also for internal consumption. Hence, culture systems have to be evolved by taking food safety and quality aspects at all stages of culture. Ensuring the availability of certified high quality fish in the market at an affordable cost is a major challenge as well as an opportunity for aquaculture professionals. Those who make space for the growth of aquaculture by taking these conditions in to account will not only become winners, but would also promote healthy and sustainable economy. Few Governments have initiated thought process and action plans in this direction, but much needs to be accomplished to ensure that the process is robust and verifiable by neutral agencies. With the improvement in economy of Asian economies, much of the aquatic food produced in Asian countries is likely to be consumed within the countries, at best within the region. In some countries of Asia, demand for the import of quality and safe products would remain high. Hence, to safeguard the health of consumers, regulatory measures that promote healthy aquaculture systems need to be promoted.

Expansion of cage culture would need clear policies of the Governments in identifying areas for the development of such systems, avoiding conflicts with traditional fishers who are dependent on such water bodies for their livelihood and developing access policies to such open water bodies need to be given priority. Aquatic resources in most countries still remain as common resources and the Governments have the best opportunity to produce aquatic food for the masses in a sustainable way by using such water bodies and developing suitable programs. Technological advances in aquaculture have not yet brought greater to poor, particularly woman and cage culture technology is no exception. Hence, to make, ocean farming a reality through cage culture and bring benefits to poor, need for greater resource allocation of resources to research and development and development of suitable policies are identified.

KA02

Promoting Aquatic Biosecurity as a Policy Instrument to ensure Production and Market Sustainability in the Asia Pacific – Role of NACA

CHADAG V. MOHAN, EDUARDO LEANO AND AMBEKAR E. EKNATH*

Network of Aquaculture Centers in Asia-Pacific (NACA)
Kasetsart University Campus, Bangkok, Thailand

*Corresponding author's e-mail: ambekar.eknath@enaca.org

Abstract

The epidemic spread and devastating impacts of aquatic animal diseases in the Asia Pacific have clearly demonstrated the vulnerability of aquaculture systems to infectious disease emergencies. The increasing globalization and trade volume of the aquaculture sector has created new mechanisms by which pathogens and diseases are introduced or spread to new areas.

The Network of Aquaculture Centres in Asia Pacific (NACA), an intergovernmental organization of 18 governments in the Asia-Pacific, works on the principle of cooperation and collaboration. Addressing aquatic animal health is one of the key program areas of NACA, with the purpose of assisting member governments to “*reduce the risks of aquatic animal diseases impacting the livelihoods of aquaculture farmers, national economies, trade, environment, and human health*”.

The focus of our presentation is on: (a) the Asia Regional Technical Guidelines developed by FAO and NACA for managing risks associated with movement of live animals and trans-boundary issues; (b) The quarterly aquatic animal disease (QAAD) reporting system in the Asia-Pacific region, being implemented as a joint activity among NACA, FAO and OIE Regional Representation (Tokyo); and (c) the governance and responsiveness of the Asia Regional Advisory Group (AG) on aquatic animal health. The AG is a 10-member high level group constituted by the Governing Council of NACA in 2001 in cooperation with OIE and FAO provides advice to NACA and Asian governments on aquatic animal health management. NACA facilitates the implementation of the mandate of the AG and works closely with the OIE and FAO to promote the role of the region in influencing international standard setting and trade policies.

Specific project driven activities facilitated and/or coordinated by NACA (visit www.enaca.org) have been contributing immensely to the strengthening of the regional health management and bio-security through capacity building, development of resource material, provision of technical assistance to individual countries and standard operating procedures; and promoting adoption of better aquatic animal health management practices.

The demand for responsibly produced and certified aquaculture products is predicted to increase substantially in coming years. It is very important that small scale farmers are better prepared to meet these challenges in order to sustain their livelihoods. One important approach is implementation of **Better Management Practices (BMPs)** through a **cluster/group management approach**. NACA has played a pivotal role in collaboration with FAO in the development of FAO Guidelines for Aquaculture Certification. NACA will continue to support aquaculture sector to prepare for and participate in public and private certification programs developed in conformity to the FAO Global aquaculture certification guidelines. NACA's experience in India, Indonesia, Thailand and Vietnam clearly suggests that adoption of BMPs improve yields and quality of products taking into consideration animal health and welfare, food safety, environmental and socio-economical sustainability.

Judging by the progress made over the last decade, it can be confidently said that the region as a whole is now in a much better state of preparedness to implement aquatic bio-security as a governance tool. However, the region can't be complacent, and should ensure strong national commitment and continuous awareness and capacity building at producer, disease support and decision making levels for effective implementation aquatic bio-security framework.

OP01

The Contribution of Full Time and Part Time Cage Culture Fisheries to Farm Household Income

JARIAH MASUD*, TENGKU AIZAN HAMID, ZUMILAH Z., ISMAIL L. AND SHARIFF M.

Institute of Gerontology, Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia

*Corresponding author's e-mail: jariah@putra.upm.edu.my

Abstract

This paper presents findings of a study on contribution of earnings from cage aquaculture to total household income. Data were collected from 34 cage aquaculturists in the East Coast of Peninsular Malaysia from the district of Besut in the State of Terengganu. Data were collected with the cooperation of Besut Fishermen's Association using a questionnaire specifically developed for the study. The respondents of the study comprised two groups, 1) those working full time as cage aquaculturists and 2) those working as part time cage aquaculturists. Mean age of full time cage aquaculturists was 49 years old and part time aquaculturists was 43 years old. All respondents involved in this study were married for an average of 19 years. In general, the full time cage aquaculturists had lower educational qualifications as compared to the part time cage aquaculturists. More than half (53%) of the part time aquaculturists had a college degree while high school or Form Six was the highest educational qualification of the full time aquaculturists. When respondents were asked to indicate income received from various sources in the last 12 month period, majority (80%) reported receiving income from two sources and only 15% had one source of income. Mean annual income from cage aquaculture was RM24,339.39 (USD8113.13*) with minimum of RM2000 (USD666.67) and maximum of RM70,000.00 (USD23,333.34). The mean annual income of those working as full time cage aquaculturists was much higher, RM30,087.50 (US10,027.16) compared to only RM18,929.41 (US6,309.80) among the part time cage aquaculturists. The mean total income reported by the respondents in this study was RM37,825.29 (USD12,608.43) with mean monthly income of RM3,152.94 (USD1,050.98), which is much higher than the poverty line income. Only four respondents earned monthly income below RM1,000.00 (USD333.33). Full time cage aquaculturists earn on the average RM37,647.06 (USD12,549.02) per annum. The cage aquaculture income contributed on the average 64% to household income. The full time cage aquaculturists received 74% of their household income as compared to only 55% amongst the part time aquaculturists. The data revealed that cage aquaculture can provide significant amount of income to even part time aquaculturists. Aquaculture should be developed hand in hand with marine fishery and with proper training and guidance for the stakeholders, aquaculture would become the industry of the future and contribute to the food security and to GDP of the country and at the same time help reduce poverty rates.

**exchange rate of USD1.00=MYR3.00*

OP02

Developing Community-Based Ecotourism of Mangrove Ecosystems to Enhance Rural Livelihoods and Conservation of Resources: The Case of Kota Marudu, Sabah, Malaysia

AWANG NOOR ABD. GHANI*, ABDULLAH MOHD, FARIDAH HANUM IBRAHIM, MOHAMED ZAKARIA HUSSIN, KAMZIAH ABDUL KUDUS AND YIP HIN WAI

Faculty of Forestry, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*Corresponding author's e-mail: awang@forn.upm.edu.my

Abstract

Mangrove ecosystems provide important marketed goods and ecological services both on and off-site. These include timber resources for charcoal and poles, marine products (fish, shellfish, prawn, crabs), medicinal plants, shoreline protection, habitat for wildlife, carbon sequestration, ecotourism, cage culture activities, recreational fishing and others. One of the mangrove services is ecotourism opportunities, which can be developed by government agencies with the participation from private sector and local communities. Mangrove and coastal resources in Kota Marudu, Sabah are rich in biodiversity and has high potential to be developed into a community-based ecotourism (CBE). The concept of CBE is to provide ecotourism that is managed and owned by the community, which uses local service providers and suppliers as well as focuses on interpreting and communicating the local culture and environment. This will enhance rural livelihoods through harnessing the mangrove resources found in the vicinity of this area. This paper highlights the results of a study conducted in Kota Marudu, Sabah by assessing mangrove resources, socio-economic of local community, cage culture activities, stakeholder analysis and their potential for ecotourism development. The study involved inventory of mangrove resources, survey of socio-economic status and their perception and willingness in CBE, analysis of cage culture and its potential development, stakeholder analysis and ecotourism development plan. The study found that mangrove in Kota Marudu is highly diverse comprising exclusive and non-exclusive mangrove species. The fauna of mangrove in Kota Marudu is mainly birds of 15 species. The local community is too dependent on fishing and marine resources for their livelihood without taking advantage of other potential use of mangrove ecosystem such as ecotourism. Cage culture activities are being carried out by coastal fishermen in the Marudu Bay in a little-mechanized, traditional fashion and small scale operation. The cage culture activity is considered as a good potential ecotourism product for the coastal fishery communities to increase their income. There are some problems related to these activities due to lack of technical know-how, lack of capital and lack of infrastructure facilities. The local communities were willing to participate in ecotourism activities including cage culture and they acknowledged that the mangrove forests can be used for this purpose as well as for habitat conservation. A long term ecotourism development plan is needed in order to increase business and local community participation. Government's role is important to upgrade infrastructure facilities in the area and incentives for ecotourism development including cage culture. Capacity building for local community was also conducted to increase knowledge and skills in ecotourism development.

OP03

Cage Aquaculture: A Sustainable Business Model

AZMI ABDUL HAMID, INDRA DEVI RAJAMANO HARAN AND ROZAINUN HJ ABDUL AZIZ*

Faculty of Accountancy & Accounting Research Institute
Universiti Teknologi MARA
40450 UiTM Shah Alam, Selangor, Malaysia

*Corresponding author's e-mail: rozainun@salam.uitm.edu.my

Abstract

Cage aquaculture is a growing industry particularly for countries lying in the Asian region. Despite its widespread recognition, the development of cage aquaculture in Asian countries like Malaysia has been slow. The Malaysian government in its Third National Agricultural Policy (1998-2010) highlighted the importance of developing the country's aquaculture industry. As a coastal developing country Malaysia occupies a strategic position in the fisheries sector. Despite its strategic position, the country faces strong competition from other developing countries within the Asian Region, who have developed large scale cage culture. In Malaysia, partly, due to the lack of proper knowledge, and also in the absence of a proper business model, potential investors are sceptical on the long term investment of cage aquaculture projects. In the absence of a formal business model, the long term sustainability of the Malaysian fishing industry can be threatened. This paper therefore discusses the on going issues and the potential benefits of cage aquaculture from a risk and return perspective. Drawing from the literature and an initial case findings an appropriate sustainable business model will be proposed for the the development and assessment of cage aquaculture projects. The proposed model will include risk, returns and value management.

OP04

Implications of Juvenile Fishery Policies and Regulations on the Feasibility of Siganid Culture in Alaminos and Bolinao, Pangasinan, Philippines

PAUL JOSEPH B. RAMIREZ*

The WorldFish Center- Philippine Country Office
College, Los Baños, Laguna, Philippines

*Corresponding author's e-mail: pjbramirez@yahoo.com

Abstract

Juvenile fishery policies in Alaminos and Bolinao, Pangasinan do not only focus on mesh-size regulation but also involves closed seasons for catching specific types of fish. In the case of Siganid juveniles (*padas*), closed seasons are set at the peak of the spawning season from April to July in Alaminos and on the month of April in Bolinao. The strict implementation of these regulations not only prevents by-catch of juveniles but also hinders those who intentionally catch *padas* sold for *bagoong* production. At first glance, it may seem that existing policies are costly both for fishers, foregoing an easy source of income, and for the LGU and organizations engaged in enforcement and monitoring. But on the sustainability side, such policies would allow replenishment of fish stocks and greater catch of full size Siganid which has a higher per unit value than the juvenile counterpart. Given this dilemma, the study compared the economic sustainability and viability of various siganid-related livelihood activities and practices such as catching *padas* used for *bagoong* production, allowing the *padas* to grow at marketable size before catching and engaging in Siganid culture. The economic cost and returns involved in each activity were analyzed and compared. The problems and constraints for these activities were also enumerated and discussed. Lastly, the study also looked at the implications on the distribution of income for adopting a particular practice.

OP05

Impact of Salinity Fluctuations of Rambungan River (Borneo Island) on Cage Aquaculture and its Economic Implications

NORZAIHAN HASHIM^{1*} AND SANDY LIM²

¹Universiti Teknologi MARA Sarawak, Jalan Meranek,
94300 Kota Samarahan, Sarawak, Malaysia

²Rambungan Marine Aquaculture, Lot 1 Sungei Rambungan,
94500 Lundu, Sarawak, Malaysia

*Corresponding author's e-mail: norzaihan@sarawak.uitm.edu.my

Abstract

Brackish water aquaculture is a highly lucrative and fast growing billion dollar industry in Malaysia. The Rambungan River in Sarawak has a huge potential in brackishwater cage aquaculture. However, there is still a lack of basic essential information on the ability of the river to support brackishwater aquaculture, particularly where water quality parameters such as salinity are concerned. As salinity is a key factor in controlling fish growth, this study provides the much needed information on salinity patterns within Rambungan River and relates it to the economic implications on the cage aquaculture. Survey stations were selected in the cage culture area within Rambungan River to collect salinity data over a period of 21 months from November 2009 until July 2011. The salinity data was charted and a cyclical pattern was charted. For most part, salinity during the survey was reasonably stable for aquaculture, ranging between 25ppt to 30ppt. However, during the first quarter of the calendar year, which coincided with the local monsoon, there was a wide fluctuation in salinity and levels could dip to below 5ppt over a period of a few days. The salinity pattern has implications on the economics of cage aquaculture as it affects the species of fishes (such as species of grouper, snapper and seabass) that are suitable for culture and the timing for stocking the juveniles.

OP06

Empowerment of Namibian Youth Group through the Uis Fish Farming Eco-Tourism Enterprise: A Case Study

MUGIHO ATAKA¹ AND MD. GHULAM KIBRIA^{2*}

¹Former Fish Culture Development Officer (JICA/JOCV Volunteer), Namibia

²Special Aquaculture Advisor to Hon Minister, Commonwealth/MFMR-Namibia

*Corresponding author's e-mail: kibriamg@mfmr.gov.na, ghulam.kib@gmail.com

Abstract

The aquaculture sector is one of the first sectors which strived at restoring the imbalances created by the apartheid. Government instituted a number of important policies and legislation to address this inequality and empower Namibians that includes youth in the aquaculture sector. The majority of Namibians employed in the aquaculture sector constitute a larger percentage of youth (60%). The youth are employed in various sub-sectors such as onshore processing factories as well as onboard of fishing vessels as crew. Uis is a village located in Erongo Region, Namibia. It belongs to the Dâures electoral constituency and is located in the former Damaraland, known for the local mineral wealth. The settlement has approximately 3,600 inhabitants and owns 10 square kilometres (3.9 sq mi) of land. Namibia is largely affected by a high rate of unemployment of more than 50%. Three quarters of unemployed are youth who have either failed at grade 10 or grade 12 or were unable to go to any University due to cost implications. The Japanese Government awarded the Uis Fish Farming Eco-Tourism Enterprise with a grant of N\$540,000. The grant was used for the purchase of four cages, fish feed, two boats with outboard motors, two chest freezers and other equipment necessary for the venture. The Enterprise commenced on the 11th September 2010, and was inaugurated by the Deputy Minister of Fisheries and Marine Resources, Hon. Kilus Nguvauva. The Enterprise was made possible by this grant, as well as the support of various stakeholders such as the Ministry of Fisheries, Ministry of Youth, Uis Village Council, the Erongo Regional Council and Japanese International Cooperation Agency. The enterprise has been conceptualized under normal business principles, where the youth have established a TRUST and an account through which transactions are made on a day to day basis. The enterprise is aimed at youth empowerment and to demonstrate the success of aquaculture as a good practice that can produce food, provide employment and generate income. The Enterprise involves farming tilapia (*Oreochromis mossambicus*) in cages in a borrow pit which has ample water supply. The project currently has 4 cages of (6m x 6m x 2m depth dimensions). Stocking density on 11 September 2010 was 17 000 fingerlings/cage. These four cages are able to produce 1 ton of fish each (of an estimated size of 400g each) for each production cycle. Sales of fish at N\$20/kg amounted to a total income of N\$26,460 per cage per production cycle. With the current 4 cages, the Enterprise can produce fish worth a total of N\$105,840 per production cycle of 8 – 10 months. If an additional 6 cages can be acquired for the enterprise, fish worth a total of N\$317,520 (6.8 N\$ = 1 US\$) can be produced over a period of one production cycle (8 – 10 months).

KA03

Cage Culture of Marine Finfish: Site Selection and Adaptation to Climate Change

SALEEM MUSTAFA*, ROSSITA SHAPAWI, ABENTIN ESTIM AND RIDZWAN ABDUL RAHMAN

Borneo Marine Research Institute, Universiti Malaysia Sabah,
88400 Kota Kinabalu, Sabah, Malaysia

*Corresponding author's e-mail: saleem@ums.edu.my, saleem.mustafa500@gmail.com

Abstract

Stocking of marine finfish in cages is a popular grow-out method in the Asia-Pacific region. Fingerlings of high value species are grown to harvestable size in cages and supplied mostly to operators of live fish trade. Environmental factors strongly influence survival, growth and productivity of captive fish whether reared in stationary or floating net cages. This paper reviews the environmental conditions considered suitable for cage culture in the inshore waters. Potential effects of climate change on cage culture are also discussed with special reference to changes in sea level, water temperature, precipitation, acidification, oxygen depletion, hydrodynamic processes, and frequency of red tides and severe weather events. Indirect effects such as the effect on supply of fish meal and fish oil for growing captive fish are highlighted.

Climate change is a powerful factor affecting the global environment and certainly has an influence on fisheries and aquaculture. Effects of changes in the oceanic conditions as explained above on the ecology and physiology of marine life have received attention in recent years but there is no empirical data on fish production that can be directly related to climate change.

Uncertainty in predicting future changes in temperature, pH, hydrology and precipitation makes it difficult to project specific effects of climate change on fish production. Models of climate change predictions are available and still evolving but the problem lies in evolving models for biological systems such as effect of climate change on fish growth and production. Of course, it will be interesting to predict fish production through cage culture in a changing climate but the requirements of models for biological and non-biological systems are so fundamentally different that even if we can predict models of sea level rise, increase in seawater temperature and acidification, a different nature of experiments and synthesis of biological information will be required for generating data that will meet the requirements of the model. As an example,

projecting specific effect of climate change on growth of fish will require data on physiological changes that temperature produces. Generally, temperature enhances rate of metabolism which stimulates growth but the metabolism-modulating role of temperature is itself modulated by pH, oxygen supply and other factors. We also do not know how food conversion in fish will be affected when the fish is faced with a multiplicity of factors to which it is not adapted. In terms of cost-benefit, if somatic gains are offset by increase in ration supply, the production might not necessarily be economically viable.

Despite such problems with modelling the predicted effect of climate change on fish in cage culture systems, action plans have to be evolved through developing adaptive strategies for addressing or mitigating its effects on fish production. The adaptability will involve site selection (for security, shelter, and stability of surrounding environment), depth (for effective flushing below the cages), trials involving location of artificial reefs, selection of more resilient species, securing cage culture from red tides, avoiding upwelling areas, and building resilience in marine critical habitats if cage culture is to establish in their close proximity.

OP07

Milkfish Culture in Marine Cages in the Philippines

CRISPINO A. SACLAUSO*

Institute of Aquaculture, College of Fisheries and Ocean Sciences,
University of the Philippines Visayas,
Miagao, Iloilo, Philippines 5023

*Corresponding author's e-mail: casacluso@yahoo.com

Abstract

Farmed milkfish in the Philippines valued at US\$ 629 M, comes mostly from brackishwater fishponds (62.4%). Due to the moratorium on the conversion of mangroves into aquaculture pond, part of this production (US\$ 161.72 M) is also sourced out from cages in freshwater, marine and brackishwater environments. Although mariculture, particularly cage farming, is confronted with issues related to resource use and pollution, it remains the only viable option for expansion.

Milkfish marine cages in the Philippines at stocking densities of less than 10 individuals m^{-3} to 38 fish m^{-3} , produce around 3.5 kg m^{-3} to 22 kg m^{-3} . Empirical evidence shows that additional production can be attained with further increases in stockloads up to 100 fish m^{-3} . Incremental production rate diminishes beyond the density of 50 fish m^{-3} as a consequence of declining specific growth rate but net biomass continues to increase proportionately with density without incurring depensatory mortalities. Size structure of populations grown at higher densities is skewed positively, yielding large biomass of small individuals (>50%) at the density of 100 fish m^{-3} . Growth and survival however, are still comparable among populations reared at different densities.

While milkfish seems tolerant to crowding, increasing the stockload beyond the density of 100 fish m^{-3} have to be judged within the context of size variability and environmental sustainability. Cage with effective volume of 8 m^3 and stock densities of 12.5-100 fish m^{-3} , can potentially release 0.575 to 3.937 kg N and 0.340 to 2.326 kg P to the environment that could affect the integrity of the habitat under the cages including those areas within few kilometres of the farming site. Thus, further expansion of aquaculture in the nearshore marine environment has to be thoroughly evaluated and regulated.

OP08

Influence of Tilapia Cage Culture on Water Quality and Plankton Composition in Lam Pao Reservoir, Thailand

PRANEET NGAMSNAE^{1*} AND PIANGPEN CHAYCHAROEN²

¹Department of Fishery Science, Faculty of Agriculture, Ubon Ratchathani University, 34190, Thailand

²Division of Fisheries and Aquaculture, Yasothon College of Agriculture and Technology, Yasothon 3500, Thailand

*Corresponding author's e-mail: praneet@agri.ubu.ac.th

Abstract

The effects of tilapia cage culture on water quality and phytoplankton composition in Lam Pao reservoir were monitored at four stations; three stations located under tilapia cage farms with capacities of about 59, 71 and 89 tons, the fourth station serving as a reference site, between February and October 2009. The results revealed that water temperature did not differ among stations while dissolved oxygen and pH values were slightly lower in the stations with cages. The presence of fish cages slightly increased ammonia and nitrate nitrogen and significantly increased orthophosphate. The abundance of phytoplankton was highest in the maximum capacity cage station. Significant increase in chlorophyll *a* in the fish cage stations was observed in rainy season. The Bacillariophyta was dominant in reference station but relatively less important in the tilapia cage sites. The abundance of phytoplankton (40 species) due to the presence of fish cage culture significantly increased compared to the findings of previous study (29 species) while the fish cage culture practices in Lam Pao reservoir had not been started. These results indicate that the cage farms had a localized effect on the reservoir water quality and plankton composition at its recent production level. The long-term effects of different farm capacities should be investigated for sustainable cage fish farming in the reservoir.

OP09

Status of Cage Culture of Fish in Nepal

MADHAV K. SHRESTHA^{1*} AND JAY D BISTA²

¹Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal

²Fisheries Research Centre, Pokhara, Kaski, Nepal

*Corresponding author's e-mail: madhavshrestha1954@gmail.com

Abstract

In most cases cage fish culture is practiced with intensive feeding with high stocking rates for higher economic benefits. However, cage fish culture in Nepal is extensive type where external feeds are not supplied and fish feeds on only naturally available plankton for growth. Such extensive culture is considered as environment friendly activity.

The cage fish culture in Nepal started in Lakes of Pokhara valley in 1975 and this technology was expanded in Indrasarobar Reservoir during 1983. At present cage culture of planktivorous fish bighead carp (*Aristichthys nobilis*) and silver carp (*Hypophthalmichthys molitrix*) are common species for extensive cage fish farming which is very much popular and profitable small-scale enterprise in Nepal. Cage culture of grass carp (*Ctenopharyngodon idella*) with aquatic grass feeding has become popular very recently with increased productivity. Now a days, cage fish culture is carried in lakes and reservoir of mid hill region of Nepal. Generally, Nylon or polyethylene made floating cage of approximately 5 m long, 5 m wide and 2 m deep with 50 cubic meters of total volume are the most common size. The productivity of cages ranges from 1.3-8.4 kg/m³/year depending on the trophic status of lake and reservoir as well as the farming method.

