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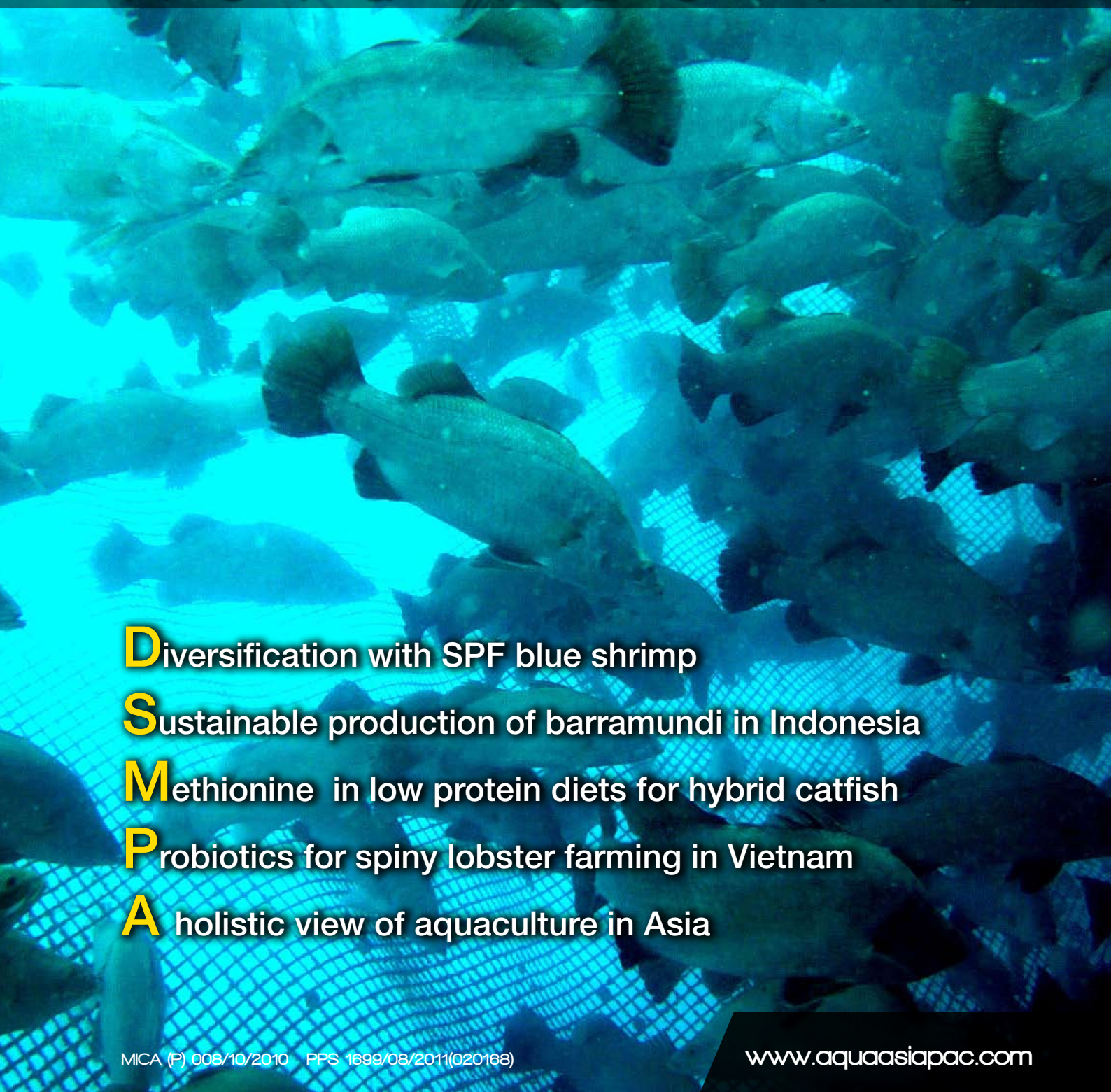
AQUA CULTURE

Asia Pacific



Diversification with SPF blue shrimp

Sustainable production of barramundi in Indonesia

Methionine in low protein diets for hybrid catfish

Probiotics for spiny lobster farming in Vietnam

A holistic view of aquaculture in Asia

MICA (P) 008/10/2010 PPS 1699/08/2011(020168)

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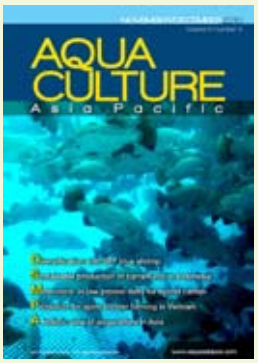

Barramundi in cages, picture by Fega Marikultura

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WRITE TO THE EDITOR

We want to hear from you. Write your comments on the industry to the editor. Letters may be edited prior to publication.

From the editor

The good, the bad and the ugly: A review of 2010

In the first quarter of 2010, the marine shrimp sector finally saw some light at the end of the tunnel, after more than 5 years of declining prices. This came about as importers began to restock the pipeline after the destocking following the October 2008 crisis. International prices continue to increase year to date, helped by lower supplies from Indonesia, Vietnam and Bangladesh. In the US, the oil spill reduced domestic supply from fishing in the Gulf of Mexico. In China, domestic demand for shrimp is increasing at around 18% annually, according to Gorjan Nikolik, a senior associate in agribusiness research at Rabobank International. There are predictions that China will become a net importer of shrimp by 2012, competing with the traditional markets of US, EU and Japan. The international market lost supply from Brazil as the strong Brazilian currency favoured the local market.

Producers are benefitting with high ex-farm prices, a jump of 26% in Indonesia and 20% in Malaysia for vannamei shrimp and in Vietnam, 30% for the large black tiger shrimp. In China, Nikolik said that prices rose by 10 to 30%, favouring larger shrimp.

Most producers of catfish and marine shrimp continue to battle diseases. In July, we published a report on the growth of pangasius catfish production in Vietnam and the significant problems related to fish disease and health management. The development of vaccines for *Edwardsiella ictaluri*, responsible for Enteric Septicemia of catfish (ESC) is ongoing. Cedric Komar of Intervet-Schering Plough Animal Health in Vietnam suggests that the industry look for a balance in terms of nutrition, husbandry, stress and possibly the use of immune stimulants to keep the fish population in a state of health and more resistant to diseases.

The white spot syndrome virus (WSSV) remains a threat to marine shrimp farms in Asia as is infectious myonecrosis virus (IMNV) for numerous farms in Indonesia. At the end of 2010, IMNV would have persisted for 18 months. To prevent its spread, many countries have restrictions on transboundary movement of the vannamei shrimp whereas in Indonesia, some of the affected farms have shifted to growing saline tilapia to break the cycle. For years, biosecurity and health have been emphasised and more farms are now walking the talk with preventive measures against WSSV. In the case of the tilapia, the scourge is *Streptococcus sp*, compounded by its spread through inter-regional trade in fry.

Producers are gradually beginning to realise that requirements on food safety and certification are not trade barriers but a means to access markets. To maintain sales to Japan, Vietnamese producers have been asked to check for chemical residues on 100% of shrimp exported to enjoy higher prices. The year also saw more upstream integration of pangasius catfish processing companies with farms and feed plants to control all aspects of the supply chain while working towards achieving GlobalGap standards. Again, this is seen as the right step to gain market access rather than seek a price premium.

Vietnam's pangasius catfish industry is regularly called to defend its products but the culmination of misinformation and the ugly side of competition, peaked in mid 2010. This was a video depicting unhygienic practices in its farming practices and also the move to term pangasius as catfish, subject to stringent checks under the USDA. Since 2003, the pangasius catfish has been subjected to US anti dumping duties and the annual review gave companies zero tariffs for 2009.

However, in September, the US Department of Commerce used Philippines, a higher cost producer of the fish but a non exporter, as the reference country and increased tariffs to 100-120%. Brazil, decided to add Vietnam's pangasius into the importation threat analysis program that would involve a temporary ban on imports. The country is not a big importer but is a gateway to South American markets. Admittedly, industry members say that it is still in need of solutions and authorities will need to instill some regulations on farming, prevent some from lowering prices and increasing glazing.

In 2011, we can look forward to good times based on some predictions that better prices are here to stay for marine shrimp and the tilapia. Vietnam's pangasius producers have decided on a floor price to keep ex-farm prices from going below USD1/kg. We should also expect more developments in the production of marine fish.

We wish all readers a HAPPY AND PROSPEROUS NEW YEAR!

Zuridah Merican

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Global Conference on Aquaculture 2010

Phuket Consensus for aquaculture in the next decade

Leading experts led discussions to develop world aquaculture into the next decade at the Global Conference on Aquaculture 2010 held in Phuket from September 22-25. The Department of Fisheries, Thailand, the Network of Aquaculture Centres in Asia-Pacific (NACA) and FAO were joint organisers.

In her welcome address, Dr Somying Piumsomboon, Director General of the Department of Fisheries Thailand emphasised the position of the country as a major producer of aquaculture products and also as the host for the millennium conference in 2000 which gave rise to the Bangkok Declaration and Strategy. This is a comprehensive document and had 17 elements for aquaculture development based on six principles: a responsible farmer is justifiably rewarded; costs and benefits are shared equitably; society benefits from the practice and products of aquaculture; adequate, affordable and safe food is available and accessible to everyone; the environment is conserved for the next generation and the development of the sector is orderly.

This formed the core guidance document for the Phuket Consensus which re-affirms the commitment to the Bangkok Declaration and which will take the aquaculture industry into the next decade. At this conference, more than 800 participants looked at the progress by industry in the past ten years since this declaration was made. In the final session of the conference, participants discussed the draft for the Phuket Consensus, prepared by the organising committee, through a very intensive consultative process over a four month period. Unlike the declaration, the Phuket Consensus is precise and short and with sufficient information for use by governments, donors and development agencies.

Apart from this, the conference had thematic sessions addressing issues in aquaculture; resources, technologies and services for the future, sector management and governance, aquaculture and the environment, market demands and challenges in food safety and quality, economic viability and sectoral diversity and enhancing its contribution to poverty alleviation, food security and rural development. Audio recordings of the keynote addresses, plenary lectures, invited guest lectures and presentations of the thematic sessions and discussions are now available for download / online streaming at www.enaca.org

Low-cost device detects damaging virus in farm ponds

The device is called a Real-time Turbidimeter for the detection of shrimp viruses. This is the result of a collaboration between the National Electronic and Computer Technology Centre (Nectec) and the National Centre for Genetic Engineering and Biotechnology (Biotec) for the loop-mediated isothermal amplification reaction (Lamp) project.

Project leader and Nectec researcher Adisorn Tuantranont said that it took the team two years in research and development. Loop-mediated isothermal amplification (Lamp) is a novel method of gene amplification that works on nucleic acid and can be applied for disease diagnosis in shrimp aquaculture. In a Lamp reaction, a white precipitate of magnesium pyrophosphate forms in correlation with the amount of synthesised DNA and indicates the presence of virus or viruses in shrimp. The turbidity of the water is then measured by a real-time turbidimeter.

The turbidimeter incorporates a heating block that maintains an optimal temperature of 63°C for the duration of a test on a shrimp sample measuring just 25 millionths of a litre, performed in a 0.2mm tube. The white turbidity from the shrimp sample can be monitored in real time when light from an inexpensive light-emitting diode passes through the tube to reach a photo diode. A spectroscopic measuring technique assesses by-products of the Lamp reaction. Readings from turbidimeters measuring eight samples simultaneously can be amplified and monitored every one second on LCD displays. Real-time measurements can be easily displayed on a computer via a USB port. This makes it a simple operation suitable for field application.

Tuantranont said that the new system offered a relatively short analysis time and at a low cost. It does not require a thermocycler, detection reagents and reaction tubes, usually required by other diagnostic methods. These are the key advantages of the Lamp-turbidity measurement system.

The system could be used for both screening and confirmatory diagnosis of shrimp viruses. Consequently, it has been recommended for application in shrimp health management programs for disease surveillance in hatcheries and grow-out ponds. He added that Nectec is currently negotiating with a private firm to transfer the technology and to develop new products to support the local shrimp-production industry. The devices will be able to detect shrimp viruses within 30 minutes and reduce losses, enabling the industry to increase its productivity. (Source: www.nationmultimedia.com)

A corporate and social role for the tilapia

The third conference on the tilapia industry was completed on October 29 in Kuala Lumpur with an active participation of 200 industry players, farmers, suppliers, academia and governments. The outcome of the conference was that the industry has responded to the stringent market and consumer requirements and is on its way to increase global production to 3 million tonnes by 2013.

In his opening speech, the Deputy Minister of Agriculture and Agro Based Industries Malaysia, Dato' Wira Mohd Johari said that the event was timely, given the importance of Malaysian aquaculture in the economic growth of the country. Malaysia also intends to build a pro-business environment, driven by the private sector whilst the government provides the basic infrastructure and supporting services. It is looking at agro-entrepreneurs developing technology to improve efficiency of production.

A total of 30 presentations were given, covering trends since 2007 in the global and regional production of the tilapia, situation outlook in selected countries and regions and markets and marketing of the fish. Top industry players including Norbert Spoons from HQ Sustainable Maritime Industries, Alejandro Tola from Trapia Malaysia and Jose Antonio Lince from Produmar, Ecuador presented developments in their respective companies.

In the concluding session, Dr Rohana Subasinghe, FAO summarised the situation with tilapia aquaculture. He said, "One of the plus points for tilapia farming is that industry has responded well to the stringent market and food safety requirements all along the supply chain. Environmental sustainability has not been a problem too with the tilapia and over the years, we have seen improvements. The industry is seeing investments, in terms of money, research and technology as well as regional co-operation."

However, indirectly the industry is seeing increasing cost of production because of higher costs of inputs. Improving economics of production is being sought through research, mainly by the private sector. Feeds and nutrition have improved and aside from lowering feed costs, productivity can be improved with higher growth rates and possibly though better health management programs which will lead to lower mortality rates.

The forte of the tilapia vis-à-vis other tropical freshwater or marine fish, is the advancements in genetic improvements and the work has been conducted not only in Asia, but also in Norway. Its husbandry is also being improved in large scale operations, to be compliant with ethical and animal welfare requirements from international trade, in particular on transportation, harvesting and slaughter.

Dr Muhammad Ayub, the new Director of INFOFISH (left) and Abdul Rahman Ellis (middle) and Hj Mohd Mohari from the Fisheries Development Authority at the closing session.

"By virtue of its history, the tilapia continues to be labelled as a low price fish. Currently, this no longer holds as we have seen from market reports that it can command USD14/kg in Malaysia and yet only USD 1/kg in Sri Lanka. Overall, we still have not seen any global trends on reducing prices. Lastly, similar to other seafood products, consumers prefer certified products and as consumers in Asia become more affluent, they demand fish meals rather than live or fresh fish. The trade pattern for the tilapia must adapt to this," added Subasinghe. "Learning from other sectors, the industry should not be pushed beyond a sustainable level and on top of this be socially responsible in less developed nations such as in Africa."

Higher shrimp prices increase revenues for CPF

Charoen Pokphand Foods Plc (CPF) announce that sales revenue will be THB 185 -190 billion (USD 6.3-6.4 billion) by end 2010, due to strong results of its overseas operations and high prices, especially of shrimp products. Revenue was THB 165 billion (USD 5.6 billion) in 2009.