OP10

Climate Change Effects on Fisheries and Aquaculture in the Philippines: Implications on Environmental Management

LEN R. GARCES*

WorldFish Center – Philippine Country Office
SEARCA Building, College
Los Baños, Laguna, Philippines

*Corresponding author's e-mail: L.GARCES@cgiar.org

Abstract

The fisheries sector is vital to the Philippine economy, providing substantial employment and income, contributing export earnings, and meeting local food security and nutrition requirements. In 2009, the contribution to the country's total fish production from fisheries and aquaculture was about 5.08 million MT (BFAR 2009). Of which aquaculture had the biggest share with 49%, while commercial and municipal fisheries contributed to approximately 25% and 26%, respectively.

Climate change stresses are anticipated to compound existing pressure on fisheries and aquaculture and threaten their capacity to provide food and livelihoods. Many capture fisheries worldwide, including that of the Philippines have declined sharply in recent decades or have already collapsed from overfishing, and major fishing grounds are concentrated in zones threatened by pollution, the mismanagement of freshwater, and habitat and coastal zone modification. Aquaculture needs to expand sustainably to fill supply shortfalls as demand for fish for human consumption continues to rise but, even more than fisheries, aquaculture is concentrated in areas with intense competition for environmental services. Sustaining fisheries in the face of these challenges, and ensuring that they contribute to development as effectively as possible, will be more difficult as the climate changes. Similarly, realizing the potential of aquaculture will require careful attention to climate change impacts and the constraints and opportunities they bring.

Southeast Asia, including the Philippines is considered highly vulnerable to climate change impacts. Changing rainfall patterns, rising temperatures, increasing frequency and intensity of typhoons and dry spells, and sea level rise are among of the expected results of climate change. This paper presents and discusses various adaptation and mitigation measures and strategic directions that the country has been undertaking or initiated. Suggested research to climate change issues related to fisheries and aquaculture are also presented.

OP11

Site Selection and Production Performance of Red Tilapia, *Oreochromis niloticus* Cage Culture Operations: The Batang Ai Hydroelectric Dam Reservoir, Sarawak, Malaysia Experience

MHD IKHWANUDDIN ABDULLAH^{1*}, HARIFFIN A.B.² AND ABOL MUNAFI AMBOK BOLONG¹

¹Institute of Tropical Aquaculture, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

²Inland Fisheries Division, Department of Agriculture, Sarawak, Menara PELITA, Petra Jaya, Kuching, Sarawak, Malaysia

*Corresponding author's e-mail: ikhwanuddin@umt.edu.my

Abstract

Cage farming of Red Tilapia, *Oreochromis niloticus* has expanded rapidly into private farm reservoirs of the Batang Ai Hydroelectric Dam Reservoir, Sarawak, Malaysia. During the grow-out season from 2000 till 2010, problem related to low productivity has caused economic losses. To set criteria for improved site selection, farm productivity information of the cage culture project was correlated with morphometric reservoir data as well as the techno-management practices. The data revealed good linkage between fish production data and reservoir information as well as techno-management practices. The production problems correlated ($P < 0.01$) with reservoir information and techno-management practices so that suggestions for risk management indicators can be made. The threshold values for good production practice were determined. Thereafter, the reservoir carrying capacity of at least 70,000 metric ton per year would be recommended which covered about 5% of total area of reservoir been farmed.

OP12

Marine Cage Culture in the Mariculture Parks of the Philippines

GIL A. ADORA AND ARNIL C. EMATA*

Bureau of Fisheries and Aquatic Resources,
3rd Floor, PCA Bldg., Diliman, Quezon City, Philippines

*Corresponding author's e-mail: Acemata01@yahoo.com

Abstract

Marine fishes are cultured in floating net cages at the Mariculture Parks of the Philippines. Established and promoted by the Bureau of Fisheries and Aquatic Resources (BFAR) of the Philippine government, mariculture parks are the present innovative approach for fish farming. Like an industrial estate, BFAR selects the sites and provides the needed infrastructure to lure investors to install and operate fish cages. The management of the mariculture park is governed by the Executive Management Council which is co-headed by BFAR Regional Director and the Chief Executive Officer or Mayor of the local government unit where the mariculture park is situated. In this way, the culture and operation of the park is guaranteed to be regulated to prevent ecological disasters and social inequities while fulfilling food security, providing livelihood and alleviating poverty for the country. Presently, almost all of the cages culture milkfish in the 67 mariculture parks established nationwide. However, high-value marine fishes are starting to be cultured in mariculture parks established in southern Philippines. Fish production from the mariculture parks is envisioned to be the major contributor for aquaculture production in the country from now on.

KA04

Large Scale Sustainable Tilapia Farming in Malaysia - Using Modern Cage Technology

OLAV JAMTØY*, LAI SEAD PING AND ALEJANDRO TOLA ALVAREZ

GenoMar AS/
Trapia Malaysia Sdn Bhd
No. 2, Jalan Taman Kinta, Chateau Garden,
30250 Ipoh, Perak, Malaysia

*Corresponding author's e-mail: olav.jamtoy@genomar.com

Abstract

The leading tilapia breeding company GenoMar, defined in 2006 a strategy to establish an integrated company within tilapia aquaculture. After a study of several locations in Asia, Lake Temenggor in Malaysia became the chosen location. Trapia Malaysia Sdn Bhd was established in 2007, with GenoMar as the main shareholder together with a local partner, with the following concept:

- Develop and implement a Vertically Integrated Tilapia Operation with “egg to plate” model
- Produce a sustainable, safe and healthy product
- Comply with global aquaculture standards and go beyond the legal environmental compliance
- Set a new industrial standard in food safety for tilapia farming

The first production started in late 2008 and the first harvest in 2009. An important part of the strategy was to use modern cage technology in the operations to utilize knowledge from other parts of the aquaculture industry into the tilapia aquaculture. As a part of this also managing a comprehensive environmental monitoring program, to secure criteria for sustainable development will be met. During the 2-3 first years of operation, all important international certificates for sustainable tilapia farming are achieved.

Trapia Malaysia Sdn Bhd has been working close with Ministry of Agriculture/Department of Fisheries, to establish a concept for local entrepreneur's to become fish farmers in a concept called Synergy Farming. One of three modules in operation is covered by this program.

In total the 3 modules has an annual capacity to produce 6 – 7.000 metric tonnes. Trapia Malaysia Sdn Bhd has a 30 year lease agreement covering in total 10 modules in Lake Temenggor.

OP13

ARDA (Association for the Development of Aquaculture in Reunion Island): The Marine Aquaculture Centre and its Innovative Cage Farming System

JÉRÔME BOSMANS* AND NICOLAS MACÉ

ARDA Aquaculture Marine Centre
Magasin 10, Port Ouest –97420 Le Port – Reunion Island (FRANCE)

*Corresponding author's e-mail: bosmansj.arda@orange.fr

Abstract

ARDA was created in 1991, with the support of the local government in order to enhance the development of Reunion Island's (located in the Indian Ocean) aquaculture sector. This R&D association operates as a link between research and professional application, in tropical continental and marine aquaculture, as well as hydrobiology.

ARDA initiates in 1998 an ambitious R&D program in order to test commercial scale marine aquaculture potential in Reunion Island. For the purpose of transferring innovative biotechnology in this field and adapting it to local conditions, a pluri-annual project starts in 1999 and is supported by EEC. It leads to the creation of two specific R&D and semi-commercial equipments:

- **A marine hatchery and nursery:** this facility can produce semi-commercial batches of tropical marine fish fry and advanced fingerlings. It was designed to develop and validate hatchery culture processes and protocols. For the past 10 years semi-commercial batches of cobia (*Rachycentron canadum*), red drum (*Sciaenops ocellatus*) and gold lined sea bream (*Rhabdosargus sarba*) fingerlings have been successfully produced and transferred to the ARDA semi-commercial pilot farm.
- **An offshore semi-commercial pilot farm:** this innovative cage farm has been designed to cope with tropical cyclone. Offshore grow-out conditions are difficult in Reunion Island due to strong current and significant swell. The farm can be purposely submerged within few hours in the case of the occurrence of high cyclonic swell. The production has been averaging 40 tonnes for the past 5 years.

The R&D aquaculture department of ARDA long term objectives are:

- to introduce new sectors of activity in Réunion Island in the domain of aquatic production
- validate economical scale technologies and biological know-how in local conditions
- to disseminate and transfer project results and technology to the private sector
- to organise international training seminars and workshops for aquaculture scientists, technical staff and managers, short courses, and student traineeships (engineers, Master's Degree, PhD)
- to initiate collaborative programs with R&D institutes in South West Indian Ocean.

OP14

Mariculture Park in the Philippines: A Model for Developing Sustainable Aquaculture Development

HERMOGENES S. TAMBALQUE III*

WorldFish Center – Philippine Country Office
SEARCA Building, College
Los Baños, Laguna, Philippines

*Corresponding author's e-mail: H.Tambalque@cgiar.org

Abstract

In 2008, the Philippines reported total fisheries production at 5,085,977 metric tons, 49% of which was from aquaculture. Traditionally, capture fisheries (commercial and municipal fisheries) accounted for the biggest volume of fisheries production but with the depletion of fish stocks, there has been a shift towards developing sustainable aquaculture to meet fish demand in the country. It is against this backdrop that the government, through the Bureau of Fisheries and Aquatic Resources (BFAR), introduced an innovative, integrated and sustainable approach to promoting aquaculture, the Mariculture Park.

A Mariculture Park consists of around 500 has or more of coastal waters chosen because of their diverse and productive environment, suitable for commercial mariculture development, access to existing infrastructure support, laboratory facilities, and input supply and markets. The mariculture park is projected to produce different high value fin fishes such as but not limited to: milkfish, siganid, grouper, red snapper, seaweeds, aquasilviculture, mussel culture, pearl oyster culture and sea ranching of lobsters and seahorses in coral reefs and sea grass areas.

The paper will attempt to analyze the reasons for the success or failure of the concept in promoting sustainable mariculture activities in the country. It will likewise identify the key issues that have affected the sustainable development of mariculture parks including the governance structure critical to sustaining efforts along this line.

OP15

Numerical Simulation Model for Cage Aquaculture Systems in the Open Sea

CHAI-CHENG HUANG*, CHIEN-NING SU AND CHUN-HO CHAN

Department of Marine Environment and Engineering,
Fisheries Extension Service Committee,
Nation Sun Yat-sen University,
Kaohsiung 804, Taiwan

*Corresponding author's e-mail: cchuang@mail.nsysu.edu.tw

Abstract

A numerical model based on a lumped-mass method is developed to simulate the dynamic behaviours of a cage aquaculture system in the open sea. The model has been verified by the experimental data obtained from physical model tests in the hydrodynamic wave tank as well as in the field tests. This paper is to present the dynamic features of a cage system under the influences of environmental loadings such as waves and currents. A fish farming system located at Xiaoliuqiu Island, Taiwan, was utilized as an example to illustrate the application of this numerical model to the field. In this model, the design sea states, water depth, and the specifications of cage system such as the size of the floating collars, the net mesh size, and the depth of fish net were used as input data. The numerical output of this model include the maximum tension of mooring lines and the most serious fish net volume reduction rate, which are essential information for successfully establishing a fish farming system in the open sea. For instance, the maximum mooring line tension could be used to design appropriate anchors to keep the cages from drifting away while the maximum volume reduction coefficient is used to adjust the fish density in net cages during harsh seasons.

OP16

Technical Efficiency Analysis of Fish Cage Culture in Peninsular Malaysia: An Application of Stochastic Frontier Production Function Approach

GAZI MD. NURUL ISLAM^{1*}, TAI SHZEE YEW² AND KUSAIRI MOHD NOH¹

¹Institute of Agricultural and Food Policy Studies, Putra Infoport, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

²Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*Corresponding author's e-mail: gazinurul236@gmail.com

Abstract

Cage culture has become increasingly important in the aquaculture industry of Peninsular Malaysia. The cage culture areas for fish continue to expand with a view to achieve higher output and generating more export earnings. This paper uses farm level data gathered from Manjung, Perak and Kota Tinggi, Johor to investigate the technical efficiency of brackish water fish cage culture. Stochastic frontier production analysis is applied to examine the determinants of frontier production function and the technical efficiency of fish cage culture system. The mean technical efficiency for sampled fish cage culture is estimated to be 36 percent. The results suggest very high degrees of technical inefficiency exist among the cage culturists. This implies that great potential exists to increase fish production through improved efficiency in cage culture management in Peninsula Malaysia. Initiatives to undertake extension programmes at the farm level are needed to help cage culturists in utilizing their resources more efficiently in order to substantially enhance their fish production.

OP17

Application of Semi-Submersible Cage Technology in Malaysia: Pulau Layang Layang Experience

**MOHAMMED MOHIDIN^{1*}, ABDUL RAZAK ABDUL RAHMAN², ALBERT CHUAN
GAMBANG¹ AND IMELDA RITI RANTTY¹**

¹Fisheries Research Institute Bintawa, Jalan Perbadanan, Bintawa,
PO Box 2243, 94744 Kuching, Sarawak, Malaysia

²Fisheries Research Institute Gelami Lemi,
Gelami Lemi, Titi, Negeri Sembilan, Malaysia

*Corresponding author's e-mail: aquamohd@gmail.com

Abstract

During the year 2007, the semi-submersible cage project to further expand off-shore aquaculture research was implemented. This cage technology, utilizing the FARMOCEAN semi-submerged cage system, was located in atoll at Pulau Layang-Layang Malaysia, which lies in the South China Sea, 170 nautical miles North-West of Labuan Federal Territory. These semi-submersible cages have the ability to be submerged appropriately during poor sea conditions and therefore incur less exposure to physical stress. This paper provides an overview of utilizing the semi-submersible offshore system, and the practical experience in its operation. The culture trials of two fish species (tiger grouper, *Epinephelus fuscoguttatus* and snapper, *Lutjanus* sp.) were carried successfully using these semi-submersible cages. The effectiveness of the system to the local conditions and available resources was also reviewed.

OP18

Comparative Growth Account of Mixed-Sex and Monosex Nile Tilapia at Various Stocking Densities during Cage Culture

SUMAN B. CHAKRABORTY^{1*} AND SAMIR BANERJEE²

¹Department of Zoology, Serampore College, Serampore, Hooghly
Pin – 712201, West Bengal, India

²Aquaculture Research Unit, Department of Zoology, University of Calcutta,
35 Ballygunge Circular Road, Kolkata - 700019
West Bengal, India

*Corresponding author's e-mail: sumanbc76@gmail.com

Abstract

Stocking density is considered one of the important factors affecting fish growth. But, information related to impact of stocking density on growth performance of androgen-treated monosex Nile tilapia, *Oreochromis niloticus* during cage culture under the ecological conditions of Gangetic plains in West Bengal, India is limited. The aim of this study was to compare the growth potential of control and hormone-treated, monosex tilapia at various stocking densities and to determine an ideal stocking density for cage culture of all-male, monosex fish in India. Mixed-sex control and 17 α -methyltestosterone treated monosex tilapia were stocked separately in standing surface cages (submerged volume 1 m³) at different stocking densities (1, 5, 10, 15, 25, 50, 75 and 100 fish m⁻³). At the end of 5-month culture period, fish in the density class of 50 fish m⁻³ showed the highest weight (71.25 \pm 1.95 g and 210.61 \pm 0.14 g for mixed-sex and monosex categories, respectively), length (16.11 \pm 0.9 cm and 21.8 \pm 0.08 cm for mixed-sex and monosex categories, respectively) and depth (6.3 \pm 0.05 cm and 8.02 \pm 0.08 cm) among all the density classes. More over, the monosex androgen treated tilapia in each density class showed significantly higher (P-value < 0.05) weight, length and depth compared to mixed-sex fish in the corresponding density class. Interestingly, the survival rate of the fish did not alter significantly with hormone treatment but stocking density had significant effect (P-value < 0.05) on it. Fish survival was ~90% at the density of 50 fish m⁻³, while the density class of 100 fish m⁻³ had only ~60% survival rate. Thus, cage culture of hormone treated monosex tilapia at a density of 50 fish m⁻³ may be considered ideal for augmented production of the fish under Indian context.

OP19

Production Potential of Herbivorous Fish Grass Carp (*Ctenopharyngodon idella*) in Floating Net Cages in Lake Phewa, Nepal

JAY D BISTA¹, SURENDRA P SAH¹ AND MADHAV K SHRESTHA^{2*}

¹Fisheries Research Centre, Pokhara, Kaski, Nepal

²Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal

*Corresponding author's e-mail: madhavshrestha1954@gmail.com

Abstract

Cage aquaculture in Nepal began in lakes of Pokhara Valley during 1975 as an alternative source of income for deprived poor, Jalari community, who mainly depend on lake fish resources. There are three major lakes being used for fish culture. The lake Phewa (523 ha) is the biggest lake in the valley. At present cage aquaculture of planktivorous fish bighead carp (*Aristichthys nobilis*) and silver carp (*Hypophthalmichthys molitrix*) are the most common in Nepal. These species are commonly used for extensive cage fish farming, which is very much popular and profitable small-scale enterprise in Nepal. Mainly planktivorous fish species are used for extensive type of cage fish farming without any external feed.

Due to the environmental alteration presently, Lake Phewa is gradually changing from mesotrophic to eutrophic status, and aquatic weeds started to emerge in the lake. The cage fish farmers, utilize this opportunity as a major biological control, and raised grass carp (*Ctenopharyngodon idella*) in more than 50% of their floating net cages to exploit aquatic weeds. Among 290 cage fish farmers, more than 80% farmers are adopting this technology with aquatic grass collected from lake to feed fish in the cages. By stocking of 40 g size of grass carp fingerlings, production has increased to 8.5 kg/m³/year which was more than double the production of 2-3.5 kg/m³/year obtained in general cage culture of planktivorous fish species. This is a low-cost and environment friendly technology for small lakes.

KA05

Advances in Seed Production of Marine Finfish in Malaysia

HUSSIN MAT ALI^{1*} AND MAZUKI HASHIM²

¹Marine Aquaculture Division, Fisheries Research Institute (FRI), Pulau Sayak, 08500 Kota Kuala Muda, Kedah, Malaysia

²Development and Technical Consultancy Services Division, Department of Fisheries Malaysia, Level 2, Block 4G2, Wisma Tani, Precint 4, Federal Government Administrative Centre, 62628 Putrajaya, Malaysia

*Corresponding author's e-mail: hussin58@msn.com

Abstract

Seed production of marine finfish is a recent development in Malaysia as compared to other countries in the Asia regions. The first private marine finfish hatchery was established in 1987, almost 14 years after the establishment of a pilot commercial cage culture project in 1973. Prior to that, seeds of brackish water finfish such as seabass (*Lates calcarifer*), golden snapper (*Lutjanus johnii*), mangrove red snapper (*Lutjanus argentimaculatus*) and orange-spotted grouper (*Epinephelus coioides*) were obtained from the wild. The first breakthrough in artificial seed production was achieved in 1981 through R&D works on seabass and followed by successful mass seeds production trials in 1985. By year 2000, seed production of 12 selected marine finfish species were recorded mainly at government hatcheries as well as private hatcheries and universities. As for now, seed production techniques for about 20 species, including a few grouper's hybrids were commercialized. However, due to several constraints, seed supply from local hatcheries has never met self sufficiency level. Thus, a substantial numbers of seeds of various marine finfish species especially groupers, have to be continuously imported either from Thailand, Taiwan or Indonesia. Seed production technology varies from semi-intensive to super-intensive using out-door ponds, intensive in-door tanks as well super-intensive RAS systems. Further advances in seed production of marine finfish both in terms of species selection and breeding technologies, should take into consideration the current and future pertinent issues including lack of domesticated, genetically enhanced and healthy broodstock, seed quality, environmental degradation, climate change, fish health, feeds cost, food security, food safety, trades, land occupation and energy demand in order to "securing the future".

OP20

Seed Production Techniques of Marble Goby *Oxyeleotris marmoratus* and some Groupers

SHIGE HARU SENOO* AND RIDZWAN A. RAHMAN

Borneo Marine Research Institute, Universiti Malaysia Sabah,
Locked Bag 2073, 88999 Kota Kinabalu, Sabah, Malaysia

*Corresponding author's e-mail: ssenoo@ums.edu.my

Abstract

The Fish Hatchery of Borneo Marine Research Institute, Universiti Malaysia Sabah (UMS Hatchery) has started research on production of groupers and marble goby, *Oxyeleotris marmoratus* since 1990s and then in 2000s the hatchery commenced the cross breeding of groupers. In this presentation, the seed production techniques of marble goby and groupers (hybrid groupers) will be introduced especially on artificial egg collection and larval rearing.

O. marmoratus is a freshwater fish under Family Eleotridae that grows up to more than 50 cm in total length and 2 kg in body weight. It is one of most popular aquaculture species and its market price is the highest among the freshwater fishes in Southeast Asia. The author has extensively researched on the artificial seed production of *O. marmoratus* since 1980s and established techniques on egg collection from natural spawning. It is considered there are several strains of *O. marmoratus* in Southeast Asia. For the larval survival of *O. marmoratus* in the first 10 days, the rearing in 10 psu seawater is indispensable in a strain of the State of Sabah, Malaysia.

Groupers are one of the most popular seawater fish on aquaculture business in Southeast Asia. Several species of groupers and hybrid groupers are targeted to be cultured in Southeast Asian countries. At present, the production of hybrid groupers contributes over 70% of the total grouper production in the state of Sabah, Malaysia. Popular hybrid trials especially among *Epinephelus* species are conducted such as TGGG (tiger grouper, *E. fuscoguttatus* x giant grouper, *E. lanceolatus*), OGTG (orange-spotted grouper, *E. coioides* x Tiger Grouper, *E. fuscoguttatus*), OGGG (orange-spotted grouper, *E. coioides* x giant grouper, *E. lanceolatus*), MGTG (mouse grouper, *C. altivelis* x tiger grouper, *E. fuscoguttatus*), SGTG (spotted grouper, *E. polyphkadion* x tiger grouper, *E. fuscoguttatus*) and SGGG (spotted grouper, *E. polyphkadion* x giant grouper, *E. lanceolatus*). Among these hybrids, TGGG and SGTG are the most popular combination in Sabah, Malaysia. The advantages of hybrids TGGG are high market value, resistant against disease and fast growth. As for TGGG and SGTG, it is very resistant against disease compare with other hybrids. There are no differences on larval rearing techniques among groupers and hybrid groupers in UMS hatchery.

OP21

Species Selection and Seed Production for Cage Culture in Malaysia

ABOL-MUNAFI AMBOK BOLONG^{1*}, AWANG-ALIM, A.K.², ARIFFIN, A.B.², DAUD, A.O.³, NORAZMI-LOKMAN, N.H.¹ AND ABDUH M.Y.¹

¹Department of Fisheries Science and Aquaculture,
Faculty of Agrotechnology and Food Science, Universiti Malaysia Terengganu,
21030 Kuala Terengganu, Terengganu, Malaysia

²Inland Fisheries Division, Department of Agriculture Sarawak,
Menara Pelita, Jalan Tun Abdul Rahman Yaakob,
Petra Jaya, 93050 Kuching, Sarawak, Malaysia

³Marine Fish Production and Research Centre,
Tanjong Demong, 22200 Besut, Terengganu, Malaysia

*Corresponding author's e-mail: munafi@umt.edu.my

Abstract

Cage culture is one of the main rearing techniques in fish production. In order to ensure success in cage culture, selecting suitable species is very important. Not all commercial species are suitable to be cultured in cages. There are six main characteristics in selecting a species for cage culture. They are 1) fast growth rate; 2) tolerance for crowded conditions; 3) diseases resistance; 4) grows well in regional environmental conditions; 5) is native to the region; 6) one that has a market value. This presentation will highlight the main species for freshwater, brackish and marine cage culture in Malaysia and also other potential species. The species includes tilapia, pangasid catfish, Asian seabass and grouper. Seed production of each highlighted species will also be covered.

OP22

Production of Hybrid Groupers: Spotted Grouper *Epinephelus polyphekadion* × Tiger Grouper *E. fuscoguttatus* and Coral Grouper *E. corallicola* × Tiger Grouper *E. fuscoguttatus*

MOHD ADDIN AAZIF MOKHTAR* AND SHIGEHARU SENOO

Borneo Marine Research Institute, Universiti Malaysia Sabah,
Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia

*Corresponding author's e-mail: lord_aazif@yahoo.co.uk

Abstract

There is a sudden spurt of interest in grouper culture in Malaysia which has a history of some two decades. The seed production of groupers is determined by its market demand and economic viability. The seed price varies with species. Seed demand has outstripped production due shortage of high quality and fertile broodstock and several constraints in survival and growth of larvae. Grouper hybridization has recently emerged as an alternative solution to overcome the problem. Pioneering work done at the hatchery of Universiti Malaysia Sabah on grouper hybridization, initially on tiger grouper *Epinephelus fuscoguttatus* × giant grouper *E. lanceolatus* (TG×GG) has given way to development of hybrids of several other species of groupers. Egg collection and larval rearing of early stage of two new hybrid groupers: spotted grouper *E. polyphekadion* × tiger grouper *E. fuscoguttatus* (SG×TG) and coral grouper *E. corallicola* × tiger grouper *E. fuscoguttatus* (CG×TG) were successfully performed. Details of the development of egg and early larva stages of these new hybrid combinations are reported in this presentation. A total of 498,000 of SG×TG eggs and 450,000 of CG×TG eggs were recorded. The fertilization and hatching rates of both hybrid groupers were 51.0 and 38.3% for SG×TG and 75.0 and 55.4% for CG×TG, respectively. Cryopreserved sperms were used for fertilization. Hatching timing for SG×TG and CG×TG eggs ranged from 19:00 to 19:50 hours after fertilization under rearing condition of 28.5-30.0°C and 30 psu water. Egg diameter, larval total length, oil globule length, yolk sac length, pigmentation and fin development in the SG×TG and CG×TG were compared and discussed. The data on fertilization, development and hatching of the eggs and early larval development obtained in this study demonstrated the practical feasibility of mass producing the seeds of these two new hybrid groupers.

OP23

Oyster Seed Production for Cage Culture in Malaysia in Relation to other ASEAN Countries

AILEEN TAN SHAU-HWAI* AND ZULFIGAR YASIN

School of Biological Sciences, Universiti Sains Malaysia,
11800 Penang, Malaysia

*Corresponding author's e-mail: aileen@usm.my

Abstract

Oysters have been harvested for food by the coastal communities for centuries throughout most ASEAN countries. However, little has been reported on the challenges and successes faced by growers in relation to seed supply and culturing the oysters using floating cages. Oysters have been collected by local fishermen for several decades from intertidal rocks, estuarine river bottom, jetties and fishing stakes in coastal areas and islands throughout Malaysia. However, compared to other seafood, oysters are relatively unknown in Malaysia due to its low production and lack of publicity. Under the auspices of the Bay of Bengal Programme (1988 – 1993) and International Development Research Centre, Canada (IDRC) (1989-1993), the Department of Fisheries Malaysia undertook the research on oysters and introduction of oysters farming in some selected areas in Malaysia using various methods including cage culture. Two of the main constraints faced by growers in Malaysia as well as in other ASEAN countries are the limited suitable sites and lack of natural seed supply to support the industry. The current oyster trade in Malaysia is 2,128 tonnes in 2009 and this represents only 14% of the demand in the country. Most of the oysters are harvested from the wild and currently Malaysia is facing serious problems in sustaining the industry due to insufficient seed stock. There was a stage that Malaysia was importing natural seeds from Thailand and Myanmar. The expansion of oyster farming industry in Malaysia could much be faster if not because of limited seed supply. Only hatchery production can provide the required supply of seed both in term of quantity and quality, for the expansion of the farming industry. However, following the oyster seed production via hatchery technology, the main constraint will be selecting the suitable size of the oyster seeds to be transferred from the nursery to cage culture. The size of seeds transferred from nursery to cage culture is very much dependent on the selected sites as well as the species to be cultured. Other ASEAN countries are still depending on wild seed supply to support their oyster industry, where most of these countries are still in the experimental stage of culturing the oysters using cages.

OP24

Gonadotropin Releasing Hormone Analogue in Enhancing Reproductive Performance of River Catfish *Hemibagrus nemurus* (Valenciennes, 1840) in Captivity

FATIMAT A. ADEBIYI¹, SITI SHAPOR SIRAJ^{1*}, SHARR AZNI HARMIN² AND ANNIE CHRISTIANUS¹

¹Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

²Center for Land and Aquatic Technology, Faculty of Science and Biotechnology, Universiti Selangor, 45600 Bestari Jaya, Selangor, Malaysia

*Corresponding author's e-mail: shapor@putra.upm.edu.my

Abstract

Hemibagrus nemurus is a riverine catfish with economic importance in most Asian countries. Several fish species fail to reproduce in captivity and hormonal therapy seems to be an alternative to enhance fish reproductive performance. Investigation on effects of gonadotropin releasing hormone analogue [GnRHa] on plasma sex steroid hormone levels and embryonic development of *H. nemurus* was carried out. Enzyme Linked Immunosorbent Assay was used to measure testosterone and 11-ketotestosterone in males and testosterone and 17 β -estradiol in females. Fish were treated with saline solution (control) and GnRHa at doses of 5 μ g/kg, 20 μ g/kg and 50 μ g/kg body weight (BW) of fish. Blood samples were collected before and after hormone treatment at 0, 6, 12 and 24 hours. Results showed that GnRHa elevated plasma sex steroid hormones even at a low dose of 5 μ g/kg BW of fish. Treatment with 50 μ g/kg BW GnRHa produced the best result. The highest levels of testosterone, 11-ketotestosterone and 17 β -estradiol were observed at 24 hours for all treatments. Fertilized eggs were collected by artificial fertilization using dry method. Fertilized eggs were spherical, adhesive and demersal. Mean oocyte diameter of fertilized egg was 1.5 \pm 0.3mm. Embryonic developmental stages of *H. nemurus* were also investigated. Seven embryonic periods (zygote, cleavage, blastula, gastrula, segmentation, pharyngula and hatching) were observed. The first hatched larva was recorded at 23 hours post fertilization at 27°C. The newly hatched larvae measured 3.0 \pm 0.2mm. Morphogenesis was completed in a day. Yolk sac was completely absorbed in three-day old larvae. The results indicated that *H. nemurus* has a short embryonic developmental period. The results indicated that GnRHa increased steroid production, thus, it is useful for seed production and larval rearing of *H. nemurus*.

OP25

Production of Carp Fingerling in Nursery Cages in the Lakes of Pokhara Valley

JAY D. BISTA^{1*}, RAM K. SHRESTHA¹ AND SURESH K. WAGLE²

¹Fisheries Research Centre, Pokhara, Nepal

²Fisheries Research Division, Godavari, Lalitpur, Nepal

*Corresponding author's e-mail: jdbista@yahoo.com

Abstract

Cage culture of planktivorous fish bighead carp (*Aristichthys nobilis*) and silver carp (*Hypophthalmichthys molitrix*) are common species for extensive cage fish farming which is very much popular and profitable small-scale enterprise in Nepal. To fulfil the high demand of large size fingerling is a challenging job for hatchery operators. To solve this problem carp fish fry nursing and rearing studies were carried out in nursery cages in the lakes of Pokhara valley. These studies focused on growth potential of lakes based on natural production, season and fry density on the production of silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Aristichthys nobilis*) fingerlings. The results showed that the lake Phewa had positive response on fingerling production in wet season (July to October). Lake Phewa showed the highest weight gain of 45.8 g in silver carp and 29.3 g in bighead carp. Lake Begnas was the poorest among this lake. Fry growth of silver carp was significantly differed between the lakes. Abundance of zooplankton in these lakes affected the growth of silver and bighead carp fry.

Water temperature was the most critical element in determining the growth of fry during winter season (October-January) in both Phewa and Begnas Lake. Begnas Lake resulted in loss of gross stocking weight at harvest during winter season. The stocking density of fry /m³ also affects the growth and recovery of fingerling in both Lakes.

KA06 Finfish Culture and Parasitic Diseases in China

TINGBAO YANG*

State Key Laboratory of Biocontrol and School of Life Sciences, Sun Yat-sen University, 135 West Xingang Rd, Guangzhou, 510275 China

*Corresponding author's e-mail: tingbao123@gmail.com

Abstract

The finfish cultures are highly diverse in both species cultured and farming patterns. There are more than 60 species of freshwater fishes and 70 species of marine fishes, including many introduced species, such as *Tilapia* spp and *Sciaenops ocellatus*, being cultured for food in China. For freshwater fishes, the traditional species such as grass carp, *Ctenopharyngodon idella*, and silver carp, *Hypophthalmichthys molitrix* are still accounting for considerable portions. Marine fishes are farmed in different systems according to the complex characters of climate, typically the intensive industrialized indoor farming systems in the North coast and caged culture in central and south parts of China coast. Offshore submersible cage culture has been boosted by the government and with rapid development. Although more than 90 species of parasites have been reported as pathogens causing diseases of cultured fishes, only around 30 species of them were frequently found from the 26 species of freshwater fishes most commonly cultured on a large scale. While for the maricultured fishes, the ciliate *Cryptocaryon* spp and the monogenean *Neobenedenia epinephelus* are the most notorious, and frequently cause trouble to many species of cultured species. The native parasites of introduced fishes have also been observed in China. It has been estimated that mortality of fishes resulted from fish parasites was between the low of 20 to 30% and the high of 90% in the fish farms in China. The management and control of parasitic diseases in aquaculture generally include pre-treatment of culture facilities, quarantine, scientific management of aquaculture systems, surveillance of diseases, chemical treatments of diseased fish, use of Chinese herbal medicines, and ecological approaches to prevention of parasite infections.

OP26

Effect of Climate Change on Fish Disease

FAIZAH SHAHAROM-HARRISON*

Institute of Tropical Aquaculture
Universiti Malaysia Terengganu
21030, Mengabang Telipot
Kuala Terengganu, Malaysia

*Corresponding author's e-mail: faizah@umt.edu.my

Abstract

The interaction between fish, environmental factors and pathogen can result in fish disease. Environmental stressors such as deteriorating water quality, increased water temperature, decreased oxygen levels can result in build up of parasites, bacteria and viruses in fish aquaculture systems and in the wild causing explosive disease outbreak. Stress factors can greatly increase mortality or disease and temperature is the most important environmental factor affecting the severity of disease in fish. Tasik Kenyir is a large man made reservoir built by inundation of several rivers in Hulu Terengganu, Terengganu, Malaysia. Sungai Como at Tasik Kenyir has been identified as a large Aquaculture Industrial zone. At present several private companies have invested large sums of money in the cage culture projects there rearing tilapia and patin (*Pangasius sutchi*). But large mortalities of fish have been reported from the cages at Sungai Como. Results have shown that there is a thermal bar in the depth of the lake at 10 to 40 meters. As a result the thermal bar the temperature of the lake is consistently high ranging from 30-31 degrees Celsius. Diagnosis showed the presence of large numbers of bacteria and parasites which are causing mortalities to the fish. Statistical analysis has shown a strong correlation between temperature and parasite infection. Climate change can affect the pathogenic strains, the distribution of carriers and reservoirs, can affect the numbers and distribution of susceptible disease and can result in physical habitat changes which can affect disease ecosystem.

OP27

Seasonal Infestation and Pathology of Capsalid Monogeneans on Cultured Red Snapper, *Lutjanus erythropterus* in Penang, Malaysia

LEONG TAK SENG*

3, Cangkat Minden, Lorong 13
11700 Gelugor, Pulau Pinang, Malaysia

*Corresponding author's e-mail: mhpg@streamyx.com

Abstract

All marine fish culture in floating net cages are infected with capsalid monogeneans. Red snapper, *Lutjanus erythropterus* is the most susceptible host in the cultured system, with frequent outbreak of benedeniasis disease resulting in mortality of up to 80%. An investigation was conducted to determine the seasonal infestation of capsalid monogeneans on red snapper in Penang, Malaysia. 10 fish were randomly selected from a cage and each fish was placed in a separate polyethylene bag containing 1 litre of freshwater. After 15 minutes, the fish was removed, weighed and measured. The content of the freshwater was examined under a dissecting microscope. The benedenid monogenean identified and counted. Three species, *Benedenia lutjani*, *B. epinepheli* and *Neobenedenia girellae* were found infecting the red snapper. *B. lutjani* was the most common species found throughout the year. *Neobenedenia girellae* infected the red snapper in July, August, September, December, January, February and March with peak in August and March. Initial infection of *B. lutjani* caused the red snapper to rub its head against the net resulting in "bald head" appearance. Also the body of many red snapper darkens with eye exophthalmia and lens opacification. Many infected fish either loss one or both eyes, but still survive. As the density of both *B. lutjani* and *N. girellae* increase causing the infected fish to rub the body surface intensively against the net resulting in severe body injuries. Initial observations on the onset of increase density of capsalid monogeneans showed batches of scale dryness on body surface. In prolong infection, the scales became loose and easily drop off. With intensive body injuries, many of the infected fish die. Also prolong infection of the monogeneans resulted in secondary infection, notably of the bacterium, *Streptococcus iniae*, causing greater number of death.

OP28

Epidemiological Study of Streptococcosis in Red Tilapia Cultured in Different Water Bodies in Malaysia

SITI-ZAHRAH, A.^{1*}, ZULKAFI, A.R.², ZAMRI-SAAD, M.³, AMAL, A.M.N.³, NUR-NAZIFAH, M.³, FIRDAUS-NAWI, M.³, RAMLEY, B.², FAHMI, S.¹ AND SHAHIDAN, H.¹

¹National Fish Health Research Centre (NAFISH), Fisheries Research Institute (FRI), 11960 Batu Maung, Penang, Malaysia

²Freshwater Fisheries Research Centre (FFRC), Fisheries Research Institute (FRI), 71650 Jekebu, Negeri Sembilan, Malaysia

³Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*Corresponding author's e-mail: siti.zahrah.abd@gmail.com

Abstract

This paper presents a comprehensive epidemiological study of Streptococcosis in red tilapia (*Oreochromis* spp.) cultured in cages in 5 different water bodies which was conducted for 2 years from 2007-2008. The five different water bodies selected were 2 reservoirs, Tasik Kenyir and Tasik Pedu, Sungai Terengganu, MADA irrigation canal, Pantai Kamloon ex-mining pool and earthen ponds in Jitra. The prevalence of *Streptococcus agalactiae*, pattern of infection, susceptibility and associated risk factors including water quality and seasons were determined. The results revealed high prevalence of *S. agalactiae* in reservoirs (12.49±19.84%) with very low water flow (0.006±0.003 m/s), compared to moderate-sized river (2.60±6.25%) with moderate water flow (0.25±0.24 m/s), small-sized earthen pond (0.69±2.77%) with extremely slow water flow (2.78⁻¹⁷±0.00 m/s), irrigation canal (0.28±0.94%) with fast water flow (0.26±0.05 m/s) and ex-mining pool (0.17±0.82%) with extremely slow water flow (2.78⁻¹⁷±0.00 m/s). Although the naturally infected red tilapias were mostly above 250g body weight, the most susceptible size was between 100-300g (10-30cm). The critical periods were the second and third quarters of the years, in association with dry months. Infected fish showed erratic swimming, exophthalmia, haemorrhages on ventral body and softening of brain tissue, while the internal organs particularly liver, spleen and kidney were congested. There were significant positive correlations between water quality parameters (temperature, pH, DO, water clarity) and the presence of *S. agalactiae* in both lakes and river. The results of water quality profiling in lakes further predisposed stressful environment to red tilapia kept at <4 m deep due to increased heat retention as a result of combination between very clear water, deeper light penetration and low flow rate but high water temperature of >29°C until 8 m deep. The above mentioned results and knowing that fry could be carrier to *S. agalactiae* in farm will provide excellent control regime for better management and vaccine program for healthy red tilapia production.

OP29

Environmental Factors Related to the Outbreaks of Cryptocaryoniasis in Marine Fishes in Cage Aquaculture in Japan

TOMOYOSHI YOSHINAGA*

Department of Aquatic Biosciences,
Graduate School of Agriculture and Life Sciences,
University of Tokyo, Yayoi 1-1-1, Bunkyo-ku, Tokyo 113-8657, Japan

*Corresponding author's e-mail: atyoshi@mail.ecc.u-tokyo.ac.jp

Abstract

Cryptocaryoniasis, or 'marine white spot disease of fish', is caused by *Cryptocaryon irritans*, an obligatorily parasitic ciliate of marine teleosts. Outbreaks of this disease often result in significant economic losses in cage aquaculture in Japan. The outbreaks are thought to be related to environmental conditions in the water surrounding the cages. This is based on accounts from fish farmers that outbreaks are seasonal, but vary between years, even in same region. Furthermore, outbreaks often occur simultaneously in the majority of cages within a bay, including in those that are managed by different individuals/companies. However, the factors triggering these outbreaks are poorly understood partly due to poor knowledge on the biology of *C. irritans*. To effectively control and manage outbreaks of cryptocaryoniasis in marine cage aquaculture, it is critical that we understand the factors leading to outbreaks.

We have investigated the biology of the developmental stages of *C. irritans* outside of fish: the protomont, the encysted tomont, and the invasive theront. Previously, we hypothesized that the disappearance of the thermocline in fall was associated with outbreaks, based on the dormancy of tomonts in low dissolved oxygen water. Recently, we evaluated the sinking velocity of protomonts, the time needed for encystment of tomonts, the swimming ability of theronts, and the daily rhythms in the shedding of protomonts from host and the excystment of theronts. Taken together, our data suggest that tidal cycles, water temperature, water depth, and the disappearance of the thermocline are the primary factors triggering the outbreaks of cryptocaryoniasis.

OP30

Control Strategy for Viral Diseases of Salmonid Fish and Flounders at Hatchery or Seed Production Facility, and Net-Pen or Tank in Japan

MAMORU YOSHIMIZU* AND HISAE KASAI

Laboratory of Biotechnology and Microbiology, Faculty of Fisheries Sciences,
Hokkaido University, Minato 3-1-1, Hakodate, Hokkaido 041-8611, Japan

*Corresponding author's e-mail: yosimizu@fish.hokudai.ac.jp

Abstract

Salmonid fish are important species for hatchery reared and released or cultured fish in net pen. Flounders are also important species for seed production and sea-farming in Japan. Viral diseases are one of the limitations of successful propagation of these species. Methods currently used to control viral diseases are 1) hygiene and sanitation in facilities, 2) disinfection of rearing and waste water using UV irradiation, ozonization and electrolyzation, 3) selection of pathogen-free brood stock by cell culture isolation and detection of specific antibody against important pathogens with ELISA or viral gene with PCR, 4) health monitoring of hatched fry for release and aquaculture by cell culture isolation and detection of pathogens by immunological and molecular biological methods, 5) control of normal intestinal flora by feeding bacteria producing antiviral substances, and 6) temperature manipulation. Under these circumstances, hatched fish are healthy and specific pathogen free, but there is still a possibility of infection by some pathogens in environmental waters after they are moved to ponds or net pens outside of facilities. For prospective studies, development of effective vaccines, vaccine injection machines and immunological tools for evaluation of vaccination effect are necessary.

OP31

Caligidae Infestation in Asian Seabass, *Lates calcarifer*, Bloch 1790 Cultured at Different Salinity in Malaysia

MUHD-FAIZUL H.A.H¹, KUA BENG CHU^{2*} AND LEAW YOON YAU³

¹Genetics and Molecular Biology, Institute of Biological Sciences,
Centre of Biotechnology for Agriculture (CEBAR), Universiti Malaya,
50603 Kuala Lumpur, Malaysia

²National Fish Health Research Centre (NaFisH), FRI NaFisH Batu Maung,
Fisheries Research Institute, Department of Fisheries Malaysia,
11960 Batu Maung, Penang, Malaysia

³Faculty of Agrotechnology and Food Science (FASM),
Universiti Malaysia Terengganu
21030 Kuala Terengganu, Terengganu, Malaysia

*Corresponding author's e-mail: kuabeng@fri.gov.my

Abstract

The Asian seabass is euryhaline, therefore it is interesting to describe the infestation and survival of caligids at varying salinity on the host. In this study, two different brackish water culture systems with monoculture and polyculture practices were investigated for the occurrence of *Caligus* spp on *Lates calcarifer*. Polyculture practices mainly consisted of snapper (*Lutjanus* spp), grouper (*Epinephelus* spp) and seabass (*L. calcarifer*), while the monoculture was stocked with only seabass. A total of 777 *Caligus* spp specimens were isolated from the sampling in 2009, consisting of three species; *C. chiastos*, *C. epidemicus* and *C. rotundigenitalis*. In 2011, the total specimen was increased to 3110 and two additional species were found; *C. punctatus* and one unknown species (*Caligus* sp). A 98.6% of the total examination was represented by *C. epidemicus*. Constant presence of *C. epidemicus* was observed throughout the study, regardless the differences in between culturing practices and systems. This species was able to survive within wide salinity range, from 5 to 28 ppt. The other isolated species (*C. chiastos*, *C. punctatus*, *C. rotundigenitalis* and *Caligus* sp) were only found infesting in polyculture cages with the salinity ranging from 25 to 28 ppt. Despite accounts for less than 2% of the total specimens, these species may able to produce a challenge for *L. calcarifer* polyculture farming activity due to their capability for host switching. The present study revealed the potential risk for cross-species transmission in polyculture practices.

OP32

Photobacteriosis in Hatchery-Cultured Asian Seabass (*Lates calcarifer*) Juvenile in Sabah

CHONG YEN THING^{1*}, JULIAN RANSANGAN¹ AND LU KEIN CHEE²

¹Microbiology and Fish Disease Laboratory, Borneo Marine Research Institute, Universiti Malaysia Sabah, Locked Bag No. 2073, 88400 Kota Kinabalu, Sabah, Malaysia

²Likas Fisheries Research Centre, Department of Fisheries, 88628 Kota Kinabalu, Sabah, Malaysia

*Corresponding author's e-mail: misscyt@hotmail.com

Abstract

Asian Seabass, *Lates calcarifer*, is one of the most common cultured marine fish species in Sabah. The seeds are produced through natural spawning of broodfish in captivity. They are normally reared in hatchery, up to juvenile stage (TL>4 inches), before being transferred to net cages. However, during the rearing period in hatchery, disease outbreak often occurs and causes significant mortality to the fish. The affected fish normally shows abdominal swelling, haemorrhage, skin lesion, and exophthalmic eyes. Characterization of isolated bacteria from the internal organs of dead and moribund fish having the clinical signs mentioned above, using biochemical and 16S rDNA sequencing analyses, revealed that most of the bacteria were identified as *Photobacterium damsela*. This is the first report of isolation of the bacterial pathogen in Asian seabass culture in Sabah. With the latest finding, the cultured Asian seabass in Sabah is not only susceptible to vibriosis and viral nervous necrosis but also to photobacteriosis. This challenges the current fish health management program and requires the review of the aquaculture practices for Asian seabass in Sabah.

OP33

Health Promoting Effects of *Excoecaria agallocha* Extract on *Elizabethkingia meningoseptica* Infected Catfish (*Clarias gariepinus*)

LAITH ABDULRAZZAK* AND NAJIAH MUSA

Department of Fisheries and Aquaculture, Faculty of Agrotechnology and Food Science,
Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

*Corresponding author's e-mail: saiflaith3@yahoo.ca

Abstract

The high consumption of antibiotics in aquaculture has instigated an escalating concern in searching for an alternative approach of disease control. Recently, most researches are focusing on finding plant based medicines that can be developed to fight antibiotic resistance bacteria. In the present study, we have to study the efficiency of mangrove plant extract, *Excoecaria agallocha* against *Elizabethkingia meningoseptica* in catfish (*Clarias gariepinus*) by analyzing the blood parameters. The experimental fish were divided into seven groups. Groups 1 to 5 were fed on leaf crude extract of *Excoecaria agallocha* with concentration 1, 2, 3, 4 and 5 mg/kg respectively. Group six were given antibiotic (flumequine 25 mg/kg). All of these groups were injected with bacteria *Elizabethkingia meningoseptica* at dose 4×10^5 (cfu/ml⁻¹). Control group was normally fed and no dosage of bacteria and crude extract was added. There were a significant difference ($P < 0.05$) between group one in packed cell volume (PCV %) (18.4 ± 6.05), haemoglobin (HB %) (4.53 ± 0.74), red blood cell (RBC %) (2.1 ± 0.27), white blood cells (WBC %) (27.3 ± 3.33), lymphocyte (LYM %) (61.78 ± 2.78) neutrophil (NEUT %) (36.79 ± 3.36), Serum total protein (TP %) (3.14 ± 0.45), and albumin (AL %) (1.61 ± 0.22), and control in packed cell volume (PCV %) (25.88 ± 6.05), haemoglobin (HB %) (16.85 ± 0.74), red blood cell (RBC %) (2.89 ± 0.27), white blood cells (WBC %) (31.7 ± 3.33), lymphocyte (LYM %) (74.9 ± 2.78) neutrophil (NEUT %) (23.5 ± 3.36), Serum total protein (TP %) (4.16 ± 0.45), and albumin (AL %) (1.19 ± 0.21), respectively There is no significant difference ($P > 0.05$) between all groups in globulin (GL %) and control.