Shrimp prices have increased 30% this year and are expected to remain high over the last quarter. Pisit Ohmpornnuwat, Executive Vice-President said in the Bangkok Post, that CPF benefited from the low global supply and shrimp exports this year is expected to reach 52,000 tonnes, up from 34,000 tonnes in 2009. Its main markets are the European Union (35%), Japan (30%), and the United States (15-20%), with the rest in Asia.

The company's flagship shrimp-based product, shrimp wonton soup, has reported strong sales and would help raise the total shipments next year to reach 75,000 tonnes when the menu is sold at 500 outlets of Wal-Mart in the US.

CPF also announced that it will increase its investment budget by 20% for domestic and overseas operations in 2011 and these should push up sales by 5-10%, despite risks from the strong baht and high commodity prices. This will be THB 6 billion baht (USD 203 million), to finance its farms and farm-related businesses in several developing markets, especially India, Russia, and Turkey, where demand for meat remains strong and market potential is high. The company has hedged its currency exchange at THB 30-31 for two months and placed advance orders for corn and soybean meal to last it to mid-2011.

News in Brief

Setting a floor price for Pangasius exports

In 2011, Vietnam's Association of Seafood Exporters and Producers (VASEP) will set the minimum export and procurement prices for pangasius and also stabilise production volumes at one million tonnes.

With the exclusion of markets in the US, a minimum export price of USD 2.8/kg will be set while farmers will earn a minimum price of VND20,000/kg (USD1). Currently, the ex farm price of the pangasius is VND18,500/kg (USD 0.90) and the export price is USD 2.7/kg.

"The regulation on floor prices aims to bring the price of the fish to its true value and ensure profits for both producers and processors," said Duong Ngoc Minh, Deputy Chairman. "It will also help avoid unhealthy competition that may lead to reduction in export prices and affect the quality of pangasius products. VASEP will also require processors to meet certain criteria for the fish such as export contract for six months or more, and to have their product quality registered and inspected."

In Vietnam, there is also a shortage of raw materials as 30% of farmers have stopped farming as a result of falling prices. This will carry on into 2011. Output is estimated at 1 million tonnes next year whilst total processing capacity is more than 2 million tonnes.

One stop traceability in China

During the China Fisheries & Seafood Expo in Dalian, ChinaTrace announced that together with Seattle-based food traceability company, Trace Register, it will launch a seafood-traceability service in China. This is a one-stop service for companies seeking assurance about the origin, processing history and integrity of seafood sourced in China. ChinaTrace which develops, tests and implements food traceability solutions will be allowed to use the Trace Register system to communicate supply chain custody, safety, quality, sustainability and other information to customers in Europe, Japan and North America. The partnership also extends to integrating certification, audit and laboratory results that are independently provided by third parties in China.

Brunei reiterates ban on live shrimp imports

The ban on imports of live vannamei shrimp has been in force since 2009 to maintain the disease free status of the 230 ha of shrimp farms. Director General of the Department of Fisheries, Hjh Hasnah Ibrahim said that this is important as it has invested in the development of SPF *Penaeus stylirostris* and *P. monodon*. An import risk analysis (IRA) to identify potential sources of diseases showed that the main risk is through the importation of live and fresh shrimp into wet markets. To date, WSSV and IHHNV have been detected. TSV and IMNV have not been detected in Brunei but its introduction would be a setback for the industry in Brunei. To date the department has confiscated 5 consignments and the penalty is BND 500 and BND 1000 for the first and subsequent offences, respectively.

New production of barramundi

Cell Aquaculture Ltd has begun the commercial production of Australian barramundi at the company's new production facilities near Phuket, Thailand. The site has a capacity to develop 500 tonnes of premium fish annually. The company also has an option for an additional adjoining site and increase production capacity to 1,000 tonnes. Executive chairman Perry Leach said, "Being a company owned facility, we can now push ahead at our desired pace. The Thailand site suits our needs perfectly and we now have very ambitious plans for the development of this project."

White shrimp helps exports in India

An estimated 20,000 tonnes of vannamei shrimp from India is expected to be exported by end 2010, according to the Seafood Exporters Association of India (SEAI). Farming of the shrimp began this year and the cost of production was reported as USD 2.29 per kg, half that for other shrimp species in India. India is a major producer of the black tiger shrimp at levels of 80,000 tonnes annually. However, SEAI said that that a global shortage of shrimp is helping with better prices.

Branding Indian BT in the US

In an agreement signed in August with the Marine Products Export Development Authority (MPEDA), Sysco, North America's leading foodservice marketeer and distributor will brand India's black tiger shrimp as 'Mpeda Portico'. In the joint promotion costing USD 2.3 million, Sysco will use its vast network in the USA and is expected to absorb almost 10,000 tonnes of the black tiger shrimp from India. MPEDA hopes that once the Indian black tiger brand is established, export of other products will also get a major boost because of better brand image of seafood exported from India.

Acquisition of feed mill

Godaco Seafood, a major producer of frozen pangasius fillet and shellfish with its main markets in the EU, Middle East, North Africa, South America and South-East Asia has acquired Hiep Thanh V JSC company in Vinh Long. The plant has a feed production capacity of 10 tonnes/hour. Godaco has farms in Tien Giang, Ben Tre and Vinh Long provinces, totalling 100 ha. Some 20 ha are GlobalGap certified. Godaco's farm supplies 70% of the raw materials for three processing plants of 25,000 tonnes per year. In the future, it expects that these farms will supply 100% of raw materials for processing.

Farmed cobia on menu in California

Farmed cobia from Vietnam has achieved a first by making it on the menu at King's Seafood restaurants in Southern California. The cobia, produced by Marine Farms, is sold under the akvacobia brand and will be featured on menus as part of the Farm to Table promotion at 12 King's Seafood locations for the rest of the year, said Seafoodsource.com. According to Harvey Lipman, director of new business development for Nordic Group, which markets the Vietnam product for Marine Farms, King is now serving the fish, both grilled and blackened. The response has been good so far. The fish is likened to Chilean sea bass and black cod and is very fatty whitefish. Marine Farms Vietnam is the world's largest producer of farmed cobia and expects 2010 output to exceed 1,500 tonnes.

Soaring black tiger shrimp prices

In Ben Tre in the Mekong Delta,Vietnam, ex farm prices of the black tiger shrimp have risen to VND 200,000/kg (USD 10.5) for 25 pcs/kg and VND120,000-125,000/kg (USD 6.3 to 6.5) for 40 pcs/kg. These prices are double those in 2009. This means that shrimp farmers can earn an average profit of VND200-350 million/ha (USD 10,526 to USD 18,421) said the report in Vietfish.org. Nguyen Van Nhi from Thanh Phuoc commune, Binh Dai district reported a gain of nearly VND700 million (USD 36,842) from 9 tonnes of shrimp harvested from a 5,500m^2 pond. Farms in Ben Tre are now stocking the 1,570ha of ponds for the second crop. More than half of the stocked area is dedicated to black tiger shrimp farming.

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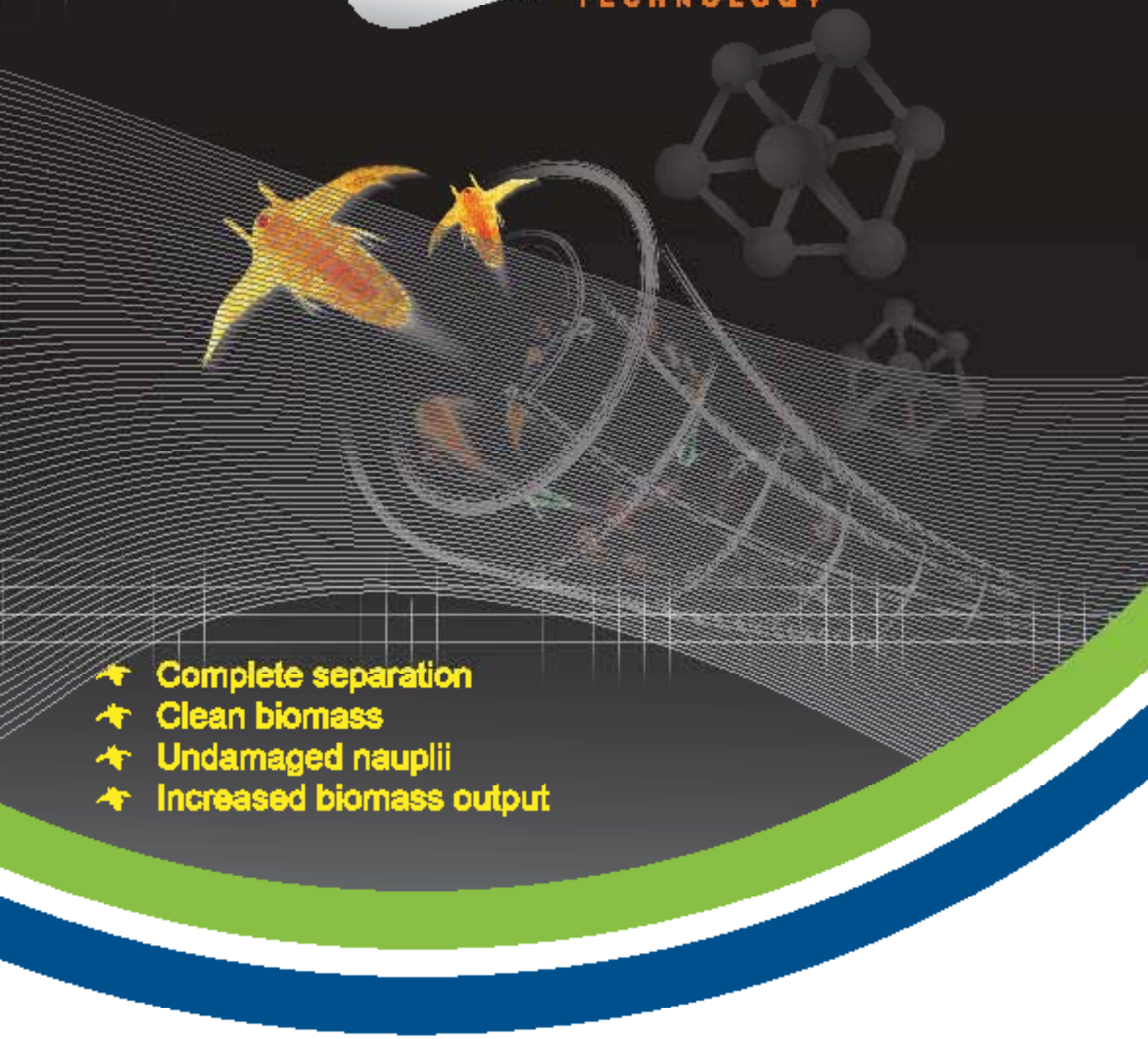

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Shrimp farming diversification with SPF blue shrimp in 2011

By Jim Wyban

A new candidate species in Asia following trials in Thailand using SPF post larvae which demonstrated growth of up to 33g in 140 days at high density stocking.

In cooperation with Sarasin Hatchery in Phang Nga Thailand, High Health Aquaculture (HHA), the Kona, Hawaii-based shrimp genetics company, conducted a production trial with the blue shrimp *Penaeus stylirostris* in a commercial pond in Phuket, Thailand. The company had developed a certified specific pathogen free (SPF) against stock of blue shrimp in 1995 and selected the stock for fast growth for 14 generations while maintaining their SPF status.

SPF blue shrimp broodstock were shipped from Hawaii to Thailand in January 2010. SPF post larvae (PL) were produced and stocked into a commercial shrimp pond for grow out trials. After 140 days, the pond was harvested and production of 30 pcs/kg shrimp (33g size) at 22.5 tonnes/ha was achieved. The large size resulted in a high pond side price (THB 250/kg) and profitability was impressive. These results demonstrated the excellent potential for SPF blue shrimp as a diversification species for shrimp farming in Asia.

Blue shrimp versus white shrimp

P. stylirostris has been farmed in Latin America for more than 30 years and in New Caledonia for 20 years. In New Caledonia, a small industry based entirely on blue shrimp farming has evolved. Culture is mostly semi-extensive culture growing shrimp in large open ponds without aeration and producing a single crop per year. Blue shrimp is farmed exclusively and typical harvest size of up to 35g is obtained in a single crop of 200 days.

In Latin America, blue shrimp was typically cultured in extensive farm systems, often in polyculture with the white shrimp *P. vannamei*. It is interesting that in polyculture systems at harvest, the blue shrimp is always at least one size class larger than the white shrimp. Stocking densities of 5-10 PL/m^2 in huge ponds, each of 3-5 ha with no aeration and poor feed quality is standard. These systems do not provide a meaningful comparison to Asian shrimp farming potential which is technology-based, using much higher stocking densities and aeration.

A major culture benefit of the blue shrimp compared to the white shrimp is that it tolerates a lower temperature regime. While white shrimp feeding and growth slows at pond temperatures below 27°C, the blue shrimp grows well down to 24°C. In Asia, the blue shrimp could be cultured during cooler weather seasons when pond temperatures are sub-optimal for the white shrimp.

In terms of growth, both species grow from PL to 20g size at the same rate at an average daily growth (ADG) of 0.2g per day. However, above 20g, the blue shrimp continues to grow quickly (0.25g per day) up to 35g while white shrimp growth usually slows to about 0.12g per day.

One data set of intensive farming of the blue shrimp is from the company Marine Culture Enterprises (MCE). MCE was funded by Coca-Cola and developed a super-intensive shrimp farming system using raceways in greenhouses. MCE undertook an elaborate R&D program where production trials, market studies and economic performance compared three candidate species, *P. vannamei*, *P. stylirostris* and *P. monodon*. Based on those rigorous tests, MCE concluded that *P. stylirostris* had the best chance for commercial success in super-intensive systems. They produced 20g shrimp in 125-day crops at harvest biomass of up to 7 kg/m^2 (Moore and Brand 1992).

SPF blue shrimp

The founding stock of HHA was imported to Kona as PL from wild *P. stylirostris* broodstock from Ecuador in 1994. They were screened for pathogens by Dr. Lightner's laboratory at the University of Arizona (both histology and PCR) at least twice per generation. All pathogen screenings were negative.

The shrimp breeding facility is located in Kona Hawaii, USA. It is operated as a completely closed quarantine. The company owns the

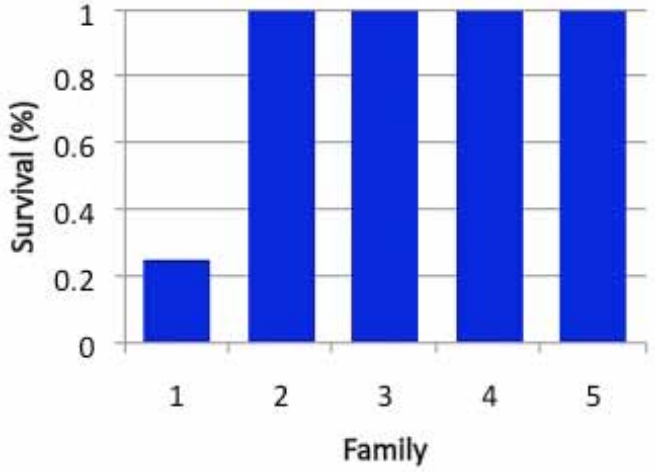
world's most diverse germplasm collection of SPF (certified pathogen free) shrimp including *P. stylirostris*, *P. vannamei*, and *P. monodon* that all pass through a rigorous quarantine and pathogen screening process following ICES guidelines before introduction to the centre.