OP34

The Effect of Thermal Bar on Distribution of Monogenean Gill Parasite on Cage-Cultured Red Hybrid Tilapia (*Oreochromis* sp) at Kenyir Lake

FAIZAH SHAHAROM-HARRISON*, ANIL CHATTERJI AND SURZANNE MOHD AGOS

Institute of Tropical Aquaculture, Universiti Malaysia Terengganu,
21030 Kuala Terengganu, Terengganu, Malaysia

*Corresponding author's e-mail: faizah@umt.edu.my

Abstract

A study was conducted on water quality profiling and the distribution, prevalence and mean intensity of monogenean infection on red hybrid tilapia, cultured in Kenyir Lake in relation to thermal bar existence. A total of 60 fishes of *Oreochromis* sp from different size classes were collected from Como River, Kenyir Lake. They were randomly sampled from different cages for a period of 6 months. The condition of fish and water quality of cage culture system were taken. To confirm the existence of thermal bar at Como River, water quality profiling was made for 24 hours monthly. Water quality parameters including temperature, dissolved oxygen and pH were measured using YSI model. Air temperature and water profiling was made from surface water, at an interval of 2 m until 20 m in depth and was taken at 6 hours interval. Nutrients analysis was done for ammonia, nitrite, nitrate, phosphate and hydrogen sulfide in the water body by using Hatch Kit. The study showed that thermal bar exists between 6 to 10 m in depth. The bar acts as the barrier between the warmwater and coldwater that prevent mixing and became the major factor in contributing to the high mortality of fish because the warmer water at surface cause stress to fish. These stressful conditions have resulted in increased parasitic and bacterial infection leading to continuous mortality of fish. The study also indicated that there were poorly developed gonads in the fish kept in the cages compared to those maintained in Aquatrop hatchery. Examination of gill parasites from *Oreochromis* sp in Kenyir Lake (Terengganu, Malaysia) revealed the presence of three different species of monogenea, all members of *Cichlidogyrus* Paperna, 1960 (Ancyrocephalidae). The prevalence, mean intensity and mode of attachment of monogenea are reported.

OP35

Disastrous Impacts of Isopod Infestation in Caged Culture Tilapia at Durian Tunggal Dam: Malaysian Experience

MUHAMMAD ZUDAIDY JAAFAR^{1*}, SITI ZAHRAH ABDULLAH², KUA BENG CHU², ROSLY HASSAN¹ AND ZULKAFI ABD RASHID¹

¹Freshwater Fisheries Research Centre, Gelami-Lemi, 71650 Titi, Jelebu, Negeri Sembilan, Malaysia

²National Fish Health Research Centre, Fisheries Research Institute, 11960 Batu Maung, Pulau Pinang, Malaysia

*Corresponding author's e-mail: zudaidy@pppat.gov.my

Abstract

Durian Tunggal dam in Macap, Melaka is originally an enclosed holding freshwater reservoir for domestic use. Economic activities in cage-culture for tilapia and *Pangasius* sp. were carried out by the local operators to provide extra income besides also being used for research purposes by FRI, Batu Berendam, Melaka. However, in early 2004 FRI received reports from the farmers as well as from the water department on the sudden outbreak of high mortality rate of cultured fish reaching almost 80%. Diagnosis revealed sudden mortality due to isopod infestation on the whole body attacking all the cultured fish causing severe anaemia and finally death. The isopod was finally identified as *Corallana nodosa* that was never before been reported in Malaysia. Control or treatment using chemicals were not possible as the measures taken will compromised safety standard for domestic water consumption even though it helps eradicating the isopods. The failure of controlling the isopods resulted in total abandonment of the cage-culture activities in the dam. It was a new emerging experience in the aquaculture industry where parasite could cause such damaging effect. Thus, knowing the origin of the parasite existence in the dam is of great importance for future precautionary measure in water management for the purpose of aquaculture. Starting from 1995, raw water from Sungai Muar, Johor, was fed into the dam without filtration and treatment to enhance the capacity of the dam. This could be the possible source or route of entry into the dam and isopod adaptation to the new habitat which better survival after a decade. The dam was thus strictly used only to provide domestic water usage as aquaculture is non-viable.

OP36

Mass Mortality Associated with a *Streptococcus agalactiae* Infection in Nile Tilapia *Oreochromis niloticus* (L.) Juveniles Cultured in Lake in Malaysia

HASSAN MOHD DAUD^{1*}, MILUD ALSAID¹, YASSER M. ABDELHADI² AND ALI ABUSELIANA¹

¹Aquatic Animal Health Unit, Department of Veterinary Clinical Studies, Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

²Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*Corresponding author's e-mail: hassanmd@putra.upm.edu.my

Abstract

Incidence of mass mortalities in tilapia cultures have been reported to occur in Malaysia, mainly in hot weather months. We reported here an incidence at Lake Temenggor in Perak state of Malaysia in July 2011. Floating cage cultured tilapias, *Oreochromis niloticus*, having body weight of 20-35 g, exhibited abnormal swimming behaviour, lethargy, exophthalmia and ascites before dying. Direct smears of caudal peduncle blood samples showed numerous streptococci in the plasma and also attached to the surface of the red blood cells, together with abnormal monocytes showing cytoplasmic vacuolation. Bacterial isolations were made from brain, kidney, liver and eyes and grown on 5 % sheep blood agar (SBA). The pure colonies morphology on SBA exhibited β -haemolytic, gram-positive, cocci in chains, oxidase-negative, catalase-negative, and non-motile. They were characterized as a Group B *Streptococcus agalactiae* (GBS) using commercial identification kits (Streptococcal grouping Kit and BBL Crystal GP ID Kit). We concluded that the current mortalities were caused by a combination of several factors such as stress associated with high temperature, fish density and poor circulation in the growout cages and the presence of opportunistic invaders or pathogens.

OP37

Differences in Haematological Parameters in Normal and Immunized Fingerlings of Red Tilapia (*Oreochromis mossambicus* X *Oreochromis niloticus*)

ALI MUHAMMAD MASTOI¹, MITHUN SUKUMARAN^{1*}, KHANIT SUWANNO², ANUAR HASSAN¹, FAIZAH SHAHAROM¹ AND ANIL CHATTERJI¹

¹Institute of Tropical Aquaculture

²Institute of Marine Biotechnology

Universiti Malaysia Terengganu,

21030, Kuala Terengganu, Malaysia

*Corresponding author's e-mail: mithunsugun@gmail.com

Abstract

In recent years, infectious diseases are a major problem in cage grown fishes which have been causing heavy loss to the fish farmers. A lot of interest has been generated to understand the various fish diseases so that they can be treated or prevented by bacterial and parasitic infections. The cultivated fishes in enclosure and cages become more susceptible not only to pathogenic but also to opportunistic bacteria. The fingerlings of red tilapia (*Oreochromis mossambicus* x *Oreochromis niloticus*) were fed in the present study with ethanolic extracts of oyster (*Saccostrea cucullata* Born, 1778), seaweed (*Sargassum baccularia* Mertens) and extract prepared by acid hydrolysing process of both the organisms. These extracts were mixed at different concentrations in commercial diet and fed to the fishes till 30 days. All groups of fishes fed with experimental and normal diets were challenged by a *gram-negative* bacterium (*Aeromonas hydrophila*) to see the effects of pathogen. Significant ($P < 0.05$) changes were observed in the haematological parameters such as; lymphocyte, neutrophil, monocyte and basophil cells with the experimental diet and control fishes. Our results are strongly suggested that ethanolic extract of oyster (*S. cucullata*) could combat the microbial infection by stimulating the immune response in red tilapia fingerlings.

OP38 Streptococcosis and Tilapia Cage Culture

YASSER MOHAMED ABDELHADI^{1,2*}

¹Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia

²The Central Laboratory for Aquaculture Research (CLAR),
Abbassa, 44662, Sharkia, Egypt

*Corresponding author's e-mail: ymhadi@yahoo.com

Abstract

Streptococcosis is considered to be the most devastating disease as it can cause massive kills of large size fish and is responsible for heavy economic losses. *Streptococcus agalactiae* is the major cause of streptococcosis in farmed tilapia. *S. iniae* also causes mortality but to a lesser extent. *Streptococcus* spp. are Gram positive, non-acid fast, non-motile, oxidase-positive, catalase-negative cocci. There is no obvious difference in the clinical signs induced by one or other of the *Streptococcus* species. Streptococcosis can be acute or chronic. Acute streptococcosis normally occurs during the warm season when the water temperature is high and will typically result in peaks of mortality that goes on for 2-3 weeks. Chronic streptococcosis occurs when the water temperature is lower and does not cause any peaks of mortality. The mortality rate will be low but the amount of dead fish will become high in the long run since the mortality level tends to be really persistent. Streptococcosis can cause mass death in tilapia farms, and unlike many other tilapia diseases it will affect even large and otherwise healthy fish. Tilapia, mainly in cage culture, weighing at least 100 grams (and more, up to 300 or 400 g) are actually more susceptible to streptococcosis than small fish. Streptococcosis outbreaks are known to take place primarily when the fish has been subjected to some form a stress, e.g. due to overcrowding, improper water chemistry or changing water temperatures. The affected fishes showed corneal opacity, exophthalmia, erratic swimming and occasional sunken body or inflammation along the base of pectorals and ventral region with mortality rate reaching 60-70%. Thus, Streptococcosis has become a major problem for tilapia farmers and there is still no effective commercial vaccine available that can be used to prevent streptococcosis in tilapia. Tilapia growers must therefore focus on prevention and treatment of the disease. However, in the near future, vaccination will be the key preventive technique to combat this disease and decrease its devastating economic impact on tilapia farming.

OP39

***Dactylogyrus macrolepidoti* (Dactylogyridae) as Bioindicator of Water Quality: Evidence from Field Survey**

BAKO MALLAM MODU^{1*}, M. SAIFUL¹, ZALEHA KASIM¹, MARINA HASSAN² AND FAIZAH M. SHAHAROM-HARRISON¹

¹Institute of Tropical Aquaculture (AKUATROP), Universiti Malaysia Terengganu (UMT), 21030 Kuala Terengganu, Terengganu, Malaysia

²Faculty of Agrotechnology and Food Sciences, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

*Corresponding author's e-mail: mammadu09@gmail.com

Abstract

A total of 630 fish – *Hampala macrolepidota* (Cyprinidae) were examined for gill monogenean in Kenyir Lake (4°43'N to 5°15'N – 102°30'E to 102°55'E) for a period of 17 months (January 2010 – July 2011). Four gill monogenean species were detected from the examined fish. They were: *Dactylogyrus hampali*, *Dactylogyrus quadribrachiatatus*, *Dactylogyrus macrolepidoti* and one unidentified species. The present study aimed to investigate the correlation between the rates of parasites infestation with some of the water quality parameters of the lake. Results revealed that there is a significant ($P < 0.01$) correlation between the parasites prevalence with some water quality parameters of the lake notably; Temperature, Dissolve oxygen, Ammonia and Total Alkalinity. The results also showed that *Dactylogyrus macrolepidoti* was a dominant species with highest prevalence rate of 100 % \pm 5.2 during dry season while the lowest rate was 57 % \pm 3.1 during monsoon period. Evidence from histopathology observed on the gills of infected fish showed some gill epithelia alteration such as hyperplasia, hypertrophy, and telangiectasia were also observed. Observation on energy dispersion spectrophotometer showed some elements of heavy metals (Lead and Ferrous ions) were also noticed on the gills of the infected fish. Effects of some heavy metals observed in the gill of infected fish and positive correlation that exist between parasites infection with the water quality variables of the lake lead to a conclusion that *D. macrolepidoti* is a good bioindicator of water quality.

KA07

Cage Culture in Asia – Feed and Feeding Perspective

WEE KOK LEONG*

School of Applied Science, Temasek Polytechnic,
21 Tampines Avenue 1, Singapore 529757

*Corresponding author's e-mail: klwee@tp.edu.sg

Abstract

In intensive fish farming, achieving high productivity is the key to the successful farming and profitability of the enterprise. Farm productivity is a function of growth performance and survival rate, which in turn are governed by the feed used and feeding management and a favourable culture environment.

The selection of the appropriate feed – in terms of its nutritional aspects and physical properties is important, to achieve optimum growth potential and feed conversion efficiencies. The use of efficient feeding strategies/system can reduce feed wastes thus improving the feed conversion ratio, and overall reduction in feed costs. Inappropriate feeding system and/or poor quality feeds, inevitably result in unacceptable level of feed wastes which can seriously affect the environment in which the farm is located. The poor water quality can cause stress, reduced immune response capacity and impacting on growth or ultimately disease manifestation.

This paper discusses the effects of feed and feeding on growth and feed conversion efficiency, and health of fish and quality of environment surrounding the farm and current challenges facing the aquaculture feed industry.

OP40

Improving Feed and Feeding Practices in Cage Culture in Asia towards Environmental Integrity and Sustainability

WEIMIN MIAO^{1*}, MOHAMMAD R. HASAN² AND SIMON FUNGE-SMITH¹

¹Regional Office for Asia and the Pacific, FAO,
39 Phra Atit Road, Bangkok, 10200 Thailand

²Aquaculture Service (FIRA), FAO, Rome, Italy

*Corresponding author's e-mail: Weimin.Miao@fao.org

Abstract

Cage culture has a long history in Asia. Over the last three decades, cage culture has achieved significant development in many Asian countries, which has been indicated by diversification of species and introduction of new cage culture systems and technologies. The estimated global cage culture production was 3.4 million tonnes in 2005. Some 80 species of finfish and other aquatic animals are culture in cage worldwide. Compared with development in species and facilities, the improvement in the management practices has not been less significantly, which is more important to the production efficiency, environmental integrity and sustainability of the industry.

Feed and feed management practices are among the most important factors that determine the sustainability of cage culture, especially in marine finfish. The use of low-value fish/trash fish in marine cage culture is widespread traditional practice in the region and has been raising wide concerns due to its potential impacts on culture environment, pressure on wild fish resources and health of cultured animal.

This paper will provide an overall perspective on current status feed and feed management practices in Asia, covering volume of low-value fish/trash fish and fishmeal production in the region, feed and feed ingredients used related to major species cultured in inland and marine environment and will highlight the key issues of concerns.

The paper will also present the results of the FAO regional TCP project, which was pilot assistance to member countries to gradually reduce the dependence of low-value fish/trash fish as feed in marine finfish cage culture. FAO supported four major marine fish culture countries (China, Indonesia, Thailand and Viet Nam) in Asia through implementation of the project in collaboration with Network of Aquaculture Centres in Asia-Pacific (NACA) during 2008-2011. This part of the presentation covers the scope and methodologies of the project, major outputs and findings and some key recommendations towards sustainable marine cage culture in the region.

OP41

Feed Management in Coastal Aquaculture in Southeast Asia – An Update on the Latest Developments

BRETT D. GLENCROSS*

Feed Technologies Stream – Theme 1021

CSIRO Food Futures Flagship / CSIRO Marine and Atmospheric Research

41 Boggo Rd, Dutton Park, QLD 4102, Australia

*Corresponding author's e-mail: brett.glencross@csiro.au

Abstract

Feeds continue to comprise the major cost in producing aquaculture species. While for some higher value species (e.g. Spiny lobster) this proportion is as low as 24% of total costs, typically it is around 50% to 70% of total costs for most other species. Because of this dominant contribution of feed costs to the total operational costs and also their key role in production performance and environmental impacts, there is an increasing imperative to better manage feeds through improvements in specification, formulation and rationing strategies. While for some sectors there is still a strong reliance on forage-fisheries for providing feed, others are now totally reliant on manufactured pellets and in some cases these pellets are almost devoid of marine resource use. However, further work needs to be done in this area to improve the ability of the feed industry to adapt to and use a wider range of alternative ingredients. The latest advances in nutritional research are now coupling these key elements of feed management (specification, formulation and rationing) and are allowing better tailoring of feed design with feed ration management to produce better production outcomes. Examples of how this is being achieved will be presented. In addition, the use of automatic feed systems and in-water camera systems is becoming more common-place and are allowing further improvements in feed ration management. Elements of each of these issues will be discussed with a view to where further gains are to be made through improving the different aspects of feed management.

OP42

Linking Physiology, Nutrition and Environment Research to Potential Impacts of Climate Change: Case-Study on Tasmanian Atlantic Salmon Aquaculture

CHRIS G. CARTER^{1*}, ROBIN S. KATERSKY², CATRIONA MACLEOD¹, HARRY R. KING³ AND STEPHEN C. BATTAGLENE¹

¹Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Tasmania 7001, Australia

²NCMCRS, University of Tasmania, Launceston, Tasmania 7250, Australia

³CSIRO, Marine and Atmospheric Research, Tasmania 7001, Australia

*Corresponding author's e-mail: chris.carter@utas.edu.au

Abstract

Atlantic salmon (*Salmo salar*) is Australia's largest and most valuable farmed seafood and makes a significant contribution to the rural economy in the state of Tasmania. It is based around transfer from freshwater hatcheries to marine cage farms and, although it accounts for a small part of global salmon production, it is noteworthy for several reasons. Industry is innovative and has developed many technological solutions. There is also a highly active research community which has collaborated widely with industry and other stake holders across ecosystem effects, genetics, health, nutrition, physiology and reproduction. Of particular interest is the relative closeness of Tasmania to the equator which, along with local conditions, means that average water temperatures sometimes approach the upper thermal limits for salmon production. Historically, high water temperatures have been advantageous in promoting high growth, the industry is now managing for potential impacts of climate change.

With increasing water temperature metabolic rate increases and dissolved oxygen (DO) decreases so that salmon are more likely to experience hypoxic conditions. Salmon have been considered hypoxia sensitive, however some Tasmanian salmon are able to regulate their metabolic rate and show a level of robustness to their environment. Furthermore, salmon perform optimally over a wide temperature range and maintain high levels of growth performance outside the optimum temperature range. Protein, lipid and mineral nutrition under sub-optimum conditions will be discussed. For example, sub-optimum temperature and DO impacted increased protein and energy requirements.

Increasing water temperatures also influences the interaction between aquaculture operations and the environment. Changes in feeds and in husbandry practices such as feeding and stocking regimes will affect the overall nature of the environmental impact, whilst broader ecosystem processes (e.g. seasonal nutrient inputs, current regimes, biogenic processes in the sediment and water column) will be influenced by climate change and may in turn affect the system's capacity of to assimilate nutrients, both at a local and a system wide scale.

Whilst limiting environmental conditions test respiratory physiology, adequacy of nutrient supply and growth, Atlantic salmon have robust physiological systems for maintaining efficient growth.

OP43

Effects of Stocking Density on Growth Parameters of Great Sturgeon (*Huso huso*) in Net Cages

MAHMOUD SHAKOURIAN*, M. POURKAZEMI, M.A. YAZDANI SADATI, N. PEYKARAN, H.R. POURALI AND U. ARSHAD

International Sturgeon Research Institute, P.O. Box 41635-3464, Rasht, Iran

*Corresponding author's e-mail: puriatania@yahoo.com

Abstract

Feed conversion rates (FCR), specific growth rates (SGR) and percentage body weight increase (BWI) were determined in two-year old great sturgeon, *Huso huso* (mean weight=1263.4±382.7 g) in order to monitor growth related to stocking density. Fish were initially stocked at low, moderate and high stocking densities of 3.9, 5.0 and 6.3 kg fish/m² in floating cages used for this experiment which lasted 90 days and were fed with a formulated diet (43% protein content, 22% fat content) two times per day at a rate of 2-3% body weight. Water temperature was monitored daily and varied from 17-27 °C.

The results obtained demonstrated the negative effect of stocking densities on growth rates, FCR, SGR and BWI%. Highest final weight was recorded in the low density group although it was not significantly different from that in other treatment groups. Production was directly affected by stocking density. Highest production belonged to the high density group and lowest to the low density group. High stocking densities causes crowding stress and has adverse effects on growth indices. In the present study increase in biomass resulted in a decrease in FCR and SGR. Some researchers are of the opinion that behavioural patterns such as interaction and maintaining territory are responsible for this. Results obtained in this study demonstrate the suitability of cage culture for great sturgeon and thus open new opportunities for the utilization of water resources, lakes and reservoirs located behind dams for cage culture of great sturgeon.

OP44

Experimental Study on Different Levels of Trash Fish Feeds for Cultured Grouper (*Epinephelus* sp) in Floating Net Cages at the Coastal Waters of Cebu State College of Science and Technology – Fishery and Industrial College San Francisco, Cebu

DOMINADOR G. SURBANO^{1*} AND BONIFACIO S. VILLANUEVA²

¹Cebu Technological University San Francisco Campus,
San Francisco, Cebu, Philippines

²Cebu Technological University Main Campus,
Cebu City, Philippines

*Corresponding author's e-mail: loloy2ann@yahoo.com

Abstract

This research was conducted to determine the growth rate of green groupers (*Epinephelus coioides*, Hamilton) locally known as “pugapo” feed with different rates of tilapia trash feeds in floating net cages at the marine waters of Cebu State College Science Technology – Fishery Industrial College. This aimed to determine the existing water conditions of the area during the four months culture period in terms of temperature, salinity, and acidity. The increment of body length, body weight, survival rate of stocks and the economic analysis of raising groupers in floating net cages were also determined.

Based on this result it was found out that Treatment (T)1 or feeding groupers with ration consisting of the 25 % was the most economical having an Return Of Investment (ROI) of 2.54 followed by T2 or the feeding ration consisting of 50 % given daily having an ROI of 2.41. The ROI of T3 or feeding 75 % was 2.37 and T4 or feeding daily with 100 % feed ration had an ROI of 2.23. It is highly recommended that prospective growers of grouper must follow the fish feeds technology using the feed ration of 25 %. It is also recommended further that prospective growers should adopt the technology as stated in the output of this study using the appropriate measurement of cages, water salinity and feeding guide.

OP45

The Effects of Varying Protein and Lipid Levels in the Diets on Growth, Feed Utilization and Body Proximate Composition of Tiger Grouper, *Epinephelus fuscoguttatus*

ISABELLA EBI, ANNITA YONG AND ROSSITA SHAPAWI*

Borneo Marine Research Institute, Universiti Malaysia Sabah,
Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia

*Corresponding author's e-mail: rossita@ums.edu.my

Abstract

Tiger grouper (*Epinephelus fuscoguttatus*) is one of the most widely cultured grouper species in the Asia Pacific region due to the fact that it is considered as a relatively “easy fish” to culture compare to other species of groupers such as the mouse grouper and giant grouper. In addition, tiger grouper command a good price and demand in the live fish trade market. Unfortunately, the sustainable growth of grouper aquaculture industry is hindered by the increasing cost of production, mainly due to unsustainable feeding approach of using trash fish as a main source of feed. To address this issue, the present study was carried out to produce fish with optimum growth rate through manipulation of major nutrients in the formulated diets – the protein and lipid. Nine experimental diets containing different protein (45%, 50%, and 55%) and lipid (8%, 12%, and 16%) levels were fed to triplicate groups of fish with initial weight of 8.8 ± 1.0 g. Fish were cultured in 150 L fibreglass tank supplied with aeration and using flow-through seawater system and hand-fed with experimental diets to apparent satiation twice a day. The highest final body weight (FBW), body weight gain (BWG) and specific growth rate (SGR) were achieved by fish fed Diet 50/16 followed by fish fed Diets 55/16, 50/8, 50/12, 45/16, 55/12, 45/12, and 55/8. In general, diets with 45% protein at all lipid levels produced fish with lower FBW, BWG and SGR compared to other fish groups. Increasing protein content to 55% protein did not improve growth rate of fish but it appears that diets with 55% protein performed better when lipid was at higher level of 16% compare to at 12 and 8 %. Feed conversion ratio (FCR) mirrors the trend of growth rate with the best FCR observed in Diets 50/16 followed by 45/16, 55/16, 50/8, 50/12, 55/12, 45/8, 45/12 and 55/8. Except for fish fed Diet 45/8, survival of fish was above 86% at the end of the feeding trial. Only crude lipid, viscerosomatic index and condition factor were affected by the dietary treatments. Therefore, the recommended dietary protein and lipid contents for optimal production of juvenile *E. fuscoguttatus* reared using flow-through culture system are 50% protein and 16% lipid. The present findings will give a significant contribution to the development of cost-effective diet for culturing tiger grouper.

OP46

Feed and Feeding in Freshwater Cage Aquaculture in Indonesia

GEDE S. SUMIARSA^{1*} AND LUKAS MANOMAITIS²

¹Local Coordinator (Aquaculture) Indonesia,
American Soybean Association International Marketing (ASA-IM)

²Technical Director (Aquaculture)
American Soybean Association International Marketing (ASA-IM)

*Corresponding author's e-mail: gedess@hotmail.com

Abstract

Total freshwater aquaculture production in 2010 in Indonesia was almost one and half million MT and 32% was produced from cage aquaculture. Main cultured species in cages were tilapias (*Oreochromis niloticus*), common carp (*Cyprinus carpio*), pangasius (*Pangasius pangasius*) and catfish (*Clarias batrachus*). Tilapias and carps are mostly cultured in floating cages in reservoirs and lakes and pangasius is cultured in cages along rivers and in earthen ponds. Commercial floating feed is common feed for tilapia and sinking feed is mostly fed to carp and pangasius with feeding frequency of 2-6 times/day. Feeding ration is practiced in some farms but most farms apply *ad libitum* feeding. Even though feed is the biggest expense in aquaculture production, cage fish farmers generally do not consider improving feed and feeding management (which are critical points to improve production margins). It is suggested that freshwater cage aquaculture industry in Indonesia could be improved significantly by devoting more efforts to better feed and feeding management through extension, training and on-site feed demonstrations. American Soybean Association International Marketing (ASA-IM) has been involved in betterment of feed and feeding management for cage fish farmers in Indonesia.

OP47

The Effects of Dietary Protein Levels on Growth Performance and Muscle Composition of Young Mekong Giant Catfish (*Pangasianodon gigas*), Raised in Cages

SUTHUS PHAUKGEEN* AND PRANEET NGAMRNAE

Faculty of Agriculture, Ubon Ratchathani University, Ubon Ratchathani, Thailand 34190

*Corresponding author's e-mail: suthus_53@hotmail.com

Abstract

Mekong Giant Catfish (*Pangasianodon gigas*), is one of the largest freshwater fish in the world, native to Mekong River basin with the fact that the species is critically endangered. The study on dietary protein levels on growth of young Mekong Giant Catfish was conducted using five formulated diets containing 20, 25, 30, 35 and 40% protein with average digestible energy of 318 Kcal/100 g. The fishes average weight 41.00 g, were maintained in each floating net cages with 1.0 x 1.0 x 1.5 m³ size, at the stocking rate of 50 fishes/cage. Fishes were fed to apparent satiation twice daily for five months. The results showed that the maximum growth was significantly ($p < 0.05$) attained at 35% protein while the fishes fed with 20% protein was the lowest. The growths of fishes fed 25, 30, and 35% dietary protein were not significantly different. Protein efficiency ratio (PER), feed conversion ratios (FCR) and apparent net protein retention (ANPR) all decreased with increasing dietary protein levels, while survival rate was not significantly affected. On the basis of percentage weight gain, daily weight gain, and specific growth rate, the dietary protein requirement of young Mekong Giant Catfish was approximately 35%. The dietary protein level producing maximum growth, calculated by broken line regression was 35.10%. The relationship between protein level (X; %) and weight gain (Y; g) was expressed as $Y = 14.46X - 10.87$. Fish muscle moisture, NFE, Fiber and ash were not clearly related to dietary protein level but low dietary protein levels resulted in significantly higher ($P < 0.05$) lipid but lower protein content.

FD01

Perspective in the Successful Cage Farming of Marine Fish: Pompano, *Trachinotus blochii* Experience

MISAI TSAI*

PT. Lucky SAMUDRA PRATAMA

Jalan Muara Baru Ujung, Blok F No.1, Jakarta 14440, Indonesia

*Corresponding author's e-mail: misai@cbn.net.id

Abstract

Facing the continuously increasing fuels, raw materials, feeds, energy, labour and all related to production cost, fish producers remain eager to economic fish prices and delicious meat tastes. Mass production is one of the practical solutions to reduce total production cost instead of simply raising prices. However, more précised cost evaluation and environmental concerns would be the key to being successful larger-scale marine fish farming.

Pompano, *Trachinotus blochii* (Japanese: Marukoban) is an example of cage culture in the Kongsu Island, the northern area of Jakarta, Indonesia. The present is to illustrate the principles and how to apply them fundamental success to larger-scale cage farming.

- Species selection by benefits of nature environment.
- Education and training for on-farm labours.
- External factors of fish: Environmental management.
- Internal factors of fish: Observation of fish health by fish anatomy.
- Feed efficiency improvement through research collaboration with feed mill.
- Standardized operation and proactive training.

Nature behaviours of fish species are closely related to specific environmental conditions particular in cage farming, these nature considerations will be taken into account at the first phase. Targeting setting, testing and evaluation for employees go through an internal audit to confirm the performance of fish farming operations. Management of sustainable environment is particularly important to larger-cage farming. For fish, day to day observation of fish organ, intestine, spleen and related physiological responses of fish will maintain fish in a healthy status and feed efficiency will also be shown correctly. Continuously conduct feed trials through different formulation strategies (example enzyme, probiotics) to improve feed performances. Creating emergency practices and induce on-farm labours to reactive the standard operation and develop employee earn capabilities to handle with more complicated problems. The ideal labours are proactive.

The future goals are to create a larger economic scale for commercial marine fish farming in a manageable operation.

FD02

Vaccine Focused Biosecurity Programs in Open-Water Cage Farms

NEIL WENDOVER* AND YULI PANCAWATI

Merck Aquatic Animal Health, Intervet Norbio Singapore Pte Ltd,
1 Perahu Road, 718847 Singapore

*Corresponding author's e-mail: neil.wendover@merck.com

Abstract

A significant challenge to the expansion of aquaculture production is the outbreak of disease. Once fully established, production diseases cause severe mortalities which impact heavily on economical Feed Conversion Ratio (FCR) and operation profitability. The occurrence of disease is a combination of the health of the animal, the condition of the environment, and the presence of a pathogen. Producers often resort to measures such as increased stocking to compensate for mortalities and the focus is generally on treatment as opposed to well defined prevention strategies.

Biosecurity can be defined as the practices, procedures and policies used to prevent the introduction and spread of disease causing organisms (e.g., bacteria, viruses, fungi, parasites). Biosecurity can be applied to aquaculture production systems through a variety of management strategies and by following internationally agreed upon policies and guidelines. The major limitation in open-water (river, lake, sea) cage aquaculture systems is that they are, integrated with and exposed to, the 'wild environment' and as such the pathogens and disease vectors therein. This means the fundamentals of a biosecurity program, i.e. pathogen exclusion and transmission prevention, are difficult to implement. However, with some basic understanding of the interaction between the disease, the species and the environment and with the right system design and Health Management Plan (HMP), open-water cage systems can continue to be sustainable and profitable businesses models

Tropical aquaculture has yet to reach its full potential. Both commercial and state sectors realise that disease is a major threat to industry expansion. The presentation highlights some of the major points and practices of biosecurity for open-water cage production systems focusing on Vaccinated Pathogen Free (VPF) seed stock. The key elements of the VPF strategy are explained along with some important, practical and operational adjustments with the overall aim of improved production efficiency and profitability for open-water cage farmers.

FD03

History and Present States of Net Cage Culture for Aquaculture Industry in Japan: From 1950s Yellow Tail to 2010s Blue Fin Tuna

SHIGEHARU SENOO^{1*}, T. OKADA² AND S. MIYASHITA²

¹Borneo Marine Research Institute, Universiti Malaysia Sabah,
Locked Bag 2073, 88999 Kota Kinabalu, Sabah, Malaysia

²Fisheries Laboratory, Kinki University, 3153,
Shirahama, Wakayama, 649-2211, Japan

*Corresponding author's e-mail: ssenoo@ums.edu.my

Abstract

Marine fish culture of Japan started with the culture of the yellowtail, *Seriola quinqueradiata* in 1927 in Kagawa Prefecture, and it was an embankment culture system (enclosed culture system), which had partitions between creek and island or between island and island by soil, sand, stones and concrete. In 1958, net partition style which was cheaper and simpler design was introduced for the yellowtail culture.

Marine fish culture using net cage was commenced by the late Professor Dr. Harada Teruo of Kinki University in 1954. He used nets (2 x 2 x 2 m) made of coir or cotton yarn with cage frames made of wood or bamboo. This small sized net cage culture system rapidly spread to all over Japan in the 1960s to 1970s. Later, this net cage culture technique spread to all over world and became the present general fish culture technique.

There are several advantages of the net cage culture with small size nets such as:

- easy and cheap to make
- cheap and easy maintenance
- easy for the feeding and harvesting
- easy to change and move the net cage
- easy to separate the cultured fish and
- easy to observe fish condition.

Since the 1980s the cage size has become larger with big capital because mass production was required and the site of cage culture moved from inshore to more offshore areas. Strong and light chemical fibres and metallic materials have being used as the net materials and frames of the cages were made with new materials such as metals, FRP (fibre reinforced plastic) and HDPE (high density polyethylene). The cultured species have being expanded from yellowtail to red sea bream *Pagrus major*, parrotfish *Oplegnathus fasciatus*, great amberjack *Seriola dumerili*, tiger puffer *Takifugu rubripes*, kue *Epinephelus bruneus*, kelp grouper *E. septemfasciatus* and bluefin tuna *Thunnus orientalis*. In this presentation, technical features of net cage culture at the present will be introduced from yellowfin to bluefin tuna culture in Japan.

FD04

Experiences and Key Challenges in Cage Aquaculture Business in Malaysia

GOH CHENG LIANG*

Group Executive Chairman, GST Group of Companies, Malaysia
No. 9, Lorong IKS, Simpang Ampat D,
MK 15, Kawasan Industri Simpang Ampat,
14100 Simpang Ampat, Seberang Perai Selatan,
Penang, Malaysia

*Corresponding author's e-mail: goh.chengliang@gstgroup.com.my

Abstract

GST Group of Companies (GST) is amongst the leading integrated seafood supplier in West Malaysia producing seafood mainly fish from farm to plate. GST is principally engaged in business activities from hatchery to marine cage farming, hatchery and fries farming, seafood processing, feed mills, distribution and trading of chilled and frozen seafood.

The Group history is remarkable; it illustrates a success story of a small family based seafood trading and supply transforming into a mega seafood business churning millions of dollars. The maiden company's name was Goh Siong Tee Seafood Suppliers, name taken after the father of Dato' Goh Cheng Liang, which started the father and son seafood supply company in 1985. Dato' Goh at the age of early 30 worked very hard by opening supply of fresh seafood to restaurants and hotels in his own capacity around the state of Penang. The business flourished to other parts of Northern Region with aggressive market networking and perseverance of Dato' Goh.

Then in early 1990's, Dato' Goh set up his first fish breeding business, Goh Siong Tee Farm. The company begins to venture in breeding of marine water fish. The sea cage culture method of cultivation was first started in Pulau Aman about 30 minutes boat ride from Tambun fishing village. The marine cage culture at Pulau Aman and the neighbouring island has flourished since early 1990's and to-date has accumulated many small holders to about 10,000 cages. Goh Siong Tee Farm has one of the largest sea cages in Pulau Aman and they have helped other farmers facing shortage of working capital to be contract farmer of Goh Siong Tee Farm.

As the profit grows, Dato' Goh expand his business activities related to seafood processing and trading.



Hatchery farm at Batu Kawan, Seberang Perai Selatan, Penang



Sea cage farming at Teluk Dalam, Pangkor Island, Perak



Processing plant at Simpang Ampat, Seberang Perai Selatan, Penang

**ABSTRACTS FOR
POSTER PRESENTATION**

PP01

Poverty Reduction and Food Security through Cage Aquaculture Development in Uis, Erongo Region: A Case Study from Namibia

JOHAN VAN DER WESTHUIZEN¹, LOUIS VAN DER WESTHUIZEN¹ AND MD. GHULAM KIBRIA^{2*}

¹UIS Aquaculture Farm, Namibia

²Special Aquaculture Advisor to Hon Minister, Commonwealth/MFMR-Namibia

*Corresponding author's e-mail: kibriamg@mfmr.gov.na, ghulam.kib@gmail.com

Abstract

This unique aquaculture project is situated in a remote and arid region of the Namib Desert of Namibia. A recirculation water system that supplies fingerlings is combined with cage culture at a nearby lake. This lake originated from a previous tin mine that was mined into an underground aquifer. Water quality was good, with dissolved oxygen level maintained by prevailing winds. Floating cages in the lake were anchored next to a floating walk way that served as a platform for feeding and harvesting. Floating cages, consisting of a floating frame of six, 25 m² for each cage, and a net suspended at a depth of 2, 5 m. Current production of 4 tons per month is achieved by stock splitting and grading at a regular rate in 24 cages. Fish (*Oreochromis mossambicus*) are harvested at 200 – 250 gram. Smaller fish harvested (100 - 200 gram) is sold to the local communities. Fingerlings are produced continuously in a recirculated aquaculture system consisting of 11 pools, producing 40 000 fingerlings a month. Eggs are harvested fortnightly, fish is grown out between 5 – 10 gram, and fingerlings are then supplied to grow-out facilities. The hatchery facility is the first recirculating system that is operational in Namibia; also this project is for the first to implement cage culture in Namibia. Water from the pools is recirculated through an aquaponics system, where various crops are grown. Return water from the aquaponics are then pumped through vortex and then bio filter system. Pool water is heated by solar panels during day time, while a heat pump maintains the temperature at above 25 °C during night time.

Feeding of fish and fry is done manually at a feeding frequency of 5 times per day. Fish feed powder with 38% CP is used for the fry and juvenile fish. Fingerlings are fed with 38% CP pellets of 2 mm diameter; while adult fish (incl. brood stock) receive 4 mm diameter pellets of 30% CP feed. Harvested fish is washed in clean water before packaging. The final product is packed in

either 5 kg frozen carton boxes or 3 kg bulk plastic bags. A policy of good personnel conduct is maintained, which include hygiene, observation and reporting of non-compliances.

The existing cage culture system only occupies about 10% of the water body available for growing out. The objective to utilize the water body to its full potential; capacity can safely be increased to 12 tons per month. A minimum depth of 3 m below the cage bottom will be maintained. Water quality is monitored continuously to determine the ultimate stocking density. A new hatchery and brood stock pool system is under construction to able the production of 120,000 *Oreochromis mossambicus* fingerlings per month. Another objective would be promoting commercial aquaculture farming and assist commercial farmers with the establishment of grow-out facilities. Fingerlings will be supplied from the UIS Aquaculture Hatchery. New brood stock is supplemented from selection of good performers that is identified during grading. We intend not to have more than two generations used for brood stock. New brood stock will be imported from facilities throughout Southern Africa. Furthermore, we are also in the process of constructing a new catfish hatchery and grow-out facility. Market research showed that there is a need for the continuous supply of fresh and frozen (filleted) catfish. The initial capacity of this catfish facility will be 60 tons per annum. Aquaculture activities in Namibia are regulated by legislation that is controlled by the Ministry of Fisheries and Marine Resources. This project maintains a close and good relationship with the Ministry knowledge and experience is shared. A remarkable contribution towards the development of the Namibian Aquaculture Industry comes from the Ministry; no doubt, establish show-case Aquaculture Industry in Namibia.

PP02

Spatial Modelling for Freshwater Cage Aquaculture Site Selection in Batur Lake, Bali, Indonesia

I NYOMAN RADIARTA*, ACHMAD SUDRADJAT AND I NYOMAN ADIASMARA GIRI

Centre for Aquaculture Research and Development,
Agency for Marine Affairs and Fisheries Research and Development,
Jl. Ragunan 20, Pasar Minggu, South Jakarta 12540, Indonesia

*Corresponding author's e-mail: radiarta@yahoo.com

Abstract

Nile tilapia (*Oreochromis niloticus*) is an important freshwater species cultured in Indonesia. To ensure both success and long-term sustainability of providing the production of this species, finding suitable site is an important step in any aquaculture operation. Spatial models to optimize suitable sites of cage culture have been developed, incorporating factors of water quality, climate, infrastructure, and socioeconomic. Five thematic layers were grouped into two basic requisites for tilapia aquaculture, namely water quality (water temperature, pH, and dissolved oxygen) and social–infrastructural (distance to town and distance to road network). While climate data were used as supplement data for investigating climate characteristics around the study area. A series of geographic information system (GIS) models was developed to identify suitable sites for tilapia culture using multi-criteria evaluation known as weighted linear combination. Suitability scores were ranked on a scale from 1 (least suitable) to 3 (most suitable) for tilapia aquaculture development. Total potential areas were about 387 ha (area buffered within 200 m to coastline). The output of the model clearly indicates the location and extent of tilapia farming areas on different suitability ranks, i.e. most suitable (270 ha), moderately suitable (117 ha), and less suitable (0 ha). This study shows that GIS can be a powerful tool for tilapia aquaculture site selection. The results from this study can give the general overview of aquaculture zoning and support for carrying capacity assessment in order to develop better planning and management of tilapia farming in the lake.

PP03

Preliminary Research Findings on Tilapia Production in Cage Culture –Batang Ai Reservoir, Sarawak

PHILIP WONG*

Inland Fishery Division, Dept. of Agriculture, Sarawak, Malaysia

*Corresponding author's e-mail: wongph@sarawaknet.gov.my

Abstract

Recently, the Inland Fishery Division of the Department of Sarawak conducted research in Batang Ai Reservoir in Sri Aman Division Sarawak to assess the performance of tilapia species under a variety of conditions and to assess the productivity of the fish under lacustrine environment. A set of 22 wooden cages at Telok Kaong were used in a trial that runs in duration of seven months from May to November 2007. The following parameters were taken up in the study:

- Effect of different stocking rates on the growth performance
- Different daily feeding regimes and impact on growth
- Comparative nett weight gain on two different strains (Citalada - Black and the Red Tilapia)

The fish were stocked at three different rates, viz. 320, 400 and 450 tails per cage, at average stocking weight of 60 gm/piece and feeding carried out at two different regimes (2X/day and 4X/day), with starter and grower feeds. The following results were obtained from the study:

- The FCR (Feeds Conversion Ratio) ranges from 1.6 to 2.2
- Survival rate ranges from 88.89 - 95.11%
- There is no significant difference in growth performance with the different stocking rates, and feeding regimes for the same species
- The Citalada (Black Tilapia) is a faster grower than the Red variety
- Feeds accounted for about 40% of the total amount spent on the project

It is hoped that this trial will stimulate interests for further research in caged tilapia and other species in the reservoir, with the ultimate aim of having the private sector to access such information to venture into aquaculture production in such water body to meet the growing demand of freshwater fish in the country.

PP04

Total Sulfide Concentrations at Batang Ai Reservoir and Implications for Aquaculture

LING TECK YEE^{1*}, DEBBIE, D.P.¹, L. NYANTI², NORHADI, I.² AND JUSTIN, J.J.E.³

¹Department of Resource Chemistry,

²Aquatic Science Department,

Faculty of Resource Science and Technology, Universiti Malaysia Sarawak,
94300 Kota Samarahan, Sarawak, Malaysia

³Natural Resources and Environment Board, Sarawak

*Corresponding author's e-mail: tyling@frst.unimas.my, teckyee60@gmail.com

Abstract

Cage aquaculture has been developed in the Batang Ai reservoir created by the hydroelectric dam. However, hydrogen sulfide, produced during the decomposition of the submerged vegetation and other organic materials under anoxic condition has been reported to be toxic to aquatic organism and little information is available on the levels of sulfide in the reservoir. Therefore, the objective of this study was to determine the level of sulfide in the reservoir. Samplings were conducted at 10 stations and at three different depths (0.5 m, 14 m and 27 m) in 2009 and 2010. Results showed that total sulfide was detected at all stations in the reservoir and concentrations ranged from 0.33 to 32.0 µg/l. Total sulfide increased with depth and the level at 0.5 m depth was significantly lower than at 27 m. The highest total sulfide occurred at 27 m depth at the place where less mixing of water occurred with low dissolved oxygen of 0.57 mg/L and high BOD₅ of 14.8 mg/L and pH of 6.19. Correlation analysis indicates that total sulfide concentrations were negatively and significantly correlated with dissolved oxygen and positively and significantly correlated with BOD₅. This study shows that selection of site for cage culture is important for successful aquaculture activities.

PP05

Impact of Cage Culture on Water Quality in Batang Ai Hydroelectric Dam Reservoir, Sarawak, Malaysia

LEE NYANTI^{1*}, HII, K.M.¹, NORHADI, I.¹ AND LING, T.Y.²

¹Department of Aquatic Science

²Department of Resource Chemistry

Faculty of Resource Science and Technology, Universiti Malaysia Sarawak,
94300 Kota Samarahan, Sarawak, Malaysia

*Corresponding author's e-mail: lnyanti@frst.unimas.my, nyantilee@gmail.com

Abstract

Cage culture is an important aquaculture industry in Sarawak as it provides a source of protein and fulfils the high market demand of freshwater fishes. The Batang Ai Hydroelectric Dam Reservoir is located in Lubok Antu, Sarawak, with an area of 8,400 ha. Currently, there are 2,696 fish cages stocked with 500 fish per cage. The objective of this study was to evaluate the impact of cage culture activities on the water quality at the reservoir. Four sampling stations were chosen where three were at cage culture sites and one near inflow which acts as a control. Triplicates samples were taken at the culture site, 20 m away and 100 m away and at three depths; subsurface, 10 m and 20 m. Temperature ranged from 25.2 - 32.2°C and were in decreasing trend as depth increases. DO range from 0.26 - 8.45 mg/l and decreased with increasing depths. DO values were not significantly different within depth but was significantly lower at 20 m depth. Water clarity decreased as we approach the cage culture sites. TSS range from 1.50 - 9.10 mg/l and were significantly higher at 20 m depth than at subsurface. Conductivity ranged from 33 ms/cm – 89 ms/cm and showed an increasing trend with depth and was significantly higher at 20 m depth. At that depth, conductivity values at all cage culture sites were higher than the control site indicating higher dissolved solids. Furthermore, BOD₅ ranged from 6.80 – 13.86 mg/l and showed an increasing trend with depths. BOD₅ at 20 m were significantly higher than subsurface. At all depths, BOD₅ increased as we approach cage culture sites. Chlorophyll *a* concentrations increased toward cage culture sites. Controlled and proper management of existing cage culture activities is required in order to ensure long term sustainability of cage culture at Batang Ai Reservoir.

PP06

Cage Culture of Asian Sea Bass (*Lates calcarifer*) in Persian Gulf and its Constraints

SOLTANI, M.^{1*}, GHANADIAN, B.², MIRZAEI² AND YAVARI, H.³

¹Department of Aquatic Animal Health, Faculty of Veterinary Medicine, University of Tehran, Iran

²Pars Abzistan Marine Fish Farm, Bushehr, Iran

³Office of Aquatic Animal Health, Veterinary Organization, Bushehr, Iran

*Corresponding author's e-mail: msoltani@ut.ac.ir

Abstract

The geographical distribution of Asian sea bass (*Lates calcarifer*) started from Persian Gulf, although this voluble species is not available in Persian Gulf any more. The first experiment of cage culture of this species was inducted in Iran side of Persian Gulf during late January till August 2010. The fingerling fish of about 3 cm in length were transported from a fish farm from Indonesia, and then being transferred to a marine fish farm in Bushehr province in south Persian Gulf. After the fish reached 13 g in the ponds, they were moved into the cages in the Kangan region, Bushehr province. Fish were then grown for 224 days in the cages at a suitable density. During this growing period water quality parameters including water temperature, salinity and dissolved oxygen were monitored and included 19°C (winter)-36°C (summer), 42-45 ppt and >7 mg/l. The food conversion rate ranged between 0.01 (beginning period) to 2.54 (end period) throughout the growth period. Average growth reached in 524 g after 224 days growth and the survival was about 94%. Although no infectious disease was seen during the growth period, the cage aquaculture has faced with a number of obstacles including lack of broodstock and modern cage technology. In this paper, the major constraints of sea bass cage culture in Persian is discussed.