HHA's SPF *P. stylirostris* are generation F14 and have been selected for fast growth. Every generation of the shrimp is naturally resistant to TSV-taura virus syndrome (Brock et al 1995). This trait was one of the principal reasons for development of its SPF stock of *P. stylirostris*. Figure 1 shows TSV laboratory challenge results testing families of SPF *P. stylirostris* from HHA (bars 2-4) conducted at the University of Arizona using Asian-strain TSV. Bar No. 1 is survival of susceptible shrimp (positive control), which demonstrates the lethal nature of this virus. These data confirm that these SPF blue shrimp are completely resistant to TSV.

While some stocks of *P. stylirostris* are susceptible to IHHNV, HHA's SPF *P. stylirostris* stock was shown to be resistant to infectious hypodermal and haematopoietic necrosis virus (IHHNV) based on challenge data from Dr. Jim Brock (pers. comm.). Like other shrimp (*P. vannamei* and *P. monodon*), *P. stylirostris* is susceptible to white spot virus (WSSV). Based on these results, we say that our SPF blue shrimp are resistant to TSV and IHHNV and susceptible to WSSV.

All of our shrimp stocks and facility are sampled and evaluated twice per year by the State of Hawaii Department of Agriculture. The samples are evaluated both by histopathology and PCR tests at the University of Arizona for these shrimp viruses; IHHNV, WSSV, TSV, Penaeus monodon-type baculovirus (MBV), hepatopancreatic parvovirus (HPV), yellow head virus (YHV), Baculovirus penaeus (BP), infectious myonecrosis virus (IMNV) and necrotizing hepatopancreatitis (NHP). In 15 years of operation, we have never experienced or detected any contagious shrimp disease at our site.

Figure 1. Lab TSV-Challenge survival (%) of HHA's SPF blue shrimp. Bar 1 is positive control (susceptible) shrimp (*P. vannamei*). Bars 2-4 are four separate families of SPF blue shrimp from HHA.



Shrimp trial in Thailand

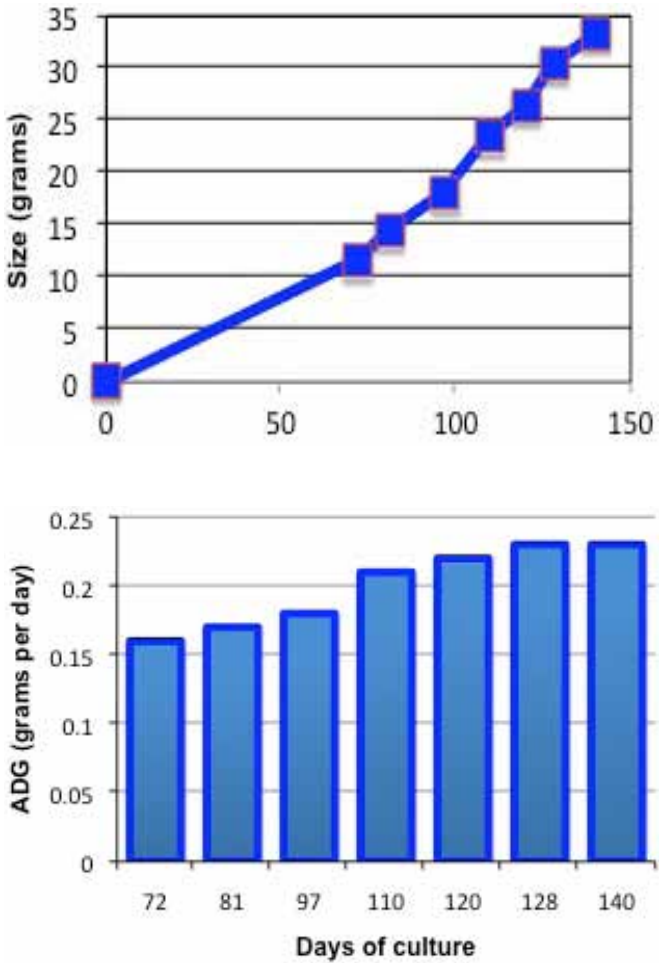
Thailand is the world's leading supplier of farmed shrimp (FAO 2008). More than 99% of Thailand's production is white shrimp (Wyban 2009). The Thai industry is concerned about this high concentration in one species and wants to study crop diversification. To this end, we prepared a comprehensive species risk assessment for introducing SPF blue shrimp to Thailand for the Department of Fisheries, Thailand (DOF) in October 2009.

Based on that document, DOF issued an import permit for Sarasin Hatchery to import SPF blue shrimp broodstock from HHA. Shrimp

broodstock (F13) were shipped to the hatchery in January 2010. The hatchery produced PL and stocked 300,000 in a 2-rai (3,200 m^2) commercial shrimp pond in Phang-Nga.

Stocking density was 94 PL/m^2. A high level of aeration (30 hp/ha), similar to Thai intensive farming practices with the white shrimp was used. A commercial diet for *P. monodon* was used throughout the trial. Individual shrimp size in grams of the blue shrimp was monitored by pond sampling (Figure 2).

Growth of blue shrimp in the Thai production trial.



Average daily growth (ADG) in gram per day was 0.23, which is excellent growth particularly in shrimp above 20g in size. The pond was harvested on September 11 and production results are listed in Table 1. Total production of 7.2 tonnes of 30 count shrimp was very exciting. Due to the large-sized shrimp at harvest (33g), the value of the crop was high with the pond side price of 250 THB/kg (USD 7.57/kg). A gross profit can be calculated subtracting PL costs and feed costs from crop value and results in a gross profit of THB 1,194,120 (USD36,185) (Table 2).

Table 1. Production statistics for a commercial crop with SPF blue shrimp in Phang-Nga Thailand between January and September 2010.

Pond size (m^2)	3,200
Stocking material	SPF blue shrimp PL
Stocking number (PL)	300,000
Stocking density (PL/m^2)	94
Crop duration (days)	140
Harvest size (count/kg)	30
Harvest size (g)	33
Growth in grams (ADG)	0.24
Total production (tonnes)	7.2
Production (tonnes/ha)	22.5
FCR	2.19

Table 2. Financials of blue shrimp production in a 2-rai pond trial.

Total production (tonnes)	7.2
Ex farm price (THB/kg)	THB 250
Revenue (crop value)	THB 1,800,000
Revenue (crop value) in USD @ THB33/USD	USD54,545
Crop value per ha in USD *	USD163,636
Gross profit (Revenue – PL & feed costs)	
Revenue	THB 1,800,000
Less PL (@THB 0.18/pc)	THB 54,000
Less Feed (@THB 35/kg)	THB 551,880
Gross Profit	THB 1,194,120
Gross profit in USD	USD 36,185
Gross profit per ha in USD*	USD 113,079

**One rai equals 1600m^2*

Conclusion

This first commercial production trial of SPF blue shrimp in Thailand clearly demonstrates that this shrimp have excellent potential as a crop diversification strategy for Thailand. HHA expects 2011 to be a big year for the production of SPF blue shrimp in Asia

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Facts on the blue shrimp

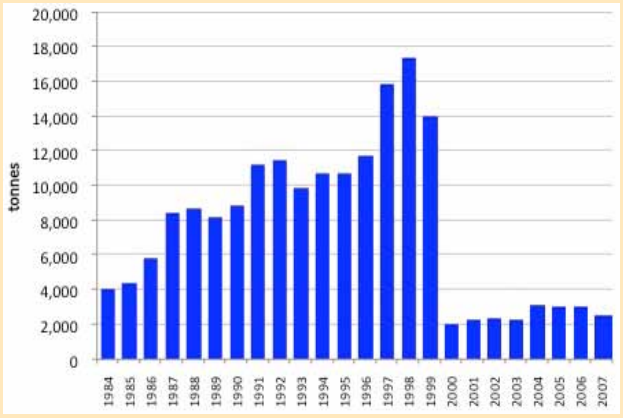
Scientific name: *Penaeus stylirostris* (Pacific blue shrimp)
Native range: Eastern Pacific Coast of Mexico, Central America and Northern South America
Reproductive anatomy: Open thelycum (identical to *P. vannamei*) but will not hybridise (Wyban, unpublished data). Production of viable nauplii for commercial hatchery production of PL is virtually identical with *P. vannamei* hatchery techniques (Wyban and Sweeney 1991).
Culture conditions: Less tolerant than the white shrimp to low salinity and needs above 10 ppt salinity. The optimum range is 25-35 ppt. Studies at HHA have been in full seawater (35 ppt) and the blue shrimp grows very well at this salinity. It is more sensitive to low dissolved oxygen than *P. vannamei* and requires dissolved oxygen of least 4 mg/l (Table 1).

Optimum environmental conditions for farming blue shrimp.

Parameters	Acceptable range	Optimum
Dissolved oxygen (mg/l)	3.5-10	4.0 or more
Temperature (°C)	20-32	28-30
Salinity (ppt)	10-35	25-35
Feed (crude protein)	35-45%	40% or more
Stocking density (PL/m^2)	25-500	120

Feeds: Both white and blue shrimp are considered omnivorous scavengers or detritus feeders. Nutritional studies have shown that the blue shrimp requires a higher protein content in applied feeds than white shrimp (Moore and Brand 1992). HHA studies in Hawaii have shown that the blue shrimp grows very well on a standard *P. monodon* diet (40% protein).
World production: The annual global production of the blue shrimp based on FAO numbers is given in the graph. The sharp increase in production between 1994 and 1999 was due to a massive switch to the blue shrimp farming in Latin America following widespread devastation caused by TSV on white shrimp. The blue shrimp is naturally resistant to TSV (Brock et al 1995) and became the species of choice. However, by 1999, when TSV–resistant white shrimp stocks became available, farmers returned to using white shrimp. Following

Annual global production of cultured blue shrimp (FAO, 2008).



2000, the annual production around 2,000 tonnes represented production in New Caledonia.
Producers: New Caledonia in the South Pacific, farms the blue shrimp exclusively. It exports these shrimp to Japan (40%) and France (60%) at high prices. The table lists their annual production and exports. Note the value of the average value of exported shrimp in 2007 was USD13.77/kg. Japan's import value for New Caledonia blue shrimp is about 3 times higher than the import value for Thai white shrimp.

New Caledonia production and exports of farm-raised blue shrimp (New Caledonia Department of Exports).

Year	Production (tonnes)	Exports (tonnes)	Value (USD million)	USD/kg
2005	2,440	1,709	28	16.38
2006	2,278	1,786	27	15.12
2007	1,843	1,307	18	13.77

Imported shrimp to Japan (Mar 07-Apr 08, Japan Ministry of Finance).

Country	Amount (tonnes)	Value (JPY)	JPY/kg	USD/kg
Thailand	26,646	22,070,000,000	828	8.75
New Caledonia	223	550,000,000	2,466	25.95

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Dr. Jim Wyban is recognized worldwide as the 'father of SPF shrimp' as he developed SPF shrimp and the first SPF shrimp breeding program. With successful production with SPF shrimp by the US industry, High Health Aquaculture was formed in 1994 to commercialize SPF technology worldwide. The goal is to upgrade global shrimp farming performance and sustainability by supplying top quality brood stock and seedstock. Email: jim.wyban@gmail.com; www.SPFGenetics.com

Methionine: a crucial amino acid in protein **reduction diets for the hybrid catfish**

By Orapint Jintasataporn, Dhanapong Sangsue and Andreas Lemme

An additional supplementation of DL methionine to a low protein diet containing only 7.5% fish meal, showed an improved growth performance of fish in this 90-day trial in Thailand.

One of the aspirations of aquaculture is to deliver protein with a high nutritive value for human consumption. However, aquaculture activities must be carried out sustainably with minimum impact on the environment. With regards to aqua feed, a reduction in protein content in feed is a means towards improved sustainability.

Several studies on protein content reduction in diets have reported supplemental free amino acids to be effective in improving growth performance in selected aquaculture species. In several locations in Southeast Asia, *Clarias* catfish is being bred, cultured and finally consumed as a common source of fish protein. The *Clarias* catfish is an omnivorous cum carnivorous fish, with a particularly high demand for dietary protein. However, knowledge on its nutrient requirements is scarce.

A study was conducted to investigate the effects of reduced protein in the diet for hybrid catfish (*Clarias macrocephalus x Clarias gariepinus*). Although relatively high fishmeal levels are common in catfish feeds, in the current experiment, the feed used contained only 7.5% fish meal. This was supplemented with free amino acids to meet the essential amino acids requirements for the fish. In addition, the effects of an extra dose of 0.3% supplemental DL-methionine in the diet was tested.

Figure 1. Growth performance of hybrid catfish fed diets with varying protein and amino acid levels).

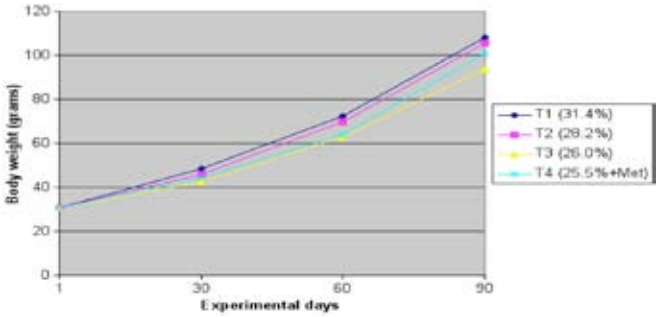
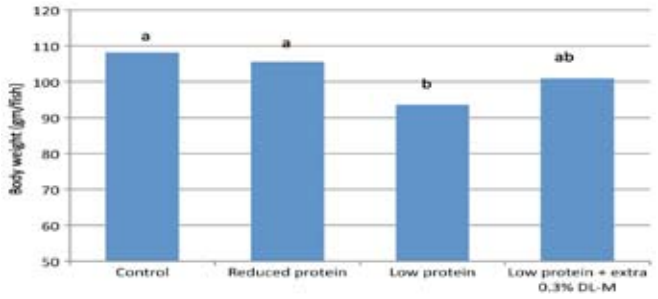


Figure 2. Body weight of hybrid catfish after 90 days fed diets with varying crude protein and amino acid levels.



Feed trials

The 90-day experiment was conducted at the Faculty of Fisheries, Kasetsart University in Bangkok, Thailand. In this trial, 240 hybrid catfish of 30.7 ± 0.3g initial weight were distributed into 16 tanks, each containing one cubic metre of water. Water temperature was 27.0 ± 2°C and dissolved oxygen was maintained at more than 6.0 mg/l. Fish were fed until satiation twice a day.

There were four dietary treatments and each treatment had four replicate tanks. Diet analyses showed treatment 1 (Control), 2, 3, and 4 containing 31.4%, 28.2%, 26.0% and 25.5% crude protein respectively. Only 7.5% fish meal was included in all of these diets while soybean meal and rapeseed meal served as the major protein and amino acid source. All diets were supplemented with amino acids to meet the requirement levels but treatment 4 was topped up with an extra 0.3% of DL-Methionine.

Growth, feed consumption, and survival data were collected during the 90-day trial. Fish were killed at the end of the experiment to determine flesh yield.

Figure 3. Cumulative feed conversion ratio after an experimental period of 90 days.

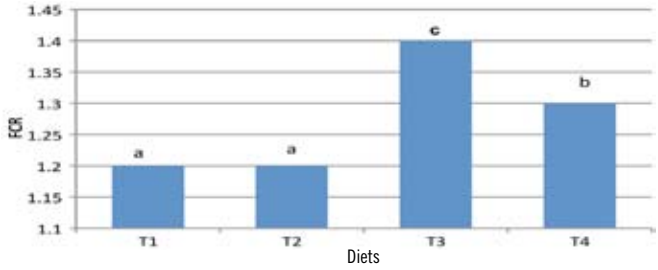


Figure 4. Cumulative survival rate after an experimental period of 90 days.

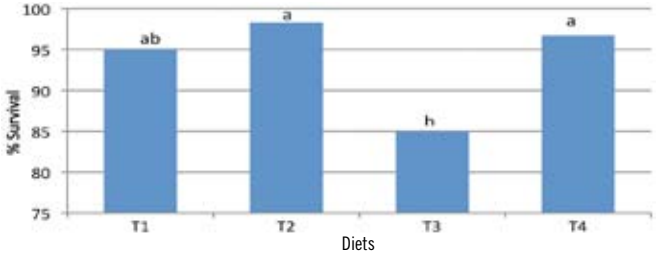


Table 1. Composition of diets.

	Diet Treatments			
Ingredients	T1 (control)	T2	T3	T4
Fish meal[a]	7.5	7.5	7.5	7.5
Blood meal[a]	5.0	5.0	5.0	5.0
Tapioca	13.3	21.1	29.6	29.2
Soybean meal, dehulled	34.0	25.0	15.0	15.0
Rapeseed meal	15.0	15.0	15.0	15.0
Rice bran	20.0	20.0	20.0	20.0
Fish oil	5.0	5.0	5.0	5.0
Soybean oil	1.7	2.7	3.6	3.7
L-Lysine HCl	0	0	0.3	0.3
DL-Methionine*	0.05	0.07	0.15	0.45
L-Threonine	0.0	0.05	0.21	0.21
Di-Calcium Phosphate	1.5	1.6	1.7	1.7
Limestone	1.2	1.2	1.1	1.1
Premix	0.25	0.25	0.25	0.25

** DL-Methionine: Evonik Degussa.*

[a] – Fish meal tuna, Thailand, Blood meal: spray dried bovine whole blood, Argentina

Table 2. Analysis of chemical and amino acid composition of experimental diets (as fed basis).

Nutrients	T1 (control)	T2	T3	T4
Crude protein (% diet)	31.4	28.2	26.0	25.5
Crude fat (% diet)	6.78	6.84	6.95	6.94
Amino acids	(% diet)			
Methionine	0.59	0.56	0.60	0.83
Met + Cys	1.04	0.96	0.95	1.18
Lysine	1.99	1.80	1.86	1.78
Threonine	1.29	1.20	1.24	1.20
Arginine	2.05	1.81	1.58	1.56
Isoleucine	1.19	1.01	0.84	0.85
Leucine	2.60	2.38	2.17	2.05
Valine	1.74	1.61	1.49	1.41
Histidine	0.98	0.93	0.88	0.82
Phenylalanine	1.58	1.43	1.30	1.23

Growth performance

The experiment showed that growth performance was not affected by a decrease in dietary protein level from 31 % to 28%. However, a further decrease to 26% protein did severely impair performance and survival, which could partly be recovered by an extra dose of DL-methionine (diet T4).

Bottom line

The diet with 26.0% crude protein resulted in an impairment in fish growth performance. The addition of an extra 0.3% DL-methionine to the low protein diet (26% CP) completely reversed the survival rate. The partially recovered growth performance indicated that dietary methionine plays a crucial role in the metabolism of the hybrid catfish metabolism, indicating that this needs to be considered when dietary protein is reduced. A level of 0.6% dietary methionine might fail to meet the requirement of *Clarias* catfish under certain conditions.

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Extruded snakehead feed in Vietnam

By Su Shi, Dong Qiufen, Nguyen Huu Loi, Vu Quang Lech, Zhang Taizhuo and Yang Yong

The introduction of floating feeds for the snakehead is improving profit margins for farmers in Vietnam.

In Asia, the carnivorous snakehead is a popular freshwater fish because of the fine flesh and flavour. The snakehead is also believed to play an important role in human health, especially in post surgical operation care because of its perceived curative properties. In Vietnam, farming of the fish has a 60 year history in several provinces in the Mekong Delta. The two main species of snakehead farmed in the region are the giant snakehead (*Channa micropeltes*) and the common snakehead (*Channa striatus*). The fish is fed trash fish (by catch from marine fisheries) or wild freshwater fish. Despite a feed conversion ratio (FCR) ranging from 4:1 to 5.0:1, the culture of this fish is profitable.

However, there are also some adverse effects with this type of traditional method of snakehead farming in that the over fishing of wild fish has exerted significant pressure on freshwater resources in the Mekong. As the price of trash fish increases, so does the cost of farming. The inefficient utilization of trash fish is not only a waste of resources but also pollutes the surrounding water area. The heavy pollution in turn can cause a number of diseases, lowering fish survival and reducing the carrying capacity of ponds and farmers' profit margins. Last but not least, the massive use of chemicals and antibiotics both threatens consumers' health and increases culture costs.

Checking snakehead feed production. Dr Yang Yong, General Manager of Hinter (middle) and Nguyen Huu Loi, Managing Director of Con Heo Vang (left).

Joint development of extruded feed

In 2008, Guangzhou Hinter Biotechnology Co. Ltd., a bellwether of the aqua feed industry in China, collaborated with Con Heo Vang Company in Dong Thap Province, Vietnam to explore the potential of extruded snakehead feed in Vietnam. Feed formulation, processing and laboratory trials were conducted over a period of 12 months, followed by

Offering technical service to the farmers.

Feeding snakehead with extruded feed.

Harvesting snakehead.

another 12 months of field trials. At the end of these trials, numerous farmers in Southern Vietnam testified that the extruded feed resulted in rapid growth, lower feed conversion ratio (FCR) of 1.2:1 to 1.4:1, lower incidences of diseases, and a lower deformity ratio. This initial success in the use of extruded snakehead feed has led to its endorsement by the Vietnamese government. Subsequently, an increasing number of snakehead farmers began to replace trash fish and farm made feeds with this extruded feed.

Case studies

The following case studies of two farmers who switched to the new extruded feed show the benefits of using extruded feed for the snakehead. In Dong Thap, Gu has been farming the snakehead for the last five years. During this period, he fed the fish with trash fish and profit margins have been relatively low. In 2009, he stocked 30,000 snakehead fingerlings (400 fish/kg) in his 560 m^2 pond. The fish were fed extruded feed for 110 days with technical support provided by experts from Hinter and Con Heo Vang. Besides a FCR of 1.24, survival rate of 98.4%, and a harvest of 9.87 tonnes, Gu had an impressive net profit of USD 4,430.20 (VND 84,616,000 at a USD 1=VND 19,100 exchange rate). The net income was USD 7.90/m^2 (VND 151,100/m^2) with a gross income of USD 15,948.50 (VND 304,616,000) and a total cost of USD 11,518.30 (VND 220,000,000) (Table 1). He used 12.13 tonnes of extruded feed. The minimum fish weight was 375g/fish.

Table 1. Cost comparison of snakehead farming using extruded feed in Dong Thap, Vietnam.

Parameters	Gu	Khi
Culture area (m^2)	560	600
Pond depth (m)	2.4	2.6
Size of juvenile fish (fish/kg)	400	400
Stocking density (fish/m^2)	53.6	50
FCR	1.24	1.33
Feed frequency (times/day)	2 to 3	2 to 3
Feed rate (%BW)	3 to 5	3 to 4
Water exchange frequency (times/day)	1 to 2	1 to 2
Water exchange rate (%/time)	20-40	30
Culture duration (days)	110	180
Body weight at harvest (g/fish)	375	750
Survival rate (%)	98.40	88.00
Yield (kg)	9,722	20,000
Price (USD/kg)	1.60*	2.00**
Gross income (USD)	15,948.50	40,837.70
Production cost (USD)	11,518.30	26,178.00
Net income (USD)	4,430.20	14,659.70
Unit production (kg/m^2)	17.60	33.30
Unit profit (USD/m^2)	7.90	24.40
B/C (%)	38	56

**Price was collected on 15/11/2009*
***Price was collected on 10/6/2010*

In May 2010, another farmer, Khi harvested 20 tonnes of snakehead from his pond after a 6-month period. As in the first case study, the fish were fed with Con Heo Vang extruded snakehead feed. The net profit was USD 14,659.70 (VND 280,000,000, Table 1). In contrast, he had a profit of USD 2,617.80 (VND 50,000,000) from the same pond when he farmed snakehead using trash fish in 2009. In comparison with Gu's farm, the larger profits were attributed to better farm management, lower incidence of diseases, larger fish size at harvest, higher unit production and higher market price.

Advantages of extruded feed

The use of extruded feeds brings with it a number of benefits to farmers and consumers as well as to the fish. The extruded feed developed by Hinter and Con Heo Vang is formulated to meet the specific nutritional requirements of the snakehead and is very different from that of trash fish as well as commercial feeds for the catfish, tilapia and climbing perch. The premix from Hinter contains peptides as attractants for the fish while the extruded feed contains a high level of marine fish meal, imported from Chile or Peru. With a protein level of 38 to 41% and a fat level of 8 to 12%, the floating extruded feed is able to meet the nutritional requirements of the snakehead. The fish can be fed at a stable feeding rate of 3-5%; however, it is also very important to wean

Table 2. A comparison between two models of snakehead culture.

Subject	Farming with trash fish	Farming with extruded feed
Culture model	Intensive farming with flowing water	
Culture site	Ponds, cages, cement pits, rivers	
Culture area (m^2)	250 to 3,000	
Pond depth (m)	2.5±0.5	
Water exchange rate (%/day)	20 to 40	
Size seed (fish/kg)	500 to 2,000	
Stocking density (fish/m^2)	50 to 100	
Body weight at harvest (g/fish)	300 to 800	
Labour	The labour needs in feed preparation and feeding of trash fish are twice as that for extruded feed	
Price of feed (USD/kg)	0.29 to 0.42	0.88 to 0.94
Feeding rate (%BW)	3 to 6	3 to 5
Culture duration (days)	110 to 180	100 to 180
FCR	4.0 to 5.0	1.2 to 1.4
Diseases	Parasitosis, hemorrhagic disease, gill erosion disease, syndrome of liver and gall, etc.	Few cases with parasitosis
Medicines	Fenbendazole, PVP-I and antibiotics	No antibiotics
Survival rate (%)	40 to 60	≥85
Production cost (USD/kg)	1.31 to 1.57	1.15 to 1.31
Unit production (kg/m^2)	8 to 12	15 to 35
Unit profit (USD/m^2)	-0.31 to 0.31	2.36 to 26.18

juvenile snakehead with a length of 3 to 6 cm onto extruded feeds before doing so.

Under similar culture models and conditions, the advantages of feeding snakehead with extruded feeds are as follows; less labour, lower FCR, less diseases, higher rate of survival, lower culture cost, higher unit yield and profits (Table 2). The previous situation of farmers with low profit margins from snakehead culture is now changing. Under the guidance of technical experts from Hinter and Con Heo Vang, banned antibiotics and other pharmaceuticals are no longer used in farming. The benefit is better consumer health.

More importantly, unlike trash or fresh fish, extruded feed do not carry pathogenic bacteria and do not contaminate the water. With extruded feed, it is easy to top dress feed with functional additives. Better bioavailability of ingredients in feed means less waste of resources and energy. The extruded feed was formulated following the dietary requirements of the species, reducing the deformity ratio to less than 5% during the culture period.

Outlook for extruded snakehead feed in Vietnam

The rich water resources in Vietnam enables natural water exchange in most ponds, which maintains oxygen concentrations and reduces electricity costs for pumping water. High yields can be expected with high culture densities and pond depths ranging from 2.5 to 5 metres. In the domestic market, the snakehead fish is very popular among the Vietnamese. There is no international pricing for this fish.

There are now approximately 1,000 ha of ponds used for snakehead farming in Vietnam. In recent years, more farmers have turned to snakehead farming following large losses in catfish farming. However, only 15% of the production is fed with extruded feed, and about 40% of the farmers are unfamiliar with this new type of feed. Thus there is a potential for this extruded feed, not only in Vietnam but also in nearby Cambodia.


Su Shi


Dong Qiufen


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Vu Quang Lech

Su Shi, **Dong Qiufen**, **Zhang Taizhuo** and **Dr Yang Yong**, professors in aquaculture nutrition, technology and health, are with Guangzhou Hinter Biotechnology Co.,Ltd, China. **Nguyen Huu Loi** and **Vu Quang Lech** are specialists in animal health and nutrition from Con Heo Vang Company, Vietnam. Email: qiufendong@yahoo.cn (Dong Qiufen).

Complete replacement of Artemia cuts weaning time for summer flounder

Larvae are weaned from rotifers to feed by day 24 without Artemia.

Following metamorphosis, larvae of summer flounder fed on Gemma Micro (top) clearly show a green-brown pigmentation compared with the grey colour of the control larvae fed on Artemia.

In a recent hatchery trial at GreatBay Aquaculture in the US, summer flounder larvae were weaned onto manufactured feed by day 24, without any Artemia. The trial with its latest Gemma Micro formulation was a significant breakthrough for hatchery production of flounder, according to a Skretting report. The formulation uses pre-digested proteins and phospholipids, and a blend of marine micro algae that give the feed its striking green colour.

Nick King of Skretting supervised the preliminary trial with summer flounder *Paralychthys dentatus* at GreatBay Aquaculture in Portsmouth, New Hampshire.

"We phased Gemma Micro in, alongside rotifers, starting with larvae at 7.5 mm on day 19. A small amount of the feed was added to the water just before each rotifer feed and, as the larvae began taking the feed, the rotifer feeds were progressively eliminated."

He added, "Basically, we applied a method that proved successful with cod in Norway. In two days all larvae were feeding so readily on the green particles that we shortened the planned weaning time to five days. The larvae were completely weaned by day 24, compared with the usual 40 days for summer flounder in this hatchery and that is already far earlier than many flatfish hatcheries. For example, with turbot, sole and halibut, weaning often takes place after metamorphosis."

Brian Gennaco, Hatchery Manager of GreatBay Aquaculture said, "We were highly impressed with the speed at which the flounder transitioned onto the new diets. The overall pigmentation, growth, and quality of the flounder exceeded our expectations. The elimination of Artemia in this trial has significantly reduced the work load of the live feed staff."

Growth comparison

Tanks with Gemma Micro were alongside tanks of summer flounder being raised on the conventional protocol using rotifer and Artemia, allowing direct comparisons of growth and development. The growth curves were a fairly close match with the feed batch moving ahead to reach 25–26 mm by day 70, 1–2 mm longer than the Artemia batch.

By day 75, the larvae fed on the feed weighed 0.4 to 0.5g compared with around 0.25g for the Artemia batch. Metamorphosis began around day 27 with Gemma Micro and was virtually complete by day 35. Eye migration began by day 43 and finished by day 50, by which time pigmentation was well advanced. The larvae were fully pigmented by day 68 and the feed batch showed an attractive green-brown colour compared with the greyish hue of the Artemia batch.

At day 75 the survival rate was a comparable 41%. Given the uncertainty of supply and erratic quality sometimes experienced with Artemia, this latest Gemma Micro appears to provide an attractive alternative option.

"Apart from removing the need for Artemia, the main advantages of the feed are significantly faster weaning with a simpler sequence from rotifer directly onto manufactured feed, better colouration and significantly reduced costs." said King.