PP07

Suitable Weight for Release Process and Marine Culture of *Rutilus frisii kutum* Fingerlings in South Caspian Sea

SEYEDALI HOSSEINI^{1*}, CHE ROOS SAAD¹, ANNIE CHRISTIANUS¹, MOHAMMAD SAYYAD BOURANI², HASSAN MOHD DAUD³, SHARR AZNI HARMIN⁴ AND HADI ZOKAEI FAR¹

¹Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

²Ministry of Agriculture Jihad, Inland Water Aquaculture Institute, Bandar Anzali P.O. Box 66

³Department of Veterinary Clinical Studies, Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

⁴Center of Land and Aquatic Technology, Faculty of Science and Biotechnology, Universiti Selangor, 40000 Shah Alam, Selangor, Malaysia

*Corresponding author's e-mail: seiedalihosseini@gmail.com

Abstract

This study was carried out to determine the appropriate (smolted) weight of hatchery-reared *Rutilus frisii kutum* (Kamenskiy, 1901) for release into habitat and probability of marine net cage culture in south Caspian Sea. The most important variables to detect the appropriate weight such as osmoregulatory hormones, level of serum osmotic pressure, Na⁺/K⁺ATPase, blood ions and gill chloride cells activity were investigated. A total of 3,157 specimens were exposed in 4 weight groups of 1, 3, 5 and 7 g, in three salinity treatments: Caspian Sea water (11‰), estuarine water (7‰) and freshwater (control, 0.3‰). The blood samples and tissue fixations were carried out from 0 to 336 hours after exposure to different salinities. The results of osmolarity and ions measurements showed that only 3, 5 and 7g kutum, are able to adapt to salinity of 7‰ and 11‰ since they maintained the osmolarity and ion concentrations. In 1g kutum, the levels of cortisol and prolactin showed significantly higher values after 48 hours until the end of the experiment compared to other weight groups (P<0.05). The size of chloride cells did not change in 1g kutum in different salinities; although in the other groups, a significant increase of this parameter was detected during the experiments (p<0.05). The Na⁺/K⁺ATPase activities in 3, 5, and 7g weight groups, under exposure to 11‰ and 7‰ salinities, were higher than in 1g kutum and their respective control level during period of the experiment (p<0.05). In conclusion, the results indicate that osmoregulatory ability of juvenile kutum depends on their weights. Despite, high ability of brackish water adaptation in 3, 5 and 7g kutum, 1g fingerlings were not able to adapt to the Caspian Sea and estuarine waters. Therefore, they cannot be considered as suitable sizes to be released into the brackish and marine environments.

PP08

Estuarine Fish and Oyster Integrated Cage Culture: An Environment Friendly Innovation

WESTLY R. ROSARIO¹, RAQUEL A. FERRER¹, REIVIN T. VINARAO^{2*}, ANGELITO C. DELA CRUZ¹, NOVA MARIE O. PESEBRE¹, ANNABELLE TENORIO¹, MEDEL M. ESPINOSA¹, CRISELDO BAUTISTA¹, RODEL BAUTISTA¹ AND JOSELITO RANTAYO¹

¹Bureau of Fisheries and Aquatic Resources-National Integrated Fisheries Development Center, Bonuan Binloc, Dagupan City, Philippines

²National Fisheries Research and Development Institute, 940 Quezon Avenue, Quezon City, Philippines

*Corresponding author's e-mail: taikyoku@yahoo.com

Abstract

This paper presents an environment friendly innovation in cage aquaculture by integrating an estuarine fish, high breed tilapia (*Molobicus*) and oyster culture in one system. The integrated cage culture technology was conceptualized as a small ecosystem within a larger system that displays a symbiotic relationship among its components. The innovation was constructed by modifying an idle and unused circular fish cage (10m and 12m inner and outer diameter). Two (2) meters bamboo were equally (1.8 meter spacing) attached in the fish cage base, appearing as sun-raises, to serve as tying bases to hold seeded oyster strings. Seeded oyster strings were tied at 0.50m intervals in the bamboo braises around the circular cage. Additional floaters were installed in the cage to hold maturing oysters. The cage was installed in Dawel River, Pangasinan and let it stand for two consecutive 120 days culture cycles. By principle, *Molobicus*, being the primary aquaculture commodity will feed on commercial feeds and release metabolic wastes (e.g. urine and feces) to the environment; the excess feeds will settle to the river bottom and basically be decomposed and will enrich the environment through photosynthesis. The excess nutrients that float in the water column will be absorbed by the oysters (being filter feeders) that are hanged within the cage periphery thus, removing organic loads which eutrophicate the sub-system. The scavenging characteristic of oysters thus cleans-up the sub-system leaving a suitable water condition for the growth of the primary commodity.

PP09

Bangus Culture in Cages at Cebu Technological University San Francisco Campus: Proposed Extension Training

**ANGELO B. DALAGUIT^{1*}, MARY ANN L. DALAGUIT¹ DOMINADOR G. SURBANO¹
AND BONIFACIO S. VILLANUEVA²**

¹Cebu Technological University San Francisco Campus,
San Francisco, Cebu, Philippines

²Cebu Technological University Main Campus,
Cebu City, Philippines

*Corresponding author's e-mail: loloy2ann@yahoo.com

Abstract

This study determined the viability and financial analysis of bangus culture in cages at Cebu Technological University San Francisco Campus fish farm. This study used sampling techniques and procedures to gather data. Factors considered were average body weight; growth range; mortality; daily feeds requirements and salinity (ppt). There were three cages constructed using bamboo frames and nets with a measurement of 7x7x2 meters. The actual number of stocks in Cage 1 was 2,568 pieces. Cage 2 had 1,878 pieces, while Cage 3 had 2,978 pieces with the mean salinity of 35 ppt within the culture period.

The average increment body weight in Cage 1 (223.7 g), in Cage 2 (259.8 g) and 281.7 g for Cage 3 during harvest. Cages 1 and 2 were within the standard growth ranging from 216 - 275 g in 91 - 105 days culture, while Cage 3 was in the growth range of 276 - 340 g in 106 – 120 days culture. A mortality rate of 8.81% for Cage 1, which was less than the standard of 10%; Cage 2 had 29.5% mortality; the last cage had 73% mortality. The finding showed that the growth and maturity range in the feeding scheme employed was normally established.

Based on the findings, it was concluded that the milkfish culture in cages at Cebu Technological University San Francisco Campus fish farm was suitable. It is recommended to continue the project for further studies.

PP10

Catching Effectiveness of the Four Shallow Water Artificial Fish Shelters (Miracle Hole) using Indigenous Materials at the Coastal Waters of the Northern Poblacion, San Francisco, Cebu: Basis for Technology Guide

DOMINADOR G. SURBANO^{1*} AND BONIFACIO S. VILLANUEVA²

¹Cebu Technological University San Francisco Campus,
San Francisco, Cebu, Philippines

²Cebu Technological University Main Campus, Cebu City, Philippines

*Corresponding author's e-mail: loloy2ann@yahoo.com

Abstract

This study finds out the most effective method of constructing artificial habitat to attract fish and shellfishes through artificial shelters made out of different indigenous materials.

A combination of four different materials (stones, logs, bamboos and buri leaves) was used in the construction of shallow water artificial fish shelters (miracle hole). These were set at the sea bottom, observed and investigated to determine their effectivity in relation to the length of time of their submersion in sea water. Three trials were patterned to a Randomized Complete Block Design (RCBD) in the intertidal zone of Northern Poblacion, San Francisco, Cebu. Difference in terms of yield, species composition and number of individuals were noted during harvests at 30 days, 60 days, 90 days and 120 days. Results were tested using Analysis of Variance (ANOVA).

Species diversity was found to have increased as the time of submersion increased. Furthermore, results showed that the harvest at 90 days gave a higher percentage of medium-sized fish (11-20 cm) than all the other harvests. All treatments, Treatment (T)0, the control group and the modified shelters; T1, modified by adding bamboos and buri leaves; T2, modified by adding logs and buri leaves and T3, modified by adding bamboos, logs and buri leaves showed increase in harvest 3, (90 days). The percentage of smaller fish (3-10cm) becomes higher at 120 days of submersion but the total yield decreases.

PP11

The Growth and Gonadal Development of Tank Cultured *Probarbus jullieni*

MOHD FARIQ AHMAT^{1*} AND ANNIE CHRISTIANUS²

¹Institute of Bioscience, Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia

²Department of Aquaculture, Faculty of Agriculture,
Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*Corresponding author's e-mail: alibubber@gmail.com

Abstract

Probarbus jullieni also known as temoleh is one of the popular gamefish in Malaysia. Record showed that it can achieved length of 150cm length and 70 kg of weight. It can only be found in Sungai Pahang and Sungai Perak in Peninsular Malaysia and in Chao Phraya and Mekong basins of Indo-China and Thailand. The price of this fish is expensive due to scarcity caused by overfishing. This species is listed as endangered species in the IUCN Red List. In this study, *P. jullieni* fingerlings of two month-old with average size 4.31 cm were taken from Aquaculture Extension Centre Perlok, Pahang in March 2010, conditioned and cultured for a period of one year in Aquaculture Research Station of Universiti Putra Malaysia at Puchong. Fingerlings were cultured at 150 fish/tank (2 tonnes capacity) for the first 4 months and then transferred to a concrete tank (40 tonnes capacity) for the rest of the culture period. Samplings of fish were carried out monthly to determine length and weight increments. At the same time, ten fishes were sacrificed in order to extract their gonad. These gonads were prepared into sections on glass slides, viewed under light microscopy to determine its developmental stages. The result in this study show there were gonad occurred but not obvious gonad development during this study. The average total length of the fish is 4.31 cm during the study started and growth to 20.7 cm when study finish. The weight increment it starts with 2.67 g during first month and end with 125.11 g in the end of the study. The survival rates of the fish is very-very low it show only 9% of the fish is survive to the end during this study it because they cannot tolerated high pH and very sensitive to low water quality.

PP12

Egg Development and Hatching in Freshwater and 10 psu Water on Marble Goby, *Oxyeleotris marmoratus* Caught in a River in Sabah, Malaysia

SIEWING NGUANG^{1*}, YOSHIKAZUMI NAKAGAWA², KEITARO KATO¹, OSAMU MURATA¹, KENJI TAKII¹, SHIGERU MIYASHITA¹ AND SHIGEHARU SENOO³

¹Fisheries Laboratory of Kinki University, Shirahama Experiment Station, Shirahama-cho 3153, Nishimuro-gun, Wakayama 649-2211, Japan

²Aqua-Bioscience and Industry, Tokyo University of Agriculture, 196 Yasaka Abashiri Hokkai 099-2493, Japan

³Borneo Marine Research Institute, Universiti Malaysia Sabah, 88999 Kota Kinabalu, Sabah, Malaysia

*Corresponding author's e-mail: nguangsiewing@gmail.com

Abstract

Marble goby, *Oxyeleotris marmoratus* (Bleeker 1852) is one of the most highly priced freshwater fish in Southeast Asia. To improve hatching technique for higher larval survival, *O. marmoratus* eggs were incubated in freshwater (FW) and 10 psu brackish water (10psuW), and egg development and hatching were recorded. There was little difference in morphological development of eggs between FW and 10psuW. Hatching gland cells (HGC) and embryonic sensory organs developed similarly in both FW and 10psuW. The hatching period ranged 27–96 h after fertilization (hAF) in 10psuW and 27–120 hAF in FW. The eggs of *O. marmoratus* from Sabah, Malaysia were euryhaline and could be incubated in either FW or 10psuW. However, eggs incubated in 10psuW had a shorter hatching period, higher hatching rate and better larval survival than those in FW. The hatching rate in FW was 62.0%, versus 80.3% in 10psuW. The deformation rate of hatched larvae was 15.3% in FW and only 2.0% in 10psuW due to delayed hatching. All larvae hatched at 96–120 hAF in FW showed deformation, while un-hatched eggs died at 96–130 hAF in 10psuW and 120–150 hAF in FW. Delayed hatching resulted in deformation and subsequent mortality; thus, hatching after 96 hAF was classified as delayed hatching in *O. marmoratus*. Under hatchery conditions, the observation of deep eye pigmentation in eggs is an index of delayed hatching. After 60 hAF, embryos in both FW and 10psuW had developed an inner ear, opened olfactory pits and free neuromast (FNM) with cupulae on their head, indicating that 60-hAF embryos had the ability to survive as fish larvae. The correct hatching stage was considered to range from 48 hAF, when embryonic HGC numbers had peaked, to 60 hAF, when embryos had developed sensory organs as fish larvae.

PP13

Effects of Timing of First Feeding for Nutrition Transition Period on Marble Goby, *Oxyeleotris marmoratus* Larvae

SITI FAIRUS MOHAMED YUSOFF¹, CHING FUI FUI² AND SHIGEHARU SENOO^{1*}

¹Borneo Marine Research Institute, Universiti Malaysia Sabah,
88999 Kota Kinabalu, Sabah, Malaysia

²Fisheries Laboratory, Kinki University, 3153, Shirahama, Wakayama, 649-2211, Japan

*Corresponding author's e-mail: ssenoo@ums.edu.my

Abstract

Marble goby, *Oxyeleotris marmoratus* is native in Southeast Asian region and one of most high-valued freshwater fish in aquaculture industry. The main constraint of *O. marmoratus* farming is insufficient of seed supply due to inconsistent survival in early larval stage. We hypothesized the problem is related to the indeterminate first feeding and understanding the optimum first feeding can support to solve the problem. For the first step, the present study focused the nutrition transition period (NTP) of *O. marmoratus* larvae with different timings of the first feeding and clarified the mutual relationship between different timings of the first feeding and the absorptions of larval yolk sac and oil globule. Firstly experiment was done to indicate larval readiness for first feeding based on morphological observation. First feeding was defined as 0 hours delayed first feeding (h DFF) and were delayed for every 12 hours interval up to 60h DFF. After indicated the first feeding time, experiment was carried out to examine the changes of yolk sac and oil globule volume of larvae fed at different first feeding times. Larval were morphologically prepared for first feeding at 36 hours after hatching (h AH). Yolk sac and oil globule volumes of larvae fed at 0h DFF were gradually declined compared to rapid reduction observed in those starved larvae. The differences of yolk sac and oil globule volume had resulted in dissimilarities of both absorption periods. Accordingly, NTP was relatively longer in 0h DFF (36-82h) compared to 12, 24, 36, 48 and 60h DFF (36-76, 36-75, 36-75, 36-73 and 36-72h) respectively. As for oil globule absorption period 0h DFF (36-86h) was longer compared with the other treatment (36-86, 36-80, 36-79, 36-77, 36-76 and 36-76h). In conclusion, delayed first feeding times leads to shorter NTP which triggered starvation in early larval stages and induced poor survival and growth of *O. marmoratus* larvae. Initiation of first feeding times at 0h DFF is recommend for *O. marmoratus* larvae.

PP14

Vitellogenin in Boosting up Reproductive Performance of *Lates calcarifer* in Captivity

NOOR FAZIELAWANIE MOHD RASHID¹, SITI SHAPOR SIRAJ^{1*}, INA SALWANY MD YASIN¹, SHARR AZNI HARMIN² AND NIK DAUD NIK SIN³

¹Department of Aquaculture, Faculty of Agriculture,
Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

²Centre for Land and Aquatic Technology, Faculty of Science and Biotechnology,
Universiti Selangor (UNISEL), 45600 Batang Berjuntai, Selangor, Malaysia

³Fisheries Research Institute (FRI), Tanjung Demong,
22200 Besut, Terengganu, Malaysia

*Corresponding author's e-mail: shapor@putra.upm.edu.my

Abstract

Vitellogenin (vtg) is a precursor of egg yolk protein, synthesized in the liver in response to circulating estrogen in matured female fish. Vitellogenin synthesis was induced in juvenile *Lates calcarifer* (n=10) by repeated injections of 17- β estradiol. Plasma vtg was purified by size exclusion chromatography using Sepachryl HR 300 column. The protein concentration as responses to E₂ treatment increased from 0.0081 mg/ml to 0.0590 mg/ml as determined by Bradford assay. A rabbit antiserum raised against purified vtg was used to detect the vtg in immunoassay analysis. In Native PAGE, the intact protein appeared as dimeric circulating form of approximately 545 kDa and reduced to a single monomer of 232.86 and 118.80 kDa in SDS-PAGE analysis. A competitive indirect ELISA was developed using rabbit antiserum for quantitatively detect the vtg levels in *L. calcarifer*. ELISA working ranges were 31.2 ng/ml to 1000 ng/ml and demonstrated precision with intra- and inter-assay variations at 50% binding of 8.4% (n=9) and 12.1% (n=5), respectively. ELISA was sensitive enough to differentiate males and non-vitellogenic females of *L. calcarifer* in captivity for reproductive physiology and farm management.

PP15

Feeding Activity of White-Leg Shrimp, *Litopenaeus vannamei* Post Larva under Different Environmental Conditions

AUDREY DANING TUZAN*, ANNITA YONG SEOK KIAN AND KIU HIE YUNG

Borneo Marine Research Institute, Universiti Malaysia Sabah,
88400 Kota Kinabalu, Sabah, Malaysia

*Corresponding author's e-mail: audrey@ums.edu.my

Abstract

This study was designed to understand how environmental conditions such as salinity and light are related in the feeding activity of white-leg shrimp, *Litopenaeus vannamei* post larva. In the 1st experiment, trials were done by feeding live and frozen *Artemia* nauplii to post larvae 8, 18 and 29 under light and dark conditions meanwhile in the 2nd experiment, trials were done by feeding live *Artemia* nauplii to post larvae 8, 18 and 29 under different salinity levels (15, 20, 25, 30 and 35ppt). Before commencing the trial, each post larvae were placed individually in small flask and starved for 6 hours. A fix number of *Artemia* nauplii was then counted and introduced into each of the flask. After 1 hour, post larvae were killed and the remaining number of *Artemia* nauplii in the flask was counted. The result showed there is no significance different on the ingestion rate of post larvae was observed in all of the treatment groups between light and dark condition fed with live and frozen *Artemia* nauplii. However, overall results indicated that small post larva (PL8) can ingest more food under dark condition, while larger post larval (PL18 and 29) ingest more food under light condition. The results for salinity experiment showed there are no significant difference among treatment group under different salinity levels at PL8 and 18. In PL29, the ingestion rate of *Artemia* nauplii was higher in 25ppt but low ingestion rate was observed in higher salinity level. However, the ingestion rates of PL 29 in salinity of 15 to 25 ppt showed no significant difference. These results may indicate that different light condition and salinity can affect the feeding activity of *L. vannamei* post larvae. Therefore, these two environmental conditions must be considered when practicing the larval rearing of *L. vannamei*.

PP16

Physiological Performance of White Shrimp, *Litopenaeus vannamei*, Cultured in Freshwater Medium by Potassium Application

AAN FIBRO WIDODO*, BRATA PANTJARA, NOOR BIMO ADHIYUDANTO AND RACHMAN SYAH

Institute for Coastal Aquaculture (RICA),
Jl. Makmur Daeng Sittaka No.129, Maros 90512, Sulawesi Selatan, Indonesia

*Corresponding author's e-mail: litkanta@indosat.net.id

Abstract

Potassium is essential for shrimp especially that cultured in the freshwater medium. Potassium acts as electrolyte balance in the body cells, particularly in the delivery of nerve impulses and releasing energy from protein, fat and carbohydrate in the metabolism process. This study aims to determine the performance of white shrimp (*Litopenaeus vannamei*) cultured in freshwater with the addition of potassium. Research was conducted at the Wet Lab Institute for Coastal Aquaculture (RICA), Maros. The test animals that used were shrimp vaname having of age 62 days with initial weight average $5,80 \pm 0,02$ g. The study used completely randomised design (RAL) which consists of 4 treatments and 3 replications. The treatments tested were the application of KCl as source of potassium into freshwater medium having the salinity of 1-0 ppt with the concentration of 25, 50, 75 and 0 ppm (control) each for treatment A, B, C and D, respectively. Shrimp was adopted in brackishwater with the salinity of 25 ppt during 10 days before application. Dilution of salinity was done using fresh water during 3 days from 25 ppt down to 1 ppt, continued by the rearing in freshwater during 30 days. Variables measured were the level of osmotic activity, the rate of oxygen consumption, blood glucose levels, survival rate, and the weight growth and daily specific length. The results showed that the application of potassium with the concentration of 25-75 ppm into rearing freshwater medium can enhance the ability of osmoregulation and reduce stress levels of the white shrimp on the freshwater medium which may increase the rate of growth and their survival rate. The statistic analysis showed that the osmotic activity, oxygen consumption rate and blood glucose levels exhibited a significant difference ($P < 0,05$) among the treatments. The best performance of white shrimp with osmoregulation level, oxygen consumption rate and the minimum blood glucose levels was found on the treatment with the application of 55,05–56,43 ppm potassium.

PP17

Quality Improvement of Broodstock, Larvae and Juvenile of Abalone *Haliotis squamata* (Reeve, 1846) through Environmental Management

IBNU RUSDI^{1*}, BAMBANG SUSANTO¹, RIANI RAHMAWATI¹ AND I NYOMAN A. GIRI²

¹Research Institute for Mariculture – Gondol,
PO Box 140 Singaraja, 81101, Bali, Indonesia

²Research and Development Centre for Aquaculture,
Jln. Ragunan No. 20 Pasar Minggu, Jakarta Selatan, Jakarta, Indonesia

*Corresponding author's e-mail: ibnurusdi09@yahoo.com

Abstract

Several problems have been faced in seed production of abalones at Research Institute for Mariculture-Gondol, such as difficulty to get mature broodstocks which are ready to spawn in the hatchery because their availability still depend on the capture from the wild. Another problem is lack of information about spawning methods and larval rearing which are suitable to produce abalone juveniles, especially for the species *Haliotis squamata*. The aim of this experiment was to find suitable methods to induce spawning of abalone broodstocks and their larval rearing until they reached the juvenile stage in order to support the mass seed production in hatchery. The results of the experiment showed that induced spawning of abalone broodstock was found to be better by using injection of pure oxygen method with aeration for 3 hours after desiccated for 2 hours compared to the other methods, such as flow-through by ultraviolet irradiated seawater, addition of hydrogen peroxide (H₂O₂) and shock temperature methods. The growth performance of abalones reared at a stocking density of 25 larvae/L showed the highest survival rate (5.36%) compared to the others 1.35% (50 larvae/L) and 1.01% (100 larvae/L). Abalone juveniles which were reared in floating net cage showed better growth of shell length (37.12 mm), shell width (24.05 mm) and body weight (7.93 g); compared to the abalones reared in the hatchery (33.54 mm; 21.26; 5.72 g). The absolute growth of abalones shell length reared in floating net cage and hatchery were 17.14 mm and 15.17 mm, respectively.

PP18

Maternal Inheritance of Yellowfin Tuna (*Thunnus albacares*) in Captivity

GUSTI NGURAH PERMANA*, JHON HARIANTO HUTAPEA, SARI BUDI MORIA AND HARYANTI

Gondol Research Institute for Mariculture, P.O. Box 140 Singaraja Bali-Indonesia,

*Corresponding author's e-mail: gustipermana@gmail.com, rimgdl@indosat.net.id

Abstract

Mitochondrial DNA introgression has been suggested to be responsible for the maternal consistent implications. Study on mitochondrial (mt-DNA) variation in the yellowfin tuna, *Thunnus albacares* using restriction fragment length polymorphisms (RFLP) have provide the evidence of maternal inheritance of yellowfin tuna in captivity. Eggs were collected during every spawning from 2004 to 2005. Mt-DNA genotypes of broodstock were compared with their eggs. The maternal inheritances of these females were determined from genotypes in the eggs. The result showed that 5 female broodstocks were observed in eggs and four of them establish a single female's identity and one types were shared by two females. The same genotype were observed almost in every sampling throughout one year. The results indicated that females broodstock were spawning daily almost a year.