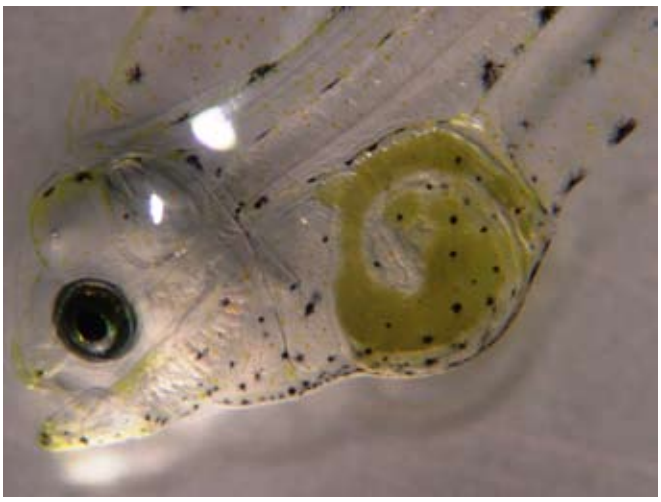
"Additionally, the upgraded Gemma Micro is easy to use whether feeding by hand or by automated micro-feeders. It spreads readily on the water surface and sinks slowly for the larvae to feed."

According to King, when Skretting first launched Gemma Micro some years ago to replace Artemia for production of marine fish species,

they measured success by trying to match the survival, growth and quality of fish that were produced using Artemia. Now, with the recent modifications to Gemma Micro, they have not only met this goal but are getting feedback that fish produced without Artemia are better fish than typically seen with Artemia.

"We are finding that increased survival is leading to greater output per unit volume in bass and bream. With bass, we have seen a general lowering of deformities coupled with a more consistent production between batches. In bream we have seen reductions in specific deformities, most notably in operculum deformities. While this is not yet fully understood the results offer a significant value to farmers in this difficult period and increase the quality of fish to the market. I see improvements in qualitative traits like feeding behaviour and activity level in cod that we never saw with Artemia and the pigmentation in flounder is another qualitative trait."

King added, "We will continue to evaluate the new Gemma Micro with other species including meagre, sole, turbot, seriola and tuna. I suspect we will be reporting more 'never been seen before' claims."



Summer flounder larvae at 22 days post hatch are transparent and green; Gemma Micro particles are clearly visible in the gut.

Mirrored in Europe

The results described by King are endorsed by the experience of several hatcheries in Europe with sea bream and sea bass. Most hatcheries in France are now working with Gemma Micro and report more consistent production from batch to batch, with fewer deformities and higher survival. In Spain commercial hatcheries are weaning sea bass and bream in 35 days compared with 55 to 60 days with Artemia.

Skretting hatchery specialist Fabio Rogato in Italy reports that some major sea bream and sea bass hatcheries in that country have tested the new Gemma Micro.

"The sea bream hatcheries especially are keen. In the south of Italy a sea bass hatchery took a cautious approach and tested the feed together with Artemia. They quickly saw that larvae preferred Gemma Micro to Artemia given at the same time. A hatchery in the north switched completely for the production of one million sea bream with excellent results. Survival rates were comparable with faster growth and fewer deformities. That hatchery is now testing the feed with other species. We also have a hatchery switching to the new Gemma Micro for sole (*Solea solea*)."

Holistic look at aquaculture in Asia

This was the focus of the conference on 'improving aquaculture through feeds and technology' organised by the American Soybean Association International Marketing Program (ASAIM), held from August 2-5, in Manila, Philippines. A team of presenters discussed with an audience of feed technicians, aquaculturists and feed company directors on approaches to improve aquaculture management in the region. The subjects ranged from marketing, feed processing technology and innovations.

A new basis for seafood

In Europe, the salmon industry, after the price collapse, did generic marketing. Without this it would not have reached the current level of success. In pangasius catfish marketing, the Vietnam Association of Seafood Exporters and Processors introduce the fish to the global market even to countries not familiar with the fish previously.

"Seafood in Asia needs to do better marketing. It has to counteract the negative publicity, mainly by environmentalists." said Dr Michael C Cremer, Global Aquaculture Manager for the US Soybean Export Council.

Market movements

According to **Dr S Subasinghe**, Infofish, seafood demand in the major markets is changing. Asian exports totalled USD 31.41 billion in 2007 to a world market worth USD99.42 billion. Since 2007, seafood imports to Japan, the largest seafood importer by value, have been declining. In 2006, fish intake (g/person/day) slipped to 80.4g/person/day, to match that of meat. It was 98.2g/person/day in 1998.

The falling restaurant business in the US affected imports of high-end seafood such as large-sized shrimp and fresh air-flown tuna. The consumer preference for medium and smaller size shrimp is reflected in increases of 35% in sales of small shrimp at Wal Mart and Cosco. The freshwater fish fillet market improved as tilapia, pangasius and catfish became cheaper alternatives, replacing salmon, in family restaurants. China led with 66% of imports (119,315 tonnes) in 2008 and Vietnam led with pangasius comprising 77% of catfish imports in 2008. In the EU, the popularity of tropical freshwater fish is rising. Imports rose to USD 747 million in 2008 with 242,000 tonnes.

China, the world's largest producer of shrimp imported 60,000 tonnes in 2005 but less in 2006 at 40,000 tonnes. In China, a report by the Norwegian Seafood Council showed that 20.84% of the household budget is spent on seafood purchases but this figure is showing an upward trend. Besides China, intraregional trade within Asia is increasing because of rising disposable income, growing concern on health, the flux of Japanese style restaurants, economic partnership agreements and increasing trade tariffs in conventional markets.

Subasinghe said, "The future will see the shrimp market stagnating but markets for tilapia and pangasius expanding. In India, 200,000 tonnes of the pangasius is produced and 50% consumed locally. Egypt imported 27,000 tonnes of pangasius in 2008 whilst tilapia imports are increasing in Africa, presumably because of the Chinese work force. Imports increased 400% from 6,332 tonnes in 2007 to 23,708 in 2008."

"However, the concern is with the low price and producers working on thin margins, competing among themselves. Vietnam has a 3-4 year lead in exporting pangasius but more pangsius production is expected from other countries. India needs a correct marketing strategy. In all, the feed component is important and cost of production should be in the final tally."

Targeted production

Japan's shrimp imports come from Vietnam, Indonesia, Thailand, India and China and a survey on shrimp purchasing behaviour in Japan showed that price, freshness, size and colour are the criteria of purchasers, said **Dr Jacques Gabaudan**, DSM Aquaculture Centre in Bangkok, Thailand. This came from a mail survey of 450 questionnaires with a 90% response. The survey showed that 94% of respondents knew about the monodon shrimp but only 18% on the vannamei shrimp. Most purchasers (81%) buy monodon shrimp at least once a month. The monodon shrimp is clearly a species of choice and the main appeal is colour.

Colour is important

In cooked as well as fresh shrimp, colour, which has been linked to quality, is a major concern and 84% of purchasers find darker colour shrimp appealing. In contrast, pale looking shrimp appears stale

Patricia Rico (right) and the Santeh team

Westly R Rosario (left) and Wilfredo Yap, Executive Director of Santeh, Aquaculture Science and Technology Foundation.

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Unlimited. DSM

The team from PT Indojaya Agrinusa and Wonokoyo Group, Indonesia

Dr Jowaman Khajarern (left) demonstrates her fast detection kit for melamine

to purchasers, under cooked or 'dried out'. The monodon shrimp is popular in Japan whilst the white shrimp remains relatively unknown. Australian consumers prefer 'very red' shrimp and are willing to pay more. In a study with a feed company, shrimp were fed feed with astaxanthin. Gabaudan explained that the penaeid shrimp convert B-carotenoids to astaxanthin but this is not a 1:1 yield. In Vietnam, the flesh colour affects the price of *Clarias* catfish. but production costs increase. Some 50 ppm of astaxanthin brings colour to seabream skin with high acceptance in Japan.

Consumers in Spain and France value flesh colour and will pay for what they want whilst UK consumers are more concerned with price. In the US, acceptance behaviour depends on whether purchasers are from the west coast or centre of the country. The former will choose the preferred pigmentation in the fillet.

The environment also has a role in imparting colour to the fish. Under stress, fish loses colouration. In the case of shrimp, immersion of newly harvested shrimp in a dark tank of water will enhance colouration. A blind net used 3-6 months before harvest improves colour in marine fish. This is significant in shallow cages although the effect in deeper cages is not known.

It is all in the ingredients and processing

In this session, presentations centred around ingredients such as crystalline amino acids and rendered meals and how to modify formulations for targeted markets. Although there is mounting evidence that supplementation of synthetic amino acids in aqua feeds promotes growth performance, the use of amino acids is constrained by issues relating to leaching and bio availability. Lysine and methionine are lacking in plant meals. The other issue with amino acids is palatability. **Dr Jesus Venero**, Novus International, USA said that non-crystalline forms and pre-coating of crystalline forms are effective in reducing leaching.

"The use of higher levels of non-marine protein meals in aqua diets has presented us with a challenge on how to add synthetic amino acids. Fish meal which meets the requirements of most aquatic species is being reduced to around 16% to 0 % in aqua feeds. The ideal protein concept, based on the ratio to lysine, the most deficient amino acid, will eventually help us get there. Aquaculture is always different, because of species variability and changing culture environments.

"To date, information is advanced in salmon diets where supplemention with lysine and methionine and threonine and arginine is worked out. In pangasius, we only have information on lysine requirements, although today almost all producers of pangasius feeds supplement feeds with methionine. Changing dietary pH can improve amino acid utilisation. Pangasius fish eats almost immediately the floating feeds and there is no leaching. In shrimp feeds, microencapsulation is required to control leaching."

A clean product

"The focus on feed and animal safety requires that we keep to using clean and safe ingredients. This is where the rendering industry's code of practice (APPI program) encompassing animal safety rules can play an important role in this increasingly competitive sector. It uses HACCP process controls and third party audits. The rendering process destroys bacteria of food safety concern and completely inactivates organisms of importance in animal and human health. They come into the picture when the industry faces high demand for fish meal and escalating prices for both fish meal and fish oil. Meat and bone meal and poultry-by-product meals are especially recommended as they have been successfully used for replacement of fish meal," said **Dr Sergio Nates**, National Renderers Association, USA.

Rendered animal proteins are especially valuable in aqua feed production because of their high protein content, digestible amino acids, mineral availability, especially in terms of calcium and phosphorus and relatively low cost. Within the EU currently, animal products such as fish meal, hydrolysed proteins from ruminant hides/skins, hydrolysed protein from non- ruminants, blood meal from non-ruminants, dicalcium phosphate and tricalcium phosphate of animal origin, gelatine collagen from ruminants, blood products from non-ruminants and animal fats are allowed in aquaculture feeds. Close to being allowed is PAP (processed animal proteins) from non-ruminants. Hydrolysed feather meal is not allowed in fish feed. However, Nates said that these might change in the next 6 months.

Aside from protein content and size of protein for palatability in rendered meals, Nates brought to the attention of feed formulators, the cholesterol composition of blood meals, as well as peptones, antioxidants and the carbon footprint for the rendering industry.

"I do not think that aquaculture can continue at such a fast pace with marine meals. There are enough alternative ingredients, but it will have to compete with the petfood industry for rendered meals."

Feed formulation modifications

The benefits of a balanced nutrition are good growth, low feed conversion ratio, lowest cost per unit gain and long term profit. The formulation of aqua feeds is for targeted results such as performance/profits, colour and sensory characteristics, storage shelf life, health benefits of seafood and disease resistance. **Dr Relicardo Coloso**, Seafdec, Philippines who presented a paper by Mark Newman, said that the targets are moving. In the case of protein, demand for protein

reduces with the stage of development, except that a higher protein content is required for broodstock diets.

To impart the desired colour; salmon flesh should contain 40-80mg/kg of astaxanthin; goldfish skin, 36 mg/kg and shrimp exoskeleton, 50 mg/kg. Some sensory flesh characteristics which have been tried are onion and garlic flavoured trout and a milder tasting tilapia by using soy oil. Shelf life storage is improved with fortified levels of vitamin C. Optimisation of the health benefits of seafood is through manipulation of omega-3 fatty acids in the meat. Lean products can be achieved via manipulation of digestible energy: protein ratios. Ratios of 8 to 8.5 create lean fish and 9.5, fatty fish whilst higher fat level in fish tends to produce firmer flesh, said Coloso.

Feeds also have to be designed for environment protection to make aquaculture sustainable. It needs to use more non-protein energy sources, reduce feed conversion ratios and should be low in phosphorus. However, this can increase feed costs.

In the case of terrestrial farmed species, there are a number of publicly available nutritional databases to help in feed formulation. Such databases are limited in the case of aquatic animal nutrition. In dealing with this, **Dr Victor Suresh**, Integrated Aquaculture International (IAI) said that there are a few databases that aqua feed manufacturers could utilise. NRC will be updating its compilation of nutrient requirements for fish and shrimp in 2011. Suppliers also provide valuable data services. For example, Evonik-Degussa routinely publishes data on amino acid composition of ingredients. He also said that feed manufacturers could themselves organise databases for their own use. He demonstrated NutriView, a database that IAI has developed. The database collects data from numerous published reports in journals, data provided by the suppliers, and data from the company's R&D program. The company has also developed nutrient value calculating models using the vast amount of data in NutriView. These models are offered in the form of an online tool called NutriCalx. The solution bridges the gap between databases and formulation programs and helps to update nutrient value of ingredients in a few easy steps.

Extrusion towards profitability

Advancements in processing technology are geared towards making some changes to increase capacity of production and reduce waste, said **Paul Chen**, Wenger USA based in Taiwan. His overview covered ten recent changes in extrusion technology developed by the company. Chen said that in the drive to improve hygiene in feed processing, a new hood design and knife assembly eliminate cross contamination of airborne bacteria and produces a cleaner environment. The design parameters of the hinged, swing-away design of the dust sprout is to minimise dust, product buildup and accumulation. The WAS or waste recovery system is a reclamation system to recover wet, under-processed product that cannot be recycled through the dryer.

"The new standard for pre-conditioning at Wenger is with the high intensity preconditioner with 2 shafts, one bigger than the other. This can give a large difference in gelatinisation from 42% to 70% and retention of heat sensitive nutrients such as lysine, vitamin A and C at 100%, 79% and 83%, respectively. A new SX design model of extruder equipped with high Intensity preconditioner expands ingredient flexibility and is good for applications requiring extreme operating parameters (SME and pressure). It also improves product uniformity

Speakers from left; Jesus Venero, Paul Chen, Victor Suresh, Sergio Nates and Relicardo Coloso

and allows for extrusion with 2-3% less moisture. The capacity average is 2.5 tonnes higher than the previous models. The highest range has a capacity average of 17.5 tonnes per hour. To extrude feeds at lower costs, the thermal versus mechanical twin extruders will not give a statistical dip in palatability. Also new to industry is the higher capacity micro-aquatic feed dies using diverging cone screws which produce more expansion and floating products. Reversely, diverging screw with oblique diverging tubes produces a higher rate of sinking products with more size uniformity and higher product density leading to a higher percentage of sinking pellets."

Technology approaches

Aquaculture needs genetically improved stocks

According to **Dr Morten Rye**, the use of genetically improved stocks is critical for cost effective production and hence for the long term sustainability of aquaculture. In his presentation on genetic improvements of hatchery production, he showed how contributions from systematic selection have been very significant for species like Atlantic salmon and Nile tilapia, with doubled growth rates resulting from 5-6 generations of selection. However, while basically 100% of the world's livestock production is based on improved stocks, the corresponding number for farmed aquaculture species overall is still no more than 10%.