PP19

Infection Susceptibility of Adult *Caligus rotundigenitalis* on Six Marine Finfish Cultured in Cages in Penang, Malaysia

LEAW YOON YAU¹, ANIL CHATTERJI², BENG CHU KUA^{3*} AND FAIZAH SHAHAROM²

¹Faculty of Agrotechnology and Food Science (FASM), Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

²Institute of Tropical Aquaculture (AQUATROP), Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

³National Fish Health Research Centre (NaFisH), FRI NaFisH Batu Maung, Fisheries Research Institute, 11960 Batu Maung, Penang, Malaysia

*Corresponding author's e-mail: kuabeng@fri.gov.my

Abstract

Examination of six species of marine cage cultured finfish species from Penang, Malaysia revealed a marked difference in the prevalence and mean intensity of *Caligus rotundigenitalis* infection between host species. Giant grouper (*Epinephelus lanceolatus*) was found to be the most preferred species with a prevalence of 96.9% as compared to Asian seabass (*Lates calcarifer*), crimson snapper (*Lutjanus erythropterus*) and tiger grouper (*E. fuscoguttatus*) with 85.7%, 83.3% and 80.0% prevalence respectively. *Lutjanus erythropterus* and *E. fuscoguttatus* were the most heavily infected with a mean intensity of 5.9 ± 5.0 . Red grouper (*E. morio*) was rarely infected as compared to the other four species in the present study. Meanwhile the golden snapper (*L. johni*) was found free from *C. rotundigenitalis* infection. There is a significant difference between the prevalence and mean intensity of *C. rotundigenitalis* infection amongst the six species of hosts. The presence of *C. rotundigenitalis* on *E. lanceolatus*, *E. morio* and *L. calcarifer* represent the new host and distribution records for Malaysia.

PP20

Antibiotic Sensitivity Study of *Aeromonas hydrophila* Isolated from Clinically Infected Freshwater Fishes (*Oreochromis mossambicus*, *Puntius gonionotus*, *Leptobarbus hoevenii*, *Pangasius pangasius*, *Anabas testudineus*, *Clarias gariepinus* and *Cichlasoma* sp.) in Malaysia

HASSAN MOHD DAUD*, RUHIL HAYATI HAMDAN, NUR HIDAYAHANUM HAMID AND MOHD FUAD MATORI

Aquatic Animal Health Unit, Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 Serdang, Selangor

*Corresponding author's e-mail: hassan@vet.upm.edu.my

Abstract

Aeromonas hydrophila is gram negative bacteria ubiquitous in aquatic environment and have been implicated in the aetiology of a variety of systemic and localized diseases in fish. Thus, this study was done to investigate the antibiotic sensitivity of *Aeromonas hydrophila* isolated from clinically infected *Oreochromis mossambicus*, *Puntius gonionotus*, *Leptobarbus hoevenii*, *Pangasius pangasius*, *Anabas testudineus*, *Clarias gariepinus* and *Cichlasoma* sp. in Selangor, Malaysia. All sampled fish showed clinical signs such as skin haemorrhages, sunken eyes and fins rot. A total of 48 isolates of *A. hydrophila* were isolated by direct streakings from skin, kidney, spleen and liver and overlaid onto Trypticase Soy Agar. All isolates were identified using commercial kit, API 20E in combination with oxidase, catalase and hemolytic activity. The isolates were tested for sensitivity to ten antibiotic namely, penicillin G (10µg), cephalexin (30µg), florfenicol (30µg), streptomycin (10µg), kanamycin (30µg), erythromycin (15µg), ampicilin (10µg), gentamicin (10µg), oxytetracycline (30µg) and tetracycline (30µg). The isolates were 100% resistant to ampicilin, cephalexin and penicillin G followed by erythromycin (92%), tetracycline (40%) and streptomycin (21%). However, 100% of isolates were demonstrated sensitive to kanamycin, florfenicol, oxytetracycline and gentamicin. In conclusion, *A. hydrophila* was sensitive to peptidyl transferase and most of the aminoglycoside group, while the bacteria were resistance to β-lactams group. Multiple Antibiotic Resistance (MAR) index for the bacterial isolates was 0.45. The current results indicated that the *A. hydrophila* in these farmed fish might have been indiscriminately and continuously exposed to those antibiotics during their culturing stages. Constant monitoring should be done in order to compile more information on antibiotic sensitivity of *A. hydrophila* and other known aquatic bacteria species in order to avoid the development of antibiotic superstrain.

PP21

Isolation, Identification and Pathogenicity of *Aeromonas hydrophila* from MAS (Motile Aeromonas Septicemia) like Disease in Juvenile Tilapia, *Oreochromis niloticus*

HASSAN MOHD DAUD*, NUR HIDAYAHANUM HAMID AND RUHIL HAYATI
HAMDAN

Aquatic Animal Health Unit, Faculty of Veterinary Medicine,
Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*Corresponding author's e-mail: hassan@vet.upm.edu.my

Abstract

Aeromonas hydrophila, a fish pathogen causing motile Aeromonas septicemia was isolated from diseased tilapia in a private farm during disease outbreak. The bacteria were isolated by direct streaking from skins, kidney, spleen and liver onto Trypticase Soy Agar (TSA, Merck, Germany). Isolated bacteria were subjected to morphological, biochemical and physiological tests. All isolates were identified using commercial kit, API20E with combination of oxidase and catalase. Haemolytic activity was done on horse blood agar (BML, Malaysia). The bacterial isolates showed positive results for ONPG, ADH, LDC, citrate utilization, gelatinase, indole production, Voges Proskauer, and acid production from mannitol. On the other hand, negative results were obtained from ODC, H₂S, urease, TDA and acid production from inositol, sorbitol, rhamnose, saccharose, melibiose, amy and arabinose. The haemolytic results showed β-haemolysis on horse blood agar. All isolates grow in less than 7% NaCl. Then, the bacterial isolates also grow at 22°C and 37°C. In a pathogenicity test, the median lethal dose (LD50) of *A. hydrophila* for tilapia (*Oreochromis niloticus*) by intraperitoneal injection was 6.41×10^6 CFU/ml. This study indicates that an action should be taken into consideration for the virulence factor and for the further treatment.

PP22

Significance of Immunity in Disease Management of Caged Grouper

CATHERINE CHIENG CHENG YUN^{1*}, MARIANA NOR SHAMSUDIN¹, FATIMAH MOHD YUSOFF¹ AND MAHA ABDULLAH²

¹Laboratory of Marine Biotechnology, Institute of Bioscience, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

²Dept. of Pathology, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*Corresponding author's e-mail: cat_ccy@hotmail.com

Abstract

In aquaculture, one of the persistent problems is disease management, whereby a lack of knowledge on fish immunity is a major contributing factor. For this reason, a complete study on the fish immunity may provide a clearer picture on the response and interaction of cells and molecules in this system with their environment, and reveal ways on how to enhance the immune system. Mucosal immunity is part of the immune system and it comprises the skin, gill and intestine. It performs its various functions primarily through the mucus secreted by these organs. The physiological functions of the mucus have been described to include ionic and osmotic regulation, excretion, communication, feeding and reproduction. Protective roles are executed by the physical barrier conferred by the organs, while substances in the mucus such as lysozyme, lectins, proteinases, complements, antibacterial peptides and antibodies generally digest the pathogen itself or neutralize the toxin produced. Mucus is also continually sloughed off to hinder pathogen establishment. Being the layer that separates the fish inner environment from outer, mucosal immunity is pivotal when viewed as the first line of defense against infections to ensure better living. The fish model employed was brown-marbled or tiger grouper (*Epinephelus fuscoguttatus*), of which the immune system is largely unknown. The skin mucus was collected and processed for two-dimensional gel electrophoresis. Mucosal tissues (skin, gill and intestine) were collected and processed for histology. Gel pictures showed fish skin mucus contained appreciable amount of protein with different sizes and isoelectric points. From the histological sections, goblet cells that secrete mucus and leukocytes that are notable immune constituents were identified. This paper describes methods which can be utilized to investigate the fish immune system; from basic microscopy techniques like histology to more recently developed two-dimensional gel electrophoresis.

PP23

Development of Monoclonal Antibodies against Phagocytic Leukocytes of Brown-Marbled Grouper, *Epinephelus fuscoguttatus*

CHONG CHOU MIN^{1,3}, MARIANA NOR SHAMSUDIN^{1,3}, THAN L.T.L.³, FATIMAH MD YUSOFF^{1,2} AND MAHA ABDULLAH^{1,4}

¹Institute of Bioscience, UPM;

²Department of Aquaculture, Faculty of Agriculture, UPM;

³Department of Medical Microbiology and Parasitology, Faculty of Medicine and Health Sciences, UPM;

⁴Department of Pathology, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

*Corresponding author's e-mail: chongchoumin@yahoo.com

Abstract

Like other higher vertebrates, fish possess strong innate immune responses upon invasion from foreign pathogens. Phagocytic leukocyte (phagocyte) is one of the major components of innate immunity which contributes clearance of pathogens by phagocytosis. There are two types of phagocytes, i.e. mononuclear phagocytes (monocyte) and polymorphonuclear phagocytes (neutrophil). Use of monoclonal antibodies is one of the efficient approaches to identify and isolate these cells. However, limited availability of fish leukocyte monoclonal antibodies in the market restricts immunoassays that can be applied to assess the immune cells. Current research has focused on the development of monoclonal antibodies to detect both phagocytes of a Malaysian cage culture finfish species of high commercial value, that is, brown-marbled grouper (*Epinephelus fuscoguttatus*). Paraformaldehyde-fixed grouper leukocytes were injected into Balb/C mice as antigens which trigger the production of antibody-producing lymphocytes in the mice. These cells were harvested from mice spleen and fused with myeloma cell line, SP2 to produce immortal hybridoma cells that are able to constantly produce the desired antibodies. Positives hybridoma cells were identified by using cell-based ELISA technique and confirmed with indirect fluorescent antibody test (IFAT). Hybridoma cells which produce monoclonal antibodies against respective mononuclear phagocytes and polymorphonuclear phagocytes were identified. This method enabled the production of monoclonal antibodies against grouper phagocytic leukocytes which can facilitate many functional assays to be performed and thus stimulating further immunological studies in the future.

PP24

Site-Specificity Study of Monogenean Gill Parasite in Pond Cultured Patin Buah (*Pangasius nasutus*) at Aquaculture Extension Centre, Perlok, Jerantut, Pahang

SURZANNE MOHD AGOS* AND FAIZAH SHAHAROM-HARISSON

Institute of Tropical Aquaculture, Universiti Malaysia Terengganu,
21030 Kuala Terengganu, Terengganu, Malaysia

*Corresponding author's e-mail: surzanne_mohdagos@yahoo.com

Abstract

A study was conducted on site-specificity, prevalence and mean intensity of monogenean gill parasite of *Pangasius nasutus*, cultured in pond culture farm at Aquaculture Extension Centre, Perlok. A total of 30 fishes of *Pangasius nasutus* from different size classes were collected and they were randomly sampled from pond starting from August to September 2008. The condition of fish and water quality of pond culture system were taken. The gills were taken and fixed in 10% formalin and examined at laboratory within two months from the date of collection. For each host, parasites numbers on each gill arch, external and internal gill filaments of right and left side gills were recorded. To provide information on site preference, the positions of parasites along the length of each gill filament and along the antero-posterior axis of the gill were noted. Each gill was divided into four approximately equal regions along the anterior posterior axis as follows: A, the region proximal to the mouth, designated the anterior-most region; B, the anterior middle region; C, the posterior middle region and D, the posterior region. Histology was carried out to study the structure of gill and to examine the structural changes on the gill infected by monogenean. Scanning Electron Microscope was done to observe more clearly the specimen and the site attachment of the parasite on gill. Examination of gill parasite from *Pangasius nasutus* in pond culture fish at Perlok (Pahang, Malaysia) revealed the presence of monogenea species, member of *Thaparocleidus* Jain, 1952. Study on prevalence, mean intensity and mode of attachment of monogenea are reported.

PP25

Preliminary Studies of Aquatic Fungi in Malaysian Water Bodies

HASSAN MOHD DAUD* AND SEYEDEH FATEMEH AFZALI

Aquatic Animal Health Unit, Faculty of Veterinary Medicine,
Universiti Putra Malaysia
43400 UPM Serdang, Selangor, Malaysia

*Corresponding author's e-mail: hassanmd@putra.upm.edu.my

Abstract

Fungal infections in fish are most frequently attributed to members of the family Saprolegniaceae in the class Oomycetes or the water molds. This preliminary study of aquatic fungi in Malaysian water system aims to isolate *Aphanomyces* spp., which is an OIE notifiable pathogen, for diagnostic purposes in the future. In this study 23 water samples were taken from Malaysian water bodies such as fish farms, recreational ponds, lakes and rivers. All samples were incubated in APW added with antibiotics and baited with sterilised maize, green peas, fish meat and insects wings for 14 days at room temperature. In some samples formation of fungus hyphae were observed after 3-7 days. These samples were examined under light microscope for genus identification. Various isolates including terrestrial fungi were successfully isolated and identified. *Saprolegnia* spp., *Achyla* spp. and *Aphanomyces* spp. were three common aquatic fungi in Malaysia's natural water bodies and fish farms, in decreasing order.

PP26

Effect of *Cinnamomum camphora* and *Thymus* as Antimicrobial in Fish *Petrophyllum scalare*

TARA ETEMADI, AMIR ABBAS ESMAILZADEH*, MARAL DARA, MOHAMMAD HOSSEIN BAZGHANDI AND FARBOD HAJOBASHI

Science and Technology Faculty, Islamic Azad University, North Tehran Branch

*Corresponding author's e-mail: ab.esmailzadeh@yahoo.com

Abstract

Nowadays, due to excessive use of chemical antimicrobial in aquaculture, some problems such as mutation and environmental pollution are increasing. The aim of this research was to find herbs which can be used as antimicrobial as alternative approach to resolve disease problems without using chemicals. In this research, *Cinnamomum camphora* and *Thymus* were used to remove all the harmful organisms within a short time. The use of these herbs as antimicrobial in fish *Petrophyllum scalare* proved effective. Three concentrations, i.e. 0.5 mg/l, 1.0 mg/l, and 1.5 mg/l were used, consisting of equal amount of both herbal extracts. The results showed that the best dose for usage as antimicrobial in fish culture was 0.5 mg/l. Herbal concentrations higher than 0.5 mg/l caused fish mortality.

PP27

Effects of Different Feeding Regimes on Growth of Nile Tilapia (*Oreochromis niloticus*)

JEONG-YEOL LEE* AND YANG GAO

Department of Aquaculture and Aquatic Science,
Kunsan National University, Republic of Korea

*Corresponding author's e-mail: yjeong@kunsan.ac.kr

Abstract

The experiment was carried out to investigate the effects of different feeding regimes on growth, feed efficiency, oxygen consumption rate and ammonia excretion rate of Nile tilapia. 240 Nile tilapia weighing 10.90-13.48 g were stocked in five of 2.5t recirculating tanks respectively. The control group was fed to satiation twice a day throughout the experiment. The other four groups were fed every other day, every three days, every five days, every one week, respectively in the first stage (80 days), and then fed to satiation during the refeeding period (100 days). At the end of the experiment, average weight and condition factor in the control group were obviously higher than the other four groups. During the refeeding period, feed intakes and specific growth rates were significantly higher in deprived fish than the control, indicating some compensatory responses in these fish. Feed intake and growth rate upon refeeding were higher the longer the duration of deprivation, no significant difference was found in feed conversion ratio between the deprived and control fish during refeeding, suggesting that hyperphagia was the mechanism responsible for increased growth rates during compensatory growth.

PP28

Palm Oil Based-Diet Enhances Growth Performance of Asian Seabass (*Lates calcarifer*, Centropomidae) Juveniles

ROSSITA SHAPAWI*, MUHAMMAD AIZAT MOHD ZAIN AND SHIGEHARU SENOO

Borneo Marine Research Institute, Universiti Malaysia Sabah,
Locked Bag 2073, 88999 Kota Kinabalu, Sabah, Malaysia

*Corresponding author's e-mail: rossita@ums.edu.my

Abstract

The replacement of dietary marine fish oil with vegetable oils was examined in Asian seabass juveniles (*Lates calcarifer*, Centropomidae), over the course of a 7-week feeding trial. Four fish meal-based diets (42% crude protein, 10% crude lipid) were formulated to contain iso-ingredients but with different sources of lipid including refined, bleached and deodorized palm olein (RBDPO), soybean oil (SBO) and canola oil (CNO), and their performance was compared with the control diet (FO) which contain cod liver oil as the added lipid source. The experimental diets were fed until satiation twice a day to triplicate groups of 12 fish in cylindrical cages that were placed in a 20 tonne polyethylene seawater tank. Fish fed diet RBDPO had significantly higher ($P < 0.05$) weight gain than other fish groups at the end of feeding trial. The feed conversion ratio of diet RBDPO (1.52) was not significantly different from the control diet (1.53), and this value was better than the other experimental diets (1.98 in SBO and 1.75 in CNO). High survival rates of seabass juveniles were observed in the present study (95.5 to 100%) and were not affected by the dietary treatments. In view of the availability and competitive price of palm oil in the global market, it can be concluded that palm oil can be an excellent source of lipid in the commercial feed of Asian seabass.

PP29

Vegetable Oils Based - Feed for Grow Out Culture of *E. fuscoguttatus*

NORFAZREENA MOHD FAUDZI, ROSSITA SHAPAWI* AND SHIGEHARU SENOO

Borneo Marine Research Institute, Universiti Malaysia Sabah,
Jalan UMS, 84000 Kota Kinabalu, Sabah, Malaysia

*Corresponding author's e-mail: rossita@ums.edu.my

Abstract

A ten – week feeding trial was conducted to evaluate the possibility of vegetable oils (VO) based - feed for grow out culture of tiger grouper, *E. fuscoguttatus*. Five isoproteic (50%) and isolipidic (10%) experimental feeds were formulated with 50% replacement of fish oil (FO) using VO (canola oil [CNO], refined, bleached and deodorized palm olein [RBDPO], soybean oil [SBO] and mixture of VO with ratio 1:1:1 [MIX]). Experimental feed with 100% FO was prepared as control. Triplicate groups of 20 tails of juvenile tiger grouper (22.7 ± 0.7 g) were stocked in 100L fibreglass tank with flow - through water system. Experimental fish were fed twice daily (0900 and 1500h) until apparent satiation level. The survival rate of experimental fish fed by CNO and RBDPO were significantly higher ($P > 0.05$) than other treatments at the end of feeding trial. Experimental fish fed with VO based - feed showed better growth performances than fish fed with FO. The weight gain ranged from 247% to 292% in experimental fish fed with VO based - feed and only 192% in fish fed with FO. The feed conversion ratio of all experimental feeds was not affected ($P < 0.05$) by experimental feeds. However, CNO showed best value of economic conversion ratio (14.88) compared to FO (24.65). The present study shows that the VO based - feed can be successfully used for grow out culture of tiger grouper.

PP30

Growth Performance of Juvenile Marble Goby *Oxyeleotris marmoratus* Fed with Different Dietary Protein Levels

OOI SHING YAU, ROSSITA SHAPAWI AND ANNITA YONG SEOK KIAN*

Borneo Marine Research Institute, Universiti Malaysia Sabah,
Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia

*Corresponding author's e-mail: annitay@ums.edu.my

Abstract

Marble goby, *Oxyeleotris marmoratus* is high valued freshwater fish and highly demanded especially in Southeast Asia. The production however, is considerably low due to several reasons and one of is the reluctant of the fish to accept formulated feed. Feeding trial was conducted to determine the growth of wild catch juvenile marble goby fed formulated feed at various protein levels. Specimens obtained from fishermen in Kota Kinabalu, Sabah were weaned to formulated feed for 2 months before the start of the feeding trial. Triplicate groups of juvenile fish with initial body weight 2.89 ± 0.04 g were fed with each of moist pellet contained different protein levels; 35, 40, 45, 50 and 55%, (P30, P40, P45, P50, and P55, respectively). Fish were fed till apparent satiation twice a day for 15 weeks in outdoor culture tanks under shaded condition and water parameter were routinely monitored. Body weight measurement was conducted every three weeks. At the end of the feeding trial, final body weight of fish in P50 and P55 was significantly higher than other treatment groups. Weight gained of fish in P35 was significantly lower than P55. Specific growth rate, feed conversion ratio and protein efficiency ratio were better in fish fed with P55 at 1.11 ± 0.25 %/day, 2.73, and 0.78, respectively. However, it has no significant different with other treatments. Feed P55 has induced significant highest HSI and VSI, however, VSI was not significant different with P50. Averaged water dissolved oxygen was 5.1 ± 0.11 mg/L and water temperature recorded were ranged from 25°C (am) to 29°C (pm). This study showed that juvenile marble goby required higher dietary protein level to gain better growth rate and this is the first reported data on dietary protein level of marble goby.

PP31

Feeding Biology and Diet Composition of the Freshwater Fish, *Sardinella tawilis* in Taal Lake (Batangas) in Southern Luzon, Philippines

RICHARD M. MAGSINO*

Biology Department, College of Education Arts and Sciences
De La Salle Lipa
Batangas, Philippines

*Corresponding author's e-mail: richard.magsino@dlsu.edu.ph

Abstract

The present study investigated the feeding biology and diet composition of the only freshwater sardine, *Sardinella tawilis* sampled from Taal Lake in Batangas, Philippines. A total of 540 samples, composed of two size-classes, were collected monthly from January – June 2010, from three sampling points in Taal Lake in the morning, noon and afternoon periods. These were analyzed for gut content and zooplankton analyses in the laboratory. Results revealed that the major diet of *S. tawilis* in Taal Lake contained different types of zooplankton including cladocerans, calanoid copepods, cyclopoid copepods, nauplii, rotifers, ostracods, and various species of protozoans and small fishes. The current study showed that copepods were the most abundant at ~45–57%, followed by the cladocerans ranging from 28–31% also in both size classes. Various copepod species (e.g., cyclopoida and calanoida) and protozoans were variably chosen both fish size classes. Smaller frequencies (ranging from 2.1% – 18.4%) of rotifers, ostracods and small fishes were also found in the gut of *S. tawilis*. There were significant differences in terms of the seasonal consumption of prey items in both size classes of *S. tawilis*. Small-sized fish consumed most of its prey in May and June and this was significantly different with their prey consumption pattern from January to April. In terms of feeding activity and main food index (MFI), most *S. tawilis* fishes have empty stomachs during the morning ($E_r=21.2\%$) and afternoon ($E_r=30.1\%$), while at night, most of the fish have food in their stomachs and the mean empty ratio is lowest at $E_r = 16.7\%$. This is the first study to report differences in the food diet of two size classes, the MFI and frequency of food occurrence, and feeding activity of *S. tawilis* in relation to vacuity index or % of empty stomachs.

**R&D FISHERIES PRODUCT
SEMINAR**

R&D FISHERIES PRODUCT SEMINAR PROGRAMME

18th Nov. 2011 (Friday) 0800 – 1700 Johor/Kedah Room (Level 2)

- 0800 – 0900 Registration
- 0900 – 0910 Doa Recital
- 0910 – 0930 **Foreward by Chairman:**
Mr. Hj. Rosly bin Hasan
Chairman of R&D Fisheries Product Seminar
- 0930 – 1015 **Keynotes address:**
Product development from local fish species: Matching the technical and market needs
Ms. Hjh Che Rohani Awang
(Deputy Director, Promotion and Technology Transfer Centre, MARDI Headquarters Serdang)
- 1020 – 1045 **Refreshment**

Morning Session

Chairperson : Mr. Ismail Hj Ishak
Rapporteur : Ms. Masazurah A. Rahim and Mr. Mohd Nor Azman Ayub

- 1045 – 1105 Production of tilapia meat powders
Jamilah Bakar, Akhter Uzzaman, Russly Abd Rahman, Rosalina Karim and Faazaz Lattif
- 1105 – 1125 Effects of degree of hydrolysis on physicochemical properties of silver catfish (*Pangasius* sp.) frame hydrolysate
Amiza M.A. and Faazaz A.L.
- 1125 – 1145 Enzymatic degradation of shrimp waste by using crude chitinase from *B.licheniformis*
Nur Aswati K.O., Noor Aina Mardiah Jamil, Madihah M.S., Osman H., Ismail I. and Faazaz A.L.
- 1145 – 1200 **Poster Session**
- 1200 – 1400 **Lunch Break**

Afternoon Session

Chairman : Ms. Hj. Faazaz Abd Latiff

Rapporteur : Ms. Devakie M. Nair and Ms. Roziawati Mohd Razali

- 1430 – 1450 Production of prodigiosin red pigment from a local strain *Serratia marcescens* USM 84”
Darah Ibrahim, Teh Faridah Nazari and Yong Soon Jiun
- 1450 – 1510 Effect of selected spices and salt on the shelf life of refrigerated tilapia fillet
Amiza M.A., Norhidayah J., Suhana M.H., Nasrenim S., Zarina M.S. and Rosly H.
- 1510 – 1530 ACE inhibitory peptides derived from sarcoplasmic enzymatic hydrolysate of freshwater fish haruan
Abdul Salam Babji, Masomeh Ghassem, and Mamot Said
- 1530 – 1550 Production of seafood flavor from cockles (*Anadara granosa*) meat wash water
Haslaniza H., Maskat M.Y., Othman H. and Wan Aida W.M.
- 1550 – 1610 Utilization and improvement of freshwater fish for value added product
Abdul Salam Babji, Masomeh Ghassem, Nur ‘Aliah Daud and Azhana Hamzah
- 1610 - 1640 Guess Speaker:
What’s next after R&D
Dr. Mohd Taupek bin Mohd Nasir
- 1640 - 1700 **Closing Ceremony:**
Y.M. Raja Mohammad Noordin Bin Raja Omar Ainuddin,
*(Director of Research, Fisheries Research Institute (FRI)
Batu Maung, Pulau Pinang)*
- 1700 – 1730 **Refreshment**

ABSTRACTS FOR ORAL

SHELFLIFE OF SPRAY-DRIED TILAPIA MEAT POWDER

Jamilah Bakar, Akhter Uzzaman, Russly Abd Rahman, Rosalina Karim, and Faazaz Lattif

Department of Food Technology,
Faculty of Food Science and Technology,
Universiti Putra Malaysia,
43400 UPM Serdang, Selangor

Abstract

Tilapia surimi was spray dried in a pilot scale spray dryer and collected for the study. Critical properties for the spray dried powder as a functional ingredient and its quality attribute were evaluated during the storage period at ambient temperature (30°C). The spray dried powder contained 2.63% moisture, 66.4% protein, 3.8 % fat, 1.7% ash, had least gelation concentration (LGC) of 8.67% and water activity of 0.255 immediately after drying. Upon storage, changes were detected in some of the parameters evaluated. The color of the powder darkened during storage. Based on the kinetic modelling, the half-life of the spray-dried tilapia powder kept at ambient temperature was predicted to be 5 months.