"In Norway, genetic improvements have been a main driving force for the development of the salmon farming industry through significant and continuous reductions in production costs. Norwegian salmon is in its F9 generation with an average genetic gain for growth in the range of 10-15% per generation. The improved growth has led to a significant improvement in feed conversion efficiency. The accumulated gains of 8 generations of selection are conservatively estimated to amount to NOK 15 (USD 2.54) per kg of salmon produced. This corresponds to an economic gain per generation of NOK 0.50 (USD 0.08). In practical terms, for the 2007 production of 814,000 tonnes salmon in Norway, the improved feed conversion efficiency reduced the industry's total feed cost by about USD 250 million as compared to production of wild, unselected material."

"However, the implementation of breeding programs for other species has been rather slow. Most are based on recently domesticated stocks. Most farmed aquaculture species have achieved only marginal improvement in productivity as compared to selected stocks of salmon and tilapia."

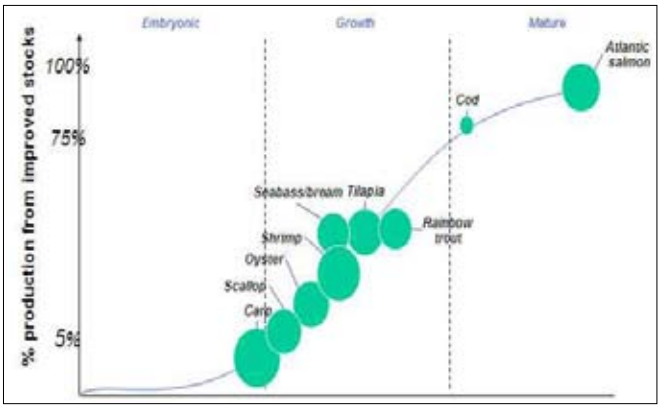
The Akvaforsk Genetics Center in Norway has been involved in selective breeding programs in several Asian countries: China with *Penaeus chinensis*, Nile, red and blue tilapia; India with the rohu carp and *P. monodon*, and Vietnam with Nile and red tilapia and pangasius catfish.

Rye highlighted the large variability in reproductive characteristics of different aquatic species. He pointed out that high fecundity and short generation interval for many species facilitate rapid improvements. Reflecting the differences in the species' generation intervals, what takes four years to achieve in Atlantic salmon can be done in one year or even less in tilapia.

Family based programs using sib information are established as the industry standard in most industrialised aquaculture productions. As compared to simple mass selection, which primarily may work for improving growth rate, family based programs are highly flexible and facilitate effective selection for all types of traits of economic importance; e.g. growth rate, carcass quality, fillet yield, disease resistance, salinity and temperature tolerance. Implementation of molecular tools such as genetic markers may further increase selection accuracy, but cannot replace conventional selection schemes.

The take home message was;
"According to FAO, we have to increase world food production by 50% by 2030. This challenge can only be met through increased production as well as improved production efficiency, where genetic selection will play a vital role. The full benefits of improved management including optimisation of feed composition, rely on genetically improved stocks. However, the relevant technology uptake in the Asian Pacific region has been slow in spite of high production volumes. This is a challenge that has to be taken at regional/national levels."

Market maturity: by species.



Aquaculture needs certification

As aquaculture expands, the response by society has been to ask for production which is 'sustainable, safe and of quality'. Industry response has been a drive towards better management and responsible aquaculture. Certification is the next step but there is an additional cost in production without any guarantees of price premiums. The only advantage is market access, said Koji Yamamoto, Network of Aquaculture Centres in Asia Pacific (NACA), Thailand in his presentation on a review of Aquaculture Certification. Certification is particularly tough for small-scale aquaculture producers which dominate Asia. NACA believes that based on successful cases in Thailand and other countries in the region, cluster farming and Cluster Farm Certification is the way forward. It will improve market access as well as improve efficiency of production. Here, there is an internal control system to push the whole group to better farming practices. An example is the shrimp cooperative program in Thailand.

As the producer needs to be able to sell their product, image and reputation are important. In Asia, there are government led programs such as Thailand's CoC (Code of Conduct). However, market recognition is unclear and thus Thailand's certification programs are geared towards strengthening environmental standards through ISO65. The conclusion is that certification must be transparent and credible through a process of multi-stakeholder involvements in standard development and review.

Better future in production processes

Whether probiotics is fact or fiction in aquaculture and whether it is an alternative to antibiotics was debated by **Mathieu Cortyl**, Norel Asia Pacific, Singapore. Probiotic use is promoted by social attitudes towards the unnecessary use of antibiotics in aquaculture and at the consumer level, the fear of harmful residues in aqua products. Two examples of probiotic effects on production of the tilapia in the Philippines and *P. vannamei* shrimp in Mexico concluded that there are technical and economic benefits in using probiotics. Probiotics promote the right balance of the gut intestinal flora and improves feed digestibility.

In his discussion on the use of medications and vaccination in aquaculture, **Dr Jan Koesling**, Bayer Thai Company Limited, anticipated in Asia Pacific the need for further harmonisation of regulatory requirements for aquaculture applications. The identification of main aquaculture species with their specific applications of medications and vaccination is still ongoing. His message is that 'high veterinary standards with available, effective, fully licensed applications against the most prevalent disease challenges are essential for sustainable industry growth.' In Asia a technically possible milestone might be the development of less stressful applications and also a more effective reduction of parasite prevalence within the culture system. However, intensive medications and vaccination development efforts will only be effectively facilitated through an industry focus on few aquaculture species with high total output values.

From left: Jan Koesling, Hsiang Pin Lan, Morten Rye and Mathieu Cortyl.

The Centre for Environment, Fisheries and Aquaculture Science (CEFAS), UK has developed synthetic feed attractants based on fish and shellfish pheromones. **Dr Andy Moore** said that these are in liquid form and are added to the pond prior to the feed. They have developed attractants for the hybrid catfish, tilapia, Japanese eel and vannamei shrimp. Laboratory and subsequent growth trials resulted in the

amount of stimulants to be sprayed to the area where food is given or the amount top coated onto feeds. Size frequency studies showed mean weight improvements to 157g from the mean of 137g for the catfish. In the case of shrimp, stimulants have to be added to feed. Moore said that feed stimulation is essential when lower fish meal diets are used. It is also to improve survival during sensitive stages such as the fry stage in the hatchery.

Proactive health management

There are several challenges in diagnosis of health problems. **Neil Wendover**, Intervet-Schering Plough Animal Health, Singapore said that the magic bullet for a future in aquaculture in Asia is good health control. This is lacking as health problems are only reported when mortality occurs and in most cases too late to reverese the situation. Environment is important. There are some species more susceptible to diseases. Milkfish under anoxic conditions, for example is very prone to diseases. Barramundi is easily infected with fungal diseases when fed with trash fish. At the farm level, feed millers and government representatives can work together to recognise trigger factors.

Dr Pedro Encarnacao, Biomin Singapore said that the toxicity of different mycotoxins which can be present in feeds and feed ingredients, will differ and that it is important to determine how high is the toxicity level of each type of mycotoxin and concurrent effect on a specific aquaculture species.

Aflatoxin B1 is recognised as one of the most toxic mycotoxins found in aqua feeds and feed ingredients. From the human food angle, the permitted level in the EU is 2 ppb for Aflatoxin B1, but recent studies have reported that carp and European seabass when fed low levels of AFB1 can show levels above 3ppb in the flesh. It is thus important that industry begins to consider the effect of mycotoxins contamination on food safety and not merely the effects on the aquaculture species. The latter has been difficult to ascertain as in general, in fish and shrimp, there is no specific pathology associated with mycotoxins contamination. Generally, the presence results in poor growth and immunesupression. However it is known that contamination with Aflatoxin, which are hepatotoxins create liver damage. Some tests have shown that channel catfish are more hardy to mycotoxins, and the yellow flesh colour of tilapia is associated with contamination with Aflatoxin. Levels as high as 200 to a low of 50ppb apparently affected shrimp. Encarnação also described the three levels in mycotoxin management in his presentation. Biomin does yearly surveys on mycotoxins contamination in feeds and feed ingredients and more information on the situation in 2010 will be available in the next issue.

Changing Taiwan's marine fish hatchery models

During the last 50 years, Taiwan's fish breeding companies have been credited with the development in marine fish culture in the region, the technological advances in fish breeding and supply of fry and fingerlings. However, the role as the leading supplier of fry and fingerlings to regional marine farms ended in the 2007-2009 period with increasing exports from Indonesia's hatchery industry, said **Kevin Nai-heng Yu**, Chairman, Fish Breeding Association (FBA) of Taiwan. The Association with 1,650 members, acts as a non-governmental body for industry development. It develops reproduction technology, integrates marketing and explores international markets.

"The association members have changed their operational models in line with changes in the global industry. Quality production is the only way to a profitable and sustainable enterprise", said Yu.

He listed some changes which member hatcheries have adopted in fry production and associated activities. Computerisation of the production allows the producers to have a better control at all stages of rearing. Other salient points are a virus free environment and the use of genetically selected strains. According to Yu, the most successful production was for the green grouper. The new species undergoing trials is the giant grouper which is difficult because of its susceptibility to diseases. Thus developing disease resistance strains is important. A recent breakthrough is the potato grouper. The Association is already exporting the hybrids of the tiger x giant grouper and work to develop the green x giant grouper hybrid is in its first year.

Changing culture models

Working closely with the ASAIM team in the Philippines, Alsons Aquaculture, part of the Alcantara Group began to make changes in their culture models. **Ramon Macaraig** said that they started the 80:20 polyculture of milkfish:shrimp in ponds. In the 80:20 system for cage culture, the species are milkfish and pompano,and siganids as net cleaners; groupers with large-sized milkfish and seaweeds are cultured in nearby rafts to soak up nutrients from feed metabolism. The high density, low volume system was adopted for milkfish and pompano, while Asian seabass in larger than 100 m^3 cages with a density of 35-40 kg/m^3 and groupers and snappers are raised in 8 m^3 cages.

Macaraig said that the satiation feeding trials for milkfish has brought down feed conversion ratios (FCR) by 20-25% and the ASAIM 34/9 feed formulation improved FCR from 3.0 to 2.5 for up to 640g milkfish. However, the target is to bring this down to 2.0 for 600g fish after a review of the cage feed formulation itself. FCR is lower at 1.2 to 1.6 in milkfish pond systems. Covering the cage with black plastic also helped to improve performance. Less success was achieved with the satiation feeding trials for pompano. It did not cut down feed volumes, possibly because of disease problems and the characteristic of the pompano to keep on feeding even if they are full.

The company has been involved in various aquaculture activities since 1988 including the production of milkfish, prawns, tilapia, pompano, sea bass, eels, snappers, groupers from ponds to meet the demand for live, chilled and processed food fish products in the Philippines and overseas markets.

In two breakout sessions, **Dr Oliver Decamp**, Inve Aquaculture and **Dr Jowaman Khajarern**, Department of Animal Science, Mahasarakam University, Thailand discussed how to increase profits with appropriate health management and practical laboratory technology for feedmills and farmers, respectively. Decamp stressed on optimisation of production conditions and reviewed various health management protocols for fish and shrimp production in Asia. According to Khajarern, high quality materials are in short supply, in particular protein meals. These also show variability in quality. Fast and accurate methods to determine the physical qualities of raw material are essential. She demonstrated a fast detection kit for melamine contamination in raw material developed at her university.

PDF versions of selected presentations are available at www.asaimsea.com

Offshore cage culture technology in China

In China, the need for cage culture to go offshore is never as critical as at present as coastal areas have become too overcrowded with traditional cages. In most coastal areas of China, the number of cages has been increasing but productivity per unit area has been declining because of poor water quality. Wooden traditional cages cannot withstand typhoons. Offshore cage culture technology (OCAT) is not new to China, as the Norwegian polarcirkel cage design was introduced in 1996. However, the adoption has been slow, hampered by the traditional level of investments and the fragmented nature of the sector, comprising mainly small family enterprises.

In 2004, the American Soybean Association International Marketing (ASAIM) program diversified its marine fish culture program to offshore open cages, where environmental conditions were better and where there was less competition from other industries. It started with four prototype cages in Hainan Island in 2004-2008. Since 1999, it had started a program to develop feed-based production of marine fish in cages in the coastal provinces of China. The testing of high soybean meal diets for the Japanese sea bass, red drum, yellow croaker, goldenfin pompano and other species with soy-inclusion feeds were successful. The team, led by Dr. Michael Cremer then went offshore where water quality conditions are better. The future of near shore cage culture in China was being threatened by deteriorating water quality. Other problems include the spread of diseases from rampant use of trash fish as feed, and the contamination of coastal waters with agriculture and industrial effluents. Initial off shore culture efforts were unsuccessful because of loss of fish stock, and cage damage from typhoons.

"What we required is a cage design that can withstand typhoon storms, a frequent phenomenon in the coastal regions in China. However, the design should not be too complicated for the small farmer to handle. Globally, there are already good designs for strong cages but costs are too high and only mega companies can afford these," said Hsiang Pin Lan, Aquaculture Specialist-Marine, US Soybean Export Council, China.

The development of the OCAT cage was funded by the United Soybean Board through the US soybean check-off program with additional funding support provided by the US Foreign Agricultural Service.

"We have been developing the OCAT design for a number of years and have been making modifications. The cage design survived the level 12 typhoon Da wei with 200 km/hr winds in 2005. The square cement anchor is 5 tonnes in weight but only 3 tonnes gravity in the water. The swivel is multidirectional as currents come from several directions. Our most important feature is the auto submersion system. During strong current conditions, the auto submersion system brings the cage below the water surface where the wind-wave force is significantly reduced. The other feature is the fish transfer tube with an underwater tunnel."

It was also important to ensure easy maintenance and Lan said, "As the cage is only 4m deep, the operator does not need diving equipment." Their tests indicated that each 100m^3 cage can hold 6 tonnes or 10,000 fish with 99% survival rate. The details of the OCAT are now available in a CD manual.

Since 2008, the team has had enough experience to site 4 cages together with one mooring for R&D purposes. In 2009, the cost was USD 15,000/cage and USD 300 for the mooring system. Work is continuing to modify the cage system, such as using copper nets which prevents biofouling. Currently, there are 7 cages; 3 cages are also located in the Black Sea under a USDA and Government of Georgia program.

"In general, the objective is not to dictate what industry should do identically, but to show concepts for their consideration," said Lan.

Hsiang Pin Lan (left) with Kevin Nai-heng Yu, Chairman, Fish Breeding Association (FBA) of Taiwan at the ASAIM conference.

Integrated production of Java barramundi

By Zuridah Merican

The objective is to be a market driven high volume producer of large barramundi. The focus is scaling up production in offshore cages for the global chilled and frozen markets.

A first grid system is in operation, picture by Fega Marikultura

After several years of pilot trials and research, PT Fega Marikultura has arrived at farming the barramundi or Asian sea bass *Lates calcarifer* in open sea cages. As a testimony to its efforts, it now has 25-30 cages set up in the 2,300 ha concession in the pristine waters of Indonesia's Thousand Island Archipelago, some 40 nautical miles offshore from Jakarta. The harvest is expected to reach 1,000 tonnes in 2010 scaling up to 5,000 tonnes in 2011. All these have been achieved with a systematic approach to farming of the fish and an industrial outlook to marine fish farming.

Since 1998, it has been the dream of Sofjan Alisjahbana, founder of Fega to innovate the farming of the barramundi away from traditional coastal cages to offshore sea cages. The basic premise is to simulate the salmon model in Europe. He has also taken a conservative approach to develop this, going through several pilot trials, in particular at the grow-out stages.

It decided to be market-led rather than product- driven and has set production volumes and margins. The target is to produce large 2.5 to 4kg fish for processing into chilled and frozen fillet and portion cuts for international markets.

Fega also knew that a large operation such as this will require not only a consistent supply of juveniles, but those of a specific quality and size. A dependence on supply from the usually small and medium-scale and backyard hatcheries was not an option. This contrasts with Europe's marine fish farming business where industrial scale production can depend on the large scale hatcheries with a consistent supply of high quality juveniles. Its hatchery is on Jukung Island, not far away by boat from the cages. The whole island is dedicated to the production of juveniles for stocking into nursery cages and provides a biosecure facility and gives the company full control on fry and juvenile production.

"The future in barramundi farming is in the Java Seas. We will maintain our principle of responsible and sustainable farming of the fish while protecting this pristine environment at the same time. We need to take a very cautious approach. We have conducted an environmental impact assessment which forms the baseline for future reference. In the initial stages, we needed a land base operation but in the long term, the strategy is to have cages far away from the islands," said Alain Michel, Chief Scientist and Project Consultant.

"We are very fortunate as we have ideal water conditions; a constant water temperature of 29ºC, salinity of 33ppt, no issues with red tides and fast flowing east to west currents which remove wastes and oxygenate the water to a constant dissolved oxygen level of 6.2 mg/l".

"Looking into the future, to be a major player, we need to be in control of all aspects of production. We also knew that we needed to carry out domestication and selective breeding of the fish, even though

Bambang Wahjudi, Farm Manager (left) and Alain Michel

Broodstock tanks

Java barramundi in cages, picture by Fega Marikultura

I was advised that this would take 15 years to achieve. So we started this immediately and our main target is selection for growth. Now we have our third generation captive stock and we are waiting for a 20% improvement in growth by generation from the selective breeding program," said Alisjahbana.

Branding and marketing 'Java barramundi'

Fega has a trademark on the name 'Java Barramundi' for its fish. Currently, fish are manually stunned according to regulations but an automatic equipment will be used soon. Fish are transported at 2 to 4ºC by boat to the processing plant in Jakarta which takes 4 hours. With juvenile production in place, the farm is rapidly expanding output and the company has embarked on a marketing campaign.

Market promotions expound on the delicate flesh of the fish produced in full saline waters all year round. Currently, fish is exported as fresh chilled to Australia and the US. This is a small niche market. It guarantees delivery of fresh fish to markets in less than 48 hours. In American markets, the retail price of frozen barramundi is USD 7-8/kg and in white table cloth restaurants, it will be sold at USD 9/kg. The next step is marketing frozen products in the US and Europe and working with seafood companies in France for value added products.

The company promoted the fish at the last European Seafood Exposition in April 2010. Prior to that it participated in a Labo-PDM where a chef from Euro-toques cooked the barramundi for French buyers and retailers. Recently in October in Kuala Lumpur, the fish cooked by a 5 star hotel chef, scored very high points for its flavour and texture at a lunch during the GOAL conference.

Traceability and certification

Fega recognises the importance of adhering to best management practices for aquaculture. While no specific standards exist now for barramundi or tropical marine fish cage culture, the team is proactively involved in ensuring traceability from hatchery production to processing. This will guarantee that when standards are available through organisations such as the Global Aquaculture Alliance and their Best Aquaculture Practices (BAP), GlobalGap or ASC, the company will be essentially compliant with these standards and readily able to become certified.

Community participation

The farm and hatchery employs a total of 100 technical staff, comprising those from Java Island living on site in Jukung and daily

Weaned fry in indoor tanks

commuters from the neighbouring island of Kelapa. For their livelihood, the community of 6,000 on Kelapa currently depend on the collection of ornamental marine fish. In the future, Fega has plans to encourage the local community to start a small scale culture of marine fish. It will supply juveniles produced at its hatchery. It will also assist with culture management and possibly buy back the fish.

Completing integration

Production will be stepped up as more and larger cages are installed. Ultimately, the plan is to develop 3 grids of 24 cages of 90m circumference producing 300 tonnes/cage and 120m circumference producing 500 tonnes/cage depending on the depth of the cage which can vary from 10-15m. Each grid will have a feeding barge in the centre, complete with a feed blower. The next step to complete the integration is a feed mill. This is in the future plans of the company but only when production gears up to 10,000 tonnes per year. At current levels of production, it is more economically viable to outsource the feeds. The ultimate target of the 3 grids will be a potential harvest of 40,000 tonnes and a real harvest per year of 30,000 tonnes in 2014. Alisjahbana is confident that the harvest in 2014 will consist of other species other than the barramundi.

At the GOAL 2010 lunch meeting in Kuala Lumpur, cooked fish scored points for its flavour and texture, picture by Darryl Jory, GAA.

Sustainability and traceability in barramundi farming

Cage production

In line with its commitment to minimise impact on the environment, Fega has begun to use the lower maintenance semi rigid and knotless netting material. With this, the use of anti fouling chemicals is avoided. The frequency of washing away biological fouling is greatly reduced. Currently, all the piping for the cage structures are local products and the staff fabricate all the stanchions and assemble these on Jukung Island before towing them to the sites.

Cages are located in three locations for the nursery and grow-out stages. A first grid system is in operation for 90m circumference cages. In general good farm practices help to avoid disease problems. Stocking in large grow-out cages is low by industry standards. From the hatchery, juveniles are stocked in offshore cages and after reaching 100g, these are transferred to larger cages.

Fish are transferred with minimal stress. During grow-out, fish are gently graded several times, essential to maximise growth and reduce mortality. Fish are fed large sinking pellets, produced by a local company and containing 40-42% protein and 15% fat. The barramundi shows a large variation in size. At the farm, the mean target size is 2.5kg in 18 months and more than 2 years for a mean of 3.5kg. The target cost of production is less than USD3/kg and as the barramundi is known to use all the nutrients in the feed for growth, the farm is convinced that it can achieve a FCR of 1:1 in the future, subject to feed quality.

Controlling disease

Since the beginning, the hatchery has been working with Intervet-Schering Plough Animal Health in Singapore in monitoring disease occurrences. The protocol is to vaccinate 10g juveniles against *Streptococcus iniae*. In cages, another threat to barramundi is the parasite *Benedenia* attacking the tail end. A 45 minute hydrogen peroxide bath is the usual remedy. However, as the fish grow, these parasites do not present a major problem.

Selective breeding

Captive F3 brood stocks are kept in large indoor tanks. In the case of the barramundi, each generation takes three years. Breeders are electronically tagged and DNA genotyped. Brood stock is part of the asset of the company and thus, the introduction of any wild stock is avoided. The hatchery has cryopreservation equipment to store male sperm for backcrossing work.

"The target of the family based selection program is an average growth to 5 kg in 18 months as opposed to the current 2.5 kg in the same period. Working with a European company, with expertise on selective breeding for the turbot and European sea bass, we are tagging and genotyping fish. The selection is based on 150 families/generation. Next, will be improving fillet yield, currently at 40-50% and disease resistance. Besides genetic variation among individuals, of interest is the environmental effect of cages on individual fish,"said Michel.

Hatchery

This is essential to any sustainable farming. On Jukung Island, facilities comprise indoor tanks and outdoor concrete ponds to hold brood stock and to carry out induced spawning, live feed production, larval rearing and weaning. The 4 to 5 year old captive brood stocks are kept in indoor tanks. Deformities in fish are avoided by controlling the nutrition of the brood stock. Weaning juveniles are fed well-balanced cold extruded pellets imported from Japan and Europe. The hatchery produces three batches of larval every two months.

The nursery culture of post-vaccinated juveniles are carried out in flow-through outdoor tanks. As demand is increasing, more tanks are being added. These allow for nursery production of 200,000 of 20g juveniles per month and also on-growing to larger fish when required. Production will double to 400,000 juveniles in 2011. Due to the large size variation at the juvenile stage, frequent grading is essential to prevent losses which can reach 30%. Nevertheless, once fish are graded and separated, the smaller fish continue to grow well.

Food safety in the live fish hub in Hong Kong

A new regulation on food safety brings live fish imports in line with other seafood imports in this major destination for Asia Pacific producers.

Hong Kong epitomises the culinary restaurant culture of consuming not only live fish but high value ones. Some 33 species of live fish are imported into Hong Kong for local consumption. Hong Kong also serves as the entry point for live fish for mainland China with 30-35% of the imports re-exported to larger cities. The main suppliers for this market are marine cage farms throughout Asia, namely, China, Indonesia, Thailand, Singapore, Vietnam and Malaysia. Groupers, wrasses, parrot fish and siganids obtained through capture fisheries also form a significant portion of live fish imports.

In 2009, the net import of live marine fish (LMF) for consumption in Hong Kong was 12,247 tonnes in 2009, according to data provided by the Agriculture, Fisheries and Conservation Department (AFCD). AFCD expects volumes to remain steady in the future. The highest volume was recorded in 2006 at 15,480 tonnes (Table 1). In 2008, the consumption of all marine fish (live, fresh, and frozen) was 109,830 tonnes. The volume imported was 99,080 tonnes but 35% (28,120 tonnes) was re-exported. Local production contributed 39,020 tonnes (AFCD, 2008).

The local production of marine fish in cages and ponds is relatively insignificant in comparison to imports. In 2009, the production was 1,473 tonnes of green grouper, brown-spotted grouper, giant grouper, Russell's snapper, mangrove snapper, red snapper, star snapper and pompano in cages and giant groupers, sea breams and spotted scat in brackishwater fish ponds.

A target market

The live fish market in Hong Kong is highly competitive as most regional producers target this market for their produce. Marketing is well organised by Hong Kong's non profit Fish Marketing Organisation (FMO) which oversees prices and volumes at its wholesale centres. It is also an attractive market because of the high wholesale prices and tariff and tax free status of seafood imports. There are import restrictions in place for CITES and endangered species. However, consumers and importers are discerning and knowledgeable on the products, demanding both high quality and value for money.

The pull factor is also the network of brokers and the system of collection for live marine fish using well boats from cage farms in the region. Well boats take a minimum volume of 20 tonnes and only of selected species. Usually, farms time harvesting to coincide with the arrival of these well boats. For smaller volumes, producers air freight fish, which is not a deterrent in light of the high wholesale prices.

Red preferred

In September, the medium priced fish as reported by the Fish Marketing Organisation are the commonly cultured species such as brown spotted, green grouper and yellow finned sea bream. The low priced fish are the snappers, breams, siganids, rabbit fish, sweetlip and the pompano (Table 2). However, prices are also high for rare fish such as the leopard coral grouper.

Tradition dictates that red brings good fortune. It is common to be presented with a red coloured fish at weddings, birthdays and

celebration dinners. There is a high demand for red fish and prices mirror the availability of the fish. Chan (1999) reported that the medium priced red coral trout *Plectropomus areolatus* was the most common medium price fish in Hong Kong and China, sold at USD 38/kg. Currently, an expensive red fish is the red spotted grouper with a wholesale price of HKD 522.75/kg (Table 2).

There are also some species which the Agriculture, Fisheries and Conservation Department have put on the conservation list. These are the green wrasse *Choerodon schoenleinii*, high finned or humpback grouper *Cromileptes altivelis* and giant grouper *Epinephelus lanceolatus*. As consumption is linked to the restaurant trade, prices fluctuate with economic conditions. In March 2009, a farm in Penang, Malaysia reported a drop in ex-farm prices of tiger grouper from USD20 to USD 10.5/kg after the economic downturn in 2009.

Table 1. Ten year trend in net imports of LMF (Source: AFCD, Hong Kong).

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Net imports (tonnes)	14,819	14,140	11,835	11,978	13,222	15,323	15,480	13,893	11,318	12,247

Food safety

Current regulations

Food laws in Hong Kong come under the purview of the Centre of Food Safety (CFS). The basic requirement is that no food intended for sale should be unfit for human consumption. The CFS carries out functions for the general protection of food purchasers, with offences in connection with sale of unfit and adulterated food, composition and labelling of food, food hygiene, seizure and destruction of unfit food coming under its purview. Fresh, chilled and prepared seafood,

Table 2. Weekly prices posted by the Fish Marketing Organization (FMO*, 20 September 2010).

Common name	Scientific name	Average Prices HKD/kg on 20 September 2010
Tiger, Brown Marbled, Flowery grouper	*Epinephelus fuscoguttatus*	197.67
Areolate; Brown-spotted grouper	*Epinephelus areolatus*	249.67
Camouflage grouper	*Epinephelus polyphekadion*	325.00
Orange-spotted; Estuary cod; Green grouper	*Epinephelus coioides*	117.50
Gold-lined seabream	*Sparus sarba*	63.00
Coral trout; Leopard coral grouper	*Plectropomus leopardus*	487.33
Red spotted grouper	*Epinephelus akaara*	522.75
Rusell's snapper	*Lutjanus russellii*	77.00
Red or Malabar snapper	*Lutjanus malabaricus*	71.00
Mangrove snapper	*Lutjanus argentimaculatus*	71.50
Painted sweetlip	*Diagramma pictum*	73.50
Pompano	*Trachinotus blochii*	65.67
Rabbit fish	*Siganus oramin*	63.00
Head grunt; Grunter bream	*Pomadasys kaakan*	59.50
Yellow-finned sea bream	*Acanthopagrus latus*	173.50
** FMO operates seven wholesale fish markets located at Aberdeen, Shau Kei Wan, Kwun Tong, Cheung Sha Wan, Castle Peak, Tai Po and Sai Kung. Source: http://www.fmo.org.hk/index/lang_en/page_price-sea/Cat_4/*		
Exchange rate : one USD=HKD7.76		

including all shellfish are covered here. At present, live fish are not subjected to any food safety regulation and do not require a health certificate; however, a health certificate may be provided to expedite customs clearance.

Under the guidelines for marine products, food importers, through close liaison with exporting countries, are responsible for ensuring marine products they procure comply with the local legislation. Marine products are liable to bacteriological or chemical contamination in the harvesting zone or handling process and are considered as high-risk food items.

The Food and Environmental Hygiene Department (FEHD) strongly encourages importers to obtain health certificates issued by the health authorities in the countries of origin to accompany their imports certifying that the marine products concerned are fit for human consumption. At present, when a consignment of marine products arrives at entry points of Hong Kong, it may be subject to inspection or sampling by the FEHD. If the importer concerned is not able to present a health certificate during inspection, the FEHD will take samples from the consignment for examinations before its release.

Pesticides and other residues

In monitoring pesticide residues in food fish, the FEHD routinely analyses samples of different foods for verification that the pesticide residues are within the "tolerance levels". The Maximum Residue Limits (MRLs) and Extraneous Maximum Residues Limits (EMRLs) adopted for pesticides is as recommended by the Codex Alimentarius Commission of the WHO/FAO (World Health Organization/Food and Agriculture Organization of the United Nations).

A major issue in the live fish trade is ciguatera fish poisoning which is reported in Hong Kong from time to time and is most often associated with the consumption of coral reef fish. In most cases, the consumption of smaller fish which have consumed toxic algae in coral reef areas by imported reef fish results in an accumulation of the ciguatera toxin in the body of the fish, in particular in the internal organs. The ciguatera toxin cannot be destroyed by cooking and, in general, the larger the fish the higher the level of the toxin. The following species have been associated with cases of ciguatera poisoning; flowery grouper, high finned grouper, humphead wrasse, leopard trout, moray eel, tiger grouper, two spot red snapper and white edged luretail.