Keywords: tilapia powder, spray drying, shelf-life, functional properties

EFFECTS OF DEGREE OF HYDROLYSIS ON PHYSICOCHEMICAL PROPERTIES OF SILVER CATFISH (*Pangasius* sp.) FRAME HYDROLYSATE

^a*Amiza, M.A.* and ^b*Faazaz, A.L.*

^aDepartment of Food Science, Faculty of Agrotechnology and Food Science, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu. Malaysia

^bFishery Research Institute, Jalan Batu Maung, 11960 Batu Maung, Penang, Malaysia

Abstract

The physicochemical properties of silver catfish frame hydrolysate powder (SCFH) at three degree of hydrolysis, DH43%, DH55% and DH68% were determined. SCFH was obtained by enzymatic hydrolysis using Alcalase[®] and spray dried to obtain the powder. It was found that total amino acids increased with DH. It was found that SCFH at DH 68% met the adult human requirement for essential amino acid except for histidine and isoleucine. Hydrolysate with DH 68% exhibited better peptide solubility and water holding capacity. As DH increased, emulsifying capacity and foaming capacity of silver catfish frame hydrolysate decreased. Foaming stability was good (above 106%) for all hydrolysate samples after 60 minutes. It was found that the lightness in fish hydrolysate powder colour decreased with increase in DH. This study shows that silver catfish frame hydrolysate has good solubility, good foaming properties and light colour profile, thus having high potential as food ingredient.

Keywords: silver catfish, hydrolysate, properties, degree of hydrolysis, foaming

ENZYMATIC DEGRADATION OF SHRIMP WASTE BY USING CRUDE CHITINASE FROM *B. Licheniformis*

Nur Aswati K. O.^a, Noor Aina Mardiah Jami^b, Madihah M.S.^a, Osman H^b, Ismail A.K.^c, Faazaz A.L.^c

^aDepartment of Industrial Biotechnology, Faculty of Biosciences and Bioengineering, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia

^bFaculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

^cFisheries Research Institute, Batu Maung, Pulau Pinang, Malaysia

Abstract

Bacillus licheniformis which isolated from Malaysia Petroleum Reservoir was grown anaerobically in batch culture reinforced medium containing 0.5% (w/v) colloidal chitin as carbon source and incubated at 50°C, pH 6.5. The highest chitinase production (0.0121 U/ml) was detected after eight hours of fermentation process. Crude chitinase was mixed with 1% (w/v) of six different pretreated shrimp waste for enzymatic degradation process. The shrimp waste was pretreated by physical pretreatments (sun dried, oven, microwave, and boiling) and chemical pretreatment (acid and alkali). The untreated shrimp waste was used as a control experiment. The enzymatic degradation of pretreated shrimp waste was conducted within seven days with incubation temperature 50°C, initial pH 6.5 and shaking at 180 rpm. Shrimp waste pretreated with oven method exhibited the highest crude chitinase activity (0.0261 U/ml) during first day of incubation. Degradation rate of oven pretreated shrimp waste was found to be 69.49% that correlates with chitinase activity. Tri-acetylchitotriose was formed with greatest amount by degradation of oven pretreated shrimp waste on day seven with value detected as 13.91 g/L. The performance of crude chitinase on shrimp waste degradation was more efficient as compared to Celluclast, Novozyme and Viscozyme. The end product of shrimp waste degradation by crude chitinase produce wide range of chitooligochitin as compared to Celluclast, Novozyme and Viscozyme. Optimization of enzymatic degradation in shake flask and 1.5 L bioreactor was performed based on the experimental design from *Design Expert® Software Version 6.0* where using Response Surface Method as the tool. With 4 variables including temperature, initial pH, agitation speed, and substrate concentration; the software had suggested 30 experiments including 6 replicates at centre point. 11 experiments were run until this far which left 19 experiments to be completed. The collected samples were tested to identify the anti-microbial activity of crude chitinase. The samples were incubated in 37 °C

and 50 °C. The highest clearing zone was detected on *Retl-Crx* colony at incubation temperature of 37 °C with 41.93 % clearing zone. However, at incubation temperature of 50C, highest clearing zone was detected on *E.coli* colonies 74.46% which consist of overlapping value due to the present of partial and full inhibition. From the test, there were partial inhibition and full inhibition detected.

Keywords: chitinase, Shrimp waste, pretreatment, *Bacillus licheniformis*, Central Composite Design, Chitinase, Design Expert® Software, Version 6.0.

PRODUCTION OF PRODIGIOSIN RED PIGMENT FROM A LOCAL STRAIN *Serratia marcescens* USM 84

Darah Ibrahim, Teh Faridah Nazari and Yong Soon Jiun

Industrial Biotechnology Research Laboratory,
School of Biological Sciences,
Universiti Sains Malaysia,
11800 Minden, Pulau Pinang, Malaysia

Abstract

The toxicity problems caused by those of artificial synthetic origin pigments to the human and animal health have created many interests towards natural pigments. Among many natural pigments, pigments from microbial sources are potentially good alternative ones to synthetic pigments. Natural pigments can be obtained from two major sources, plants and microorganisms. The accessible authorized natural pigments from plants have numerous drawbacks such as instability against light, heat or adverse pH, low water solubility and are often non-availability throughout the year. Therefore, microbial natural pigments are of great interest owing to the stability of cultivation technology. Furthermore, the advantages of natural pigments production from microorganisms include easy and fast growth in the cheap culture medium, independence from weather conditions and colors of different shades. Hence, microbial natural pigment production is now one of the emerging areas of research to demonstrate its potential for various industrial applications, especially in aquaculture industry as feeds for prawns and fishes. The USM84 strain was isolated from the surface of a marine sponge collected at the lagoon in Terengganu in 2007. The isolate was identified by using conventional and molecular approaches, and was confirmed as *Serratia marcescens* strain. It produced a natural red pigments which was grouped in carotenoid and possessed antibacterial activity of prodigiosin type which is suitable to be used as feeds for aquaculture industry. The maximal production of biomass of about 2.12 g/L which produced the highest antibacterial activity of about 35.313 U/ml at the 40 hours of cultivation in a shake flask system were obtained, when the optimized conditions (cultivation medium of a marine broth semi-solid medium with the addition of 3% agar-agar, initial medium pH of 7.5, incubation temperature of 25°C, inoculum size of 2.0% and agitation speed of 200 rpm) were used. After achieving the highest biomass and antibacterial activity in a shake flask system, 5 L commercial stirred-tank fermentor was then used to have a bigger volume of cultivation medium. The highest biomass of about 0.624 g/L and antibacterial activity of 20.284 U/ml were achieved at 32 hours of cultivation time, with the optimized conditions of cultivation medium of a marine broth semi-solid medium with the addition of 3% agar-agar, initial medium pH of 7.5, incubation temperature of 25°C, inoculum size of 2.0% and agitation speed

of 150 rpm) were used. The results showed that the conditions in 5 L fermentor needed to be optimized again in order to have higher amount of biomass and antibacterial activity yield compared to the shake flask system. In addition, the toxicity study on the biomass as well as the pigment revealed that it was not toxic against *Artemia salina* and therefore this natural red pigment that possesses antibacterial activity (prodigiosin) is a suitable candidate for fish and prawn feed formulation to enhance their muscle and skin coloration.

Keywords: natural red pigment, prodigiosin, *Serratia marcescens* USM84, aquaculture feeds, carotenoids

EFFECT OF SELECTED SPICES AND SALT ON THE SHELF LIFE OF REFRIGERATED TILAPIA FILLET

^a*Amiza, M.A.,^aNorhidayah, J.,^aSuhana, M.H.,^aNasrenim, S.,^aZarina, M.S. and^bRosli. H.*

^aDepartment of Food Science, Faculty of Agrotechnology and Food Science, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu. Malaysia

^bFishery Research Institute, Jalan Batu Maung, 11960 Batu Maung, Penang, Malaysia

Abstract

This study was conducted to determine the effects of turmeric powder, chili powder and acetic acid on the shelf life of refrigerated tilapia fillets at 5°C. Six treatments were applied to the tilapia fillets which were salt (S), salt and turmeric (ST), salt and chili (SC), salt, turmeric and sodium acetate (2.5% w/v dip) (STNaA) and salt, chili and sodium acetate (2.5 w/v % dip) (SCNaA) and control (CO). The refrigerated tilapia fillets were analyzed in 15 days for microbiological, chemical and physical analyses. It was found that there were significant differences ($p < 0.05$) in all microbiological analysis of fish treated with STNaA and SCNaA compared to other treatments. Microbiologically, the shelf life of fillets treated with STNaA and SCNaA was 12 days, fillet treated with ST, SC and S were 6 days, and that of control fillet was 3 days. Based on TVB-N and TMA values, ST fillets were still acceptable up to 12 to 15 days. TBA values were in acceptable range for all treatments in 15 days. The texture quality in decreasing order was given by fillets with SCNaA, SC, STNaA, ST, S and CO treatment. In conclusion, the best treatment to extend the shelf life of refrigerated Tilapia fillet in term of microbiological, chemical and physical quality was given by STNaA, followed by SCNaA and ST.

Keywords: shelf life, tilapia, turmeric, chilli, acetic acid

ACE INHIBITORY PEPTIDES DERIVED FROM SARCOPLASMIC ENZYMATIC HYDROLYSATE OF FRESHWATER FISH HARUAN

Abdul Salam Babji, Masomeh Ghassem and Mamot Said

Food Science Program, School of Chemical Sciences and Food Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

Abstract

Hypertension is one of the major risk factor for development of cardiovascular diseases. Among the process related to hypertension, ACE plays a crucial role in the regulation of blood pressure. In this study, sarcoplasmic protein hydrolysates of freshwater fish haruan (*Channa striatus*), obtained by treatment with proteinase K, thermolysin and the mixture of enzymes, were analyzed for their ACE inhibitory activities. Hydrolysate generated with proteinase K, with degree of hydrolysis of 89% and molecular weight cut-off less than 3 KD, displayed the lowest IC₅₀ value of 0.038 mg/mL. This hydrolysate was then fractionated by size exclusion chromatography on polyacrylamide Bio-Gel P-2 column into four fractions (P1–P4). P4 was found to display the highest ACE inhibitory activity (75.23%) and then fractionated by reversed-phase high-performance liquid chromatography (RP-HPLC) into seven fractions (A–G). The amino acid sequence of sub-fraction F with the strongest ACE inhibitory activity, (81%) was determined by ESI–MS/MS as YSMFPP with the IC₅₀ value 1.8 μM. The ACE inhibitory activity of purified peptide did not change after in vitro digestion with gastrointestinal proteases. The results of this study presented a new ACE inhibitory peptide formed from sarcoplasmic protein hydrolysate of haruan fish meat which could be used as health enhancing ingredient in the formulation of functional foods in order to prevent hypertension.

Keywords: Sarcoplasmic protein, Proteinase K, ACE-inhibitory activity, ESI/MS-MS, gastrointestinal proteases

PRODUCTION OF SEAFOOD FLAVOR FROM COCKLES (*Anadara granosa*) MEAT WASH WATER

Haslaniza, H., Maskat, M.Y., Othman, H. & Wan Aida, W.M.

Food Science Programme,
School of Chemical Sciences and Food Technology,
Faculty of Science and Technology, Universiti Kebangsaan Malaysia,
43600 UKM Bangi, Selangor, Malaysia

Abstract

Cockle wash water protein hydrolysate was produced from cockle meat wash water precipitate, a by-product from waste cockles industry, by acid hydrolysis using hydrochloric acid (HCl) and enzymatic hydrolysis using bromelain. For protein hydrolysate using acid hydrolysis, furfural, 2-octanone and 2-heptanone were detected while 3-methyl-butanol and 1-pentanol are the major flavor compounds detected in protein hydrolysate with enzymatic hydrolysis. The volatile compounds detected in protein hydrolysis using acid hydrolysis resembled flavor compounds in seafood such as cooked crayfish, cooked shrimp, pasteurized crab meat and cooked krill. The volatile compounds detected in protein hydrolysis using enzymatic hydrolysis also resembled flavor compounds in seafood such as cooked crayfish, cooked shrimp, raw/ cooked crab meat, steamed clams and oyster. Sensory analysis proved that protein hydrolysate from cockle meat wash water using enzymatic hydrolysis was more acceptable compared to protein hydrolysate from cockle meat wash water using acid hydrolysis.

Keywords: cockle meat wash water, acid hydrolysis, enzymatic hydrolysis, Response Surface Methodology (RSM)

UTILIZATION AND IMPROVEMENT OF FRESHWATER FISH FOR VALUE ADDED PRODUCT

Abdul Salam Babji, Masomeh Ghassem, Nur 'Aliah Daud and Azhana Hamzah

Food Science Program, School of Chemical Sciences and Food Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

ABSTRACT

Fishery by-products are subject to strict environmental regulations due to limited land and increased environmental concerns such as groundwater contamination and foul odor. Compliance with environmental standards and a better understanding of the potential values of processing by-products for a variety of applications have resulted in technological innovations for seafood wastes as nutraceuticals and functional foods. There has been a growing interest in natural ingredients which are readily available from seafood discards. However, lack of adequate utilization technology to fully convert such wastes into value-added products must be seriously addressed. Nutraceutical, a term combining the words "nutrition" and "pharmaceutical," is a broad umbrella term used to describe any food or food product derived from food sources that provides extra health benefits in addition to the basic nutritional value found in foods. Products typically claim to prevent chronic diseases, improve health, delay the aging process, and increase life expectancy. Collagen from the skin of tilapia, catfish, and patin yield high amount of hydrolysed collagen/gelatin with high gel strength. Commercial production of gelatin is in the development stage with one small manufacturer in Malaysia. In Thailand, catfish skin is treated with alkaline, then with acid to extract collagen and gelatin. In Taiwan, tilapia skin and scale are separated, hydrolyzed with enzymes and extracted then spray-dried and commercially marketed as "fish collagen peptide" for skincare or as nutraceutical products. Fish collagen may also be made as collagen drink and collagen marshmallow. In Indonesia, a process was established to boil the raw material to extract the collagen from fish bones. The extract is then dried and immersed in acid until ossein is obtained. The dried powder of ossein is called collagen. Research & development over the last few years has resulted in a few proto-type VAP products like collagen drink, hydrolysed gelatine powder capsules, Anti-hypertensive peptides freeze dried powder and fish based products like low calorie burger, hotdogs and fish balls. Future work will look into nano-freeze technology of collagen derived from fish skin, bone and also bioactive components extracted from the low cost fresh water fish meat proteins of sarcoplasmic, myofibrillar and stroma component of the fish muscle.

ABSTRACTS FOR POSTER

ISOLATION AND PURIFICATION OF ACE INHIBITORY PEPTIDIC FRACTIONS FROM FRESHWATER FISH MUSCLE PROTEIN THERMOLYSIN HYDROLYSATE

Masomeh Ghassem, Abdul Salam Babji and Mamot Said

Food Science Program, School of Chemical Sciences and Food Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

Abstract

“Haruan” (*Channa striatus*) is a freshwater fish popular among post-operative patients to induce wound healing in Malaysia. Hypertension is considered a risk factor for developing cardiovascular diseases and ACE is involved in increasing blood pressure. This study was conducted to evaluate the ACE inhibitory activity of haruan muscle protein hydrolysate. Myofibrillar protein was hydrolysed with thermolysin at 37° C for 2 h. The thermolysin catalysed hydrolysate with degree of hydrolysis of 89% was fractionated by ultrafiltration membranes size 10 and 3 KD molecular weight cut-off (MWCO), respectively. Peptides with MWCO < 3 KD exhibited high ACE inhibitory activity ($IC_{50} = 0.033$ mg/mL) and were separated into three fractions with gel chromatography on polyacrylamide Bio-Gel P-2 column. Fraction 2 with the ACE inhibitory activity of 67.23% was further separated into five (A-E) potent fractions with reversed-phased high performance liquid chromatography (RP-HPLC), which Fraction C with the lowest IC_{50} value of 10.32 μ g/mL was lyophilized and characterized with HPLC mass spectrometry-Time Of Flight (LC-MS-TOF). Two peptides with the sequences of VPAAPPK and NGTWFEPK with IC_{50} value of 0.45 and 0.63 μ M were identified for the most active fraction C, respectively. The high ACE inhibitory activity suggest that haruan muscle protein thermolysin hydrolysate could be used as functional ingredients for blood pressure reduction.

Keywords: haruan myofibrillar protein, Thermolysin hydrolysate, ACE-inhibitory activity, mass spectrometry

COBIA TEMPURA USING LOCAL STARCHES

Nor Salasiah Mohamed and Che Rohani Awang

Food Technology Research Centre, MARDI Kuala Terengganu,
P.O. Box 3, 20700 Kuala Terengganu

Abstract

Cobia (Rachycentron canadum) has been identified by the Department of Fisheries as one of the high potential species for open sea cage culture. The rapid growth rate and good white-flesh quality of cobia make it potentially as one of the most important marine fish for future production. Cobia price at RM 10/kg is cheaper than the other species of cage culture. Coated foods have a good market worldwide, in UK the market for coated foods is worth over £1.3 billion. Therefore, coated products from cobia have good economic potential. The specialty of these products was the batter formulation of the coated cobia tempura. The objective was to replace imported starches from corn and potato starch with local starches. The batter mixture was developed using 70% local starches from rice and tapioca flours and formulated to reduce oil uptake during frying process. Fresh cobia was filleted manually and skinned using a skinning machine. After filleting the fillet was portioned into small sizes of 5-6cm. Fish portions were dipped into batter and fried at 200°C for 20 second and frozen to some temperature of -20°C. This product was pack in polyethylene tray and box for 250g and kept frozen at -18°C. Protein content (13-25g/100g) was much higher than the commercial chicken or fish tempura in the market (<15g/100g). The shelf life was longer than 10 months. Based on sensory evaluation for overall acceptability, the results showed that Cobia tempura was more accepted by trained panelist compared to commercial tempura from Allaskan Pollock in the market.

DEVELOPMENT OF BUDU POWDER

^aFisal Ahmad*, ^aWan Mohd Faiz Akmal, ^bMohd Nor Azman Ayub,
^bSaadiah Ibrahim, ^bRoziawati Mohd Razali, and ^bNorhanida Daud.

^aDepartment of Food Science, Faculty of Agrotechnology and Food Science, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

^bFisheries Research Institute, Department of Fisheries Malaysia, Batu Maung, Pulau Pinang, Malaysia

ABSTRACT

This study was conducted to develop *Budu* powder which produced by different methods of drying. The objective of this study was to determine the best drying method that can be used to produce *Budu* powder. There are three drying method that was used which are oven-drying (60°C), vacuum-oven drying (30°C) and spray-drying (Inlet temperature; 170°C, outlet temperature; 107.5°C). These drying methods were varied in term of temperature and drying condition. Physical analysis that are tested after rehydrated were determination of viscosity, color profile (L^* , a^* , b^*), solubility and sedimentation. From the data analysis, it revealed significant different ($p < 0.05$) on color profile, solubility and sedimentation among each *Budu* powder. Based on the chemical analysis data, there are significant different ($p < 0.05$) among *Budu* powder for moisture, protein, ash, carbohydrate, pH and salt content. Besides, Amino acid profile revealed the different result from each *Budu* powder. *Budu* powder from vacuum-oven drying had the highest amount of amino acid profile and the lowest amount in *Budu* powder from spray-drying. Based on the result from physico-chemical properties, the best drying method in producing *Budu* powder was vacuum-oven drying. According to sensory evaluation of *Budu* in liquid form, there are no significant different for overall acceptance among *Budu* powder and control. It indicates that, *Budu* powder from different drying methods was accepted by consumer when it converted into liquid.

Keywords: budu powder, oven drying, vacuum drying, spray drying

**EFFECT OF PH AND TEMPERATURE ON THE ACTIVITY
AND STABILITY OF CRUDE TRYPSIN FROM
SILVER CATFISH (*Pangasius sp.*)**

^aAmiza, M.A., Bibi Syahila, M.S. and ^bRosli, H.

^aDepartment of Food Sciences, Faculty of Agrotechnology and Food Sciences, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

^bFisheries Research Institute, Jalan Batu Maung, 11960 Batu Maung, Penang, Malaysia

Abstract

This study determined the effect of pH and temperature on the activity and stability of crude trypsin from intestine and pyloric caeca of silver catfish. Temperature and pH activity were determined using BAPNA as a substrate at various temperature (10°C-80°C) and pH (1.5-12). Crude trypsin from silver catfish exhibited maximal activity at 60°C-70°C and pH 8-9. Effects of temperature and pH on trypsin stability were calculated by determining residual activity after incubation at various temperature (10°C-80°C) and pH (1.5-12). Trypsin from intestine was stable up to 50°C, while trypsin from caeca was stable until 40°C only. It was found that silver catfish trypsin was stable over wide pH range (6-11).

Keywords: trypsin, silver catfish, intestine, caeca, thermostability, pH stability

DEVELOPMENT OF EDIBLE FILMS AND COATINGS FOR SHRIMP PASTE CUBE

^a*Fisal Ahmad**, ^a*Wan Mohd Faiz Akmal*, ^b*Mohd Nor Azman Ayub*,
^b*Saadiah Ibrahim*, ^b*Roziawati Mohd Razali* and ^b*Norhanida Daud*

^aDepartment of Food Sciences, Faculty of Agrotechnology and Food Sciences, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

^bFisheries Research Institute, Department of Fisheries Malaysia, Batu Maung, Pulau Pinang, Malaysia

ABSTRACT

This study was conducted to develop edible films and coatings as a barrier against shrimp paste odour. A number of edible films and coatings had successfully developed from four different types of biopolymers; Gelatin (G), Wheat Gluten (WG), Carboxymethyl cellulose (CMC) and Carrageenan (C); as the base material. All the films had been produced by casting technique. The developed films had been assessed their physical and mechanical properties in order to evaluate, screen and select the best performance edible films and further studied as a coating to shrimp paste cube. The barrier efficiency of those films and coatings were determined by model technique through sensorial evaluation. From the data obtained, two out of four from each base had been selected and preceded as coatings to the shrimp paste cube sample. These two from each bases was first assessed their barrier against descriptive odours of the shrimp paste sample. From the result of the film-model application obtained, it can be concluded that Wheat Gluten-based edible films produced the high barrier ability against the descriptive odours which approximating the barrier ability of the control film (polyethylene plastic film). Then, for the results of assessment of their barrier against descriptive odours in applied coating form, Wheat Gluten-based edible coatings also produced the highest barrier efficiency among those coatings but for only a limited period which could be due to the internal interactions between coating and the shrimp paste cube.

Keywords: edible film, edible coating, gelatin, wheat gluten, Carboxymethyl cellulose, carrageenan

NOTES

NOTES