A new Food Safety Bill

Under the proposed imported aquatic products regulation, Hong Kong will have new requirements under the Food Safety Bill to provide for import control of aquatic products. This will close the gap for live imports which are not covered under the current regulations. This is appropriate as a recent survey conducted by the Perishables Group and presented at Asian Seafood 2010 noted that food safety is a key issue for seafood consumers in Hong Kong and southern China.

In addition, FEHD proposes that all importers of aquatic products to register with the Director of Food and Environmental Hygiene. Each consignment of import of cultured live or unprocessed aquatic products has to be accompanied by a health certificate issued by the health authorities of the place of origin. However, it noted that it would be impractical to require health certificates for wild catch aquatic products. Hong Kong would instead require these consignments to be accompanied by a self-declaration recording details of the catch.

For certain high risk aquatic products, such as puffer fish products, wild-caught coral reef fish likely associated with ciguatera food poisoning, and ready-to-eat raw oysters, FEHD is considering more stringent requirements. In addition to the official health certificate or self-declaration, it will require importers of these aquatic products to obtain an import permit issued by the department and to notify it before each consignment arrives, so that it can inspect the consignments before they enter the market if necessary. FEHD also proposes to prohibit the import of live puffer fish due to the high risk of tetrodotoxin. The administration is now consulting the trade on the above proposed control measures, and will take into account the views of traders in refining the proposal where appropriate.

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Food and Environmental Hygiene Department: http://www.fehd.gov.hk

Fish Marketing Organization: http://www.fmo.org.hk

The safety and efficacy of a *Streptococcus iniae* vaccine in Asian sea bass

By Nantarika Chansue, Jirasak Tangtongpiros and John S. Clark

A European system of immersion followed by injection vaccination is indicated as the strategy of choice in the control of this pathogen.

Asian sea bass (*Lates calcarifer*), also known as barramundi, is becoming increasingly popular as a food fish in export markets such as the US and EU. As demand increases, more and more farms are appearing in the South East Asian region to supply these growing markets. Concomitantly with the rise in production is increased disease risk. In hatcheries, sea bass larvae are prone to *Vibrio* infections and to Viral Nervous Necrosis (VNN); in the nursery culture phase, *Vibrio*, *S. iniae* and Iridovirus are problematic. In both these phases of culture, protozoan ecto-parasites such as scuticociliates are prevalent. Risk is greatest, however, during the grow-out phase of culture. Ecto-parasites such as capsalid flukes and sea lice are prevalent and conventional bathing treatments are ineffectual. There is a need, currently being addressed, for in-feed treatments to control and eradicate these parasites.

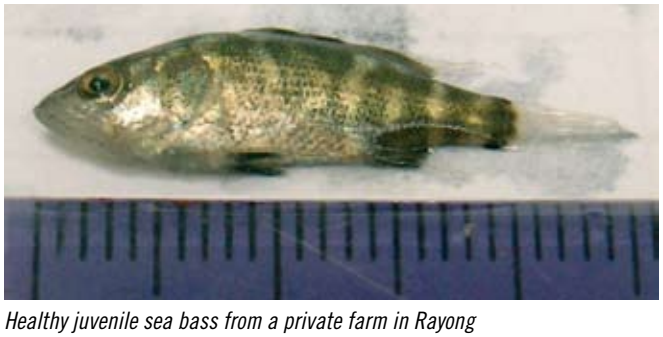
Such parasites, feeding on skin, mucous and blood of the host, leave many portals of entry for pathogens such as *S. iniae*, a commercially important pathogen in sea bass culture. Antibiotic treatments for this pathogen are limited in use due to the ability of the pathogen to "hide" within the body. Vaccination would appear to be the only viable route to protect cultured fish from such a pathogen. The aim of the following research work was to established safety and efficacy data for immersion and injection forms of a *S. iniae* vaccine for application to Asian sea bass culture in Thailand and the Asian region.

Experimental details

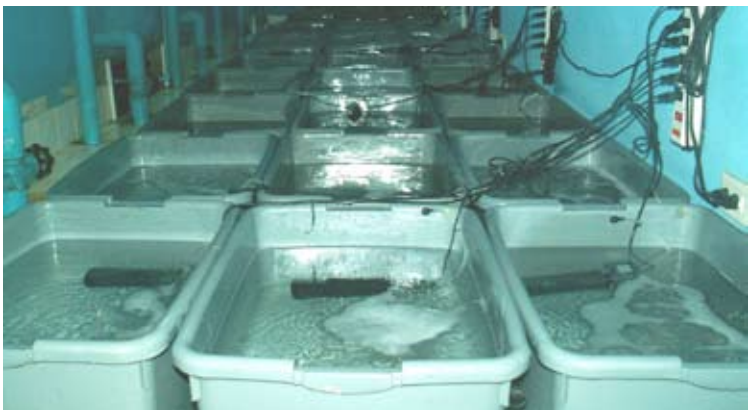
In this experiment, 1,000 juvenile sea bass approximately 5-7 cm body length were used. These fish were purchased from a private farm. Fish were acclimated in 2,000 litre concrete tanks for 14 days prior to beginning of the experiment. Three replicate tanks of 20 fish each were used in all immunization and infection experiments. Aeration was efficiently supplied by air stones. Fifty percent water was changed every 3 days. The fish were fed at 5% body weight daily. Feed used was commercial feed (INVE, Thailand).

To verify the *S. iniae* free status of the fish two fish were sacrificed and samples were obtained for bacterial culture by inoculation loop from kidney and brain. The samples were streaked directly on TSA (Tryptic Soy Agar) and sheep blood agar and then were incubated at 30°C for 24 hours. PCR used for final confirmation of pathogen presence or absence.

The temperature and water quality were monitored daily. Water pH, hardness, ammonia, nitrite and alkalinity were determined using a commercial test kit (AQUA-VBC, Thailand). In all trials, the temperature was stable at 27°C, pH was 8.5-9, hardness was 1,200-1,400 ppm, ammonia was 0.01 ppm and nitrite was 0.2-0.25 ppm, salinity was 34 ppt, and alkalinity was 90-110 ppm.



Healthy juvenile sea bass from a private farm in Rayong



Rearing tanks of 50 litres with individual water filter pumps

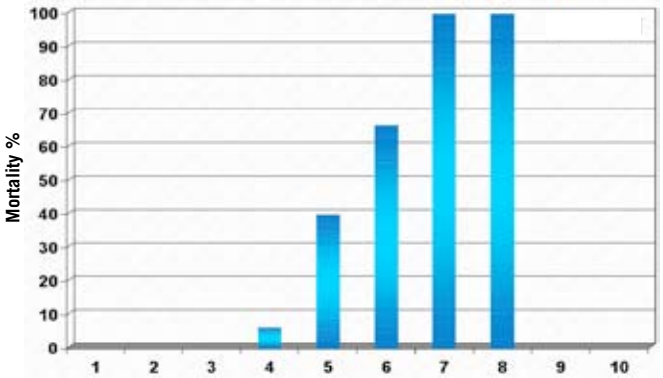
Bacteria

S. iniae isolated from moribund adult sea bass was provided by VMARC (Chulalongkorn University, Thailand). The isolate was plated onto supplemented TSA and harvested after 24 hours of growth. Bacteria were presumptively identified as *S. iniae* by their transparent colonies and coccal shaped cell morphology, Gram-positive stain, negative catalase production and bacterial species were confirmed by using API 20 (BioMerieux, Madrid, Spain) and the API profiles compared with the API database (Apilab Plus, version 3.3.3.; BioMerieux).The pure isolate was kept in stock media at room temperature. PCR was used for final confirmation.

The bacterial isolate used for virulence assays was inoculated into 420 juvenile sea bass via intra-peritonial injection (IP). The culture was adjusted to an optical density of 540 nm using a spectrophotometer to give *S. iniae* doses ranging in concentration from 10^3 to 10^8 CFU/ml. Each concentration in a volume of 0.01 ml was used to establish pathogen doses that would kill 50% (50% lethal dose; LD50) of injected fish within 72 hours. Each dose had 3 replicates with 20 fish in each replicate.

Control groups were injected with sterile 0.9 % (v/v) normal saline. After injection of the pathogen, fish were observed daily. Mortalities were recorded on a daily basis, and symptoms associated with the ensuing pathogen attack were recorded and photographed. Samples of liver, kidney, gill, digestive tract and brain were preserved for histological examination, and a photographic record was maintained.

Figure 1. Determination of LD50 for *S.iniae* in juvenile sea bass.



The mean lethal dose (LD 50) was calculated by the Reed and Muench (1938) procedure for establishing optimal pathogen dose. The dose response curves for this particular isolate of *S. iniae* clearly indicate $1x10^5$ CFU/ml to be used during the efficacy stage of the trial (Figures 1 and 3).

Vaccination

The two types of vaccine used were injection and immersion vaccine forms.

Injection

Three hundred juveniles were divided into 5 groups as follows: 0.01 ml vaccine injection (T2), large volume 0.02 ml vaccine injection (T3) and 3 groups of non-immunized controls (injected with sterile normal saline at a volume of 0.02 ml (CN), no injection (C) and non-vaccinated, injected with LD50 dose of *S. iniae*).

Three replicates were conducted per group of 20 fish each. Fish were not sedated to minimise the effects of over handling. The vaccine was administered intra-peritoneally (IP) to each fish. Fish were then returned to their designated tanks.

Immersion

Sixty juveniles were use in this trial at three replicates of 20 fish each. One litre of vaccine was maintained at 4°C. The vaccine was shaken thoroughly then diluted with 9 litres of clean, well-oxygenated fresh water and mixed thoroughly. The vaccine bath was well oxygenated during the vaccination of the fish to minimize stress. Fish are placed in a fine mesh, soft net then were immersed for a period of 1 minute in the vaccine bath. After vaccination (T1), the fish were returned to their respective tanks.

Immunized and control fish were held for 21 days before challenge. All groups were monitored for mortality on a daily basis. In this manner, vaccine safety could be established.

Challenge tests

At 21 days post-vaccination, the positive control and all test groups received a 0.01 ml aliquot of *S. iniae* at 50% lethal dose concentration or $1x10^5$ CFU/ml administered IP (determined by previous study). The non-immunized controls were injected with normal saline 0.01ml (CN). The fish were monitored for mortality for 72 hours post-challenge.

Fish mortalities were observed and recorded on a daily basis and symptoms of the ensuing pathogen attack were recorded and photographed. Tissue samples of liver, kidney, gill, digestive tract and brain were preserved for histological examination, again with a corresponding photographic record. The percentage mortality rates of each vaccine dose were calculated against the relevant controls. In this way, the efficacy of both vaccine doses could be established.

Dead fish were removed immediately when observed and upon post-mortem examination, specimens were obtained aseptically from kidney, liver and brain sites for examination of *S. iniae* infection. Specimens were cultured directly onto TCBS at 30°C for 24 hours and biochemically identified by API 20 Strep. The mortality data for each group was analyzed by two-way analysis of variance using a SPSS program. Significant differences were determined at P<0.05.

Table 1. Mean % mortality of juvenile sea bass at day 21 after vaccination (safety study).

Group	% mortality
Control (C)	0.00±0.00a
Injection with normal saline (CN)	5.00±0.00a
Immersion group (T1)	0.00±0.00a
0.01 ml vaccine injection (T2)	5.00±7.07a
0.02 ml vaccine injection (T3)	10.0±0.00a

**Values are not significantly different at P<0.05.*

S. iniae was not isolated from the randomly selected sea bass, indicating that fish held at the start of the experiment were clear of *S. iniae* infection.

In the safety study of vaccine determined by a 21 day period after vaccination, pre-challenge. Table 1 and Figure 1 showed no significant difference in the percentage mortality rate in all groups when compared to the control groups (P>0.05). There is an indication that the higher injection volume of 0.02ml was in fact more stressful for fish and this should be taken into consideration when planning a vaccination strategy.

Table 2. Mortality rate of juvenile sea bass after challenged with *S. iniae* (efficacy study).

Group	% Mortality	RPS
Control (C)	0.00±0.00b	100
Immersion group (T1)	14.16±9.52 cd	84.83
0.01 ml vaccine injection (T2)	4.91±2.19 bd	95.61
Positive Control (PC)	93.33±8.75	0

In this efficacy test of vaccination, all vaccine treated groups had significantly lower mortality rates than the control group with normal saline injection (CN) and with the negative control (NC). The highest rate of protection against *S. iniae* was observed at 0.01 ml vaccinated fish (IS) which had significantly lower percentage mortality rates (4.91%) in other groups (P<0.05), excluding only the positive control group (C). The immersion group (T1) displayed 14.16% mortality rate, which was regarded as excellent for an immersion route vaccine. Table 2 and Figures 2- 4 summarise the results of safety, efficacy and RPS.

The dead fish from this challenge experiment were confirmed positive for *S.iniae* infection by re-culture and re-identification using API 20 Strep and PCR techniques.

Clinical signs observed in infected fish included symptoms such as stationary or quiescent behaviour at the bottom of the aquaria, loss of equilibrium, frequent sinking and rising, lethargy, slow acceptance or refusal of food. Dark skin colouration, exophthalmia and corneal opacity were noted in moribund fish. The majority of these fish died over the course of the next 72 hours after sampling.

Histopathological findings included vacuolar degeneration in the liver tissue. Numerous melano-macrophages infiltrated in the kidney, spleen and liver (Plate 1). The brain showed meningio-encephalitis with thick outer layers of tissue and leucocyte infiltration (Plate 2).

Conclusion

From the vaccine safety study, the vaccine, regardless of route of administration, showed high safety to juvenile experimental fish. There

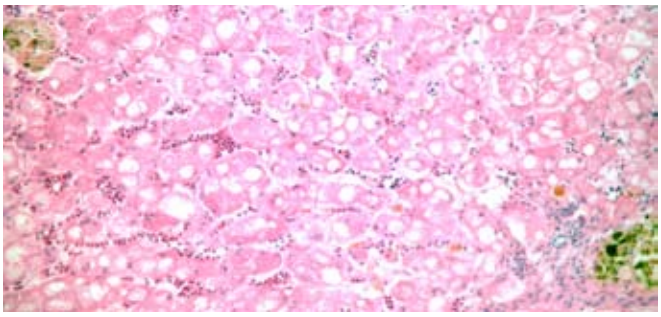


Plate 1. Remarkable hepatic cell swelling and vacuolation with severe panlobular fatty degeneration with mutifocal melano-macrophages of the liver (x100)

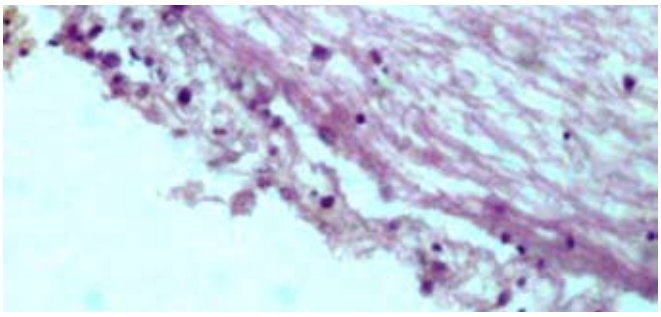


Plate 2. Meninges showed swollen outer layer tissue and leucocyte infiltration (x400).

Figure 2. The 21 day safety of control (not injected), control (saline injected, immersion vaccinated (test 1) and vaccine injected (tests 2 and 3) in juvenile sea bass.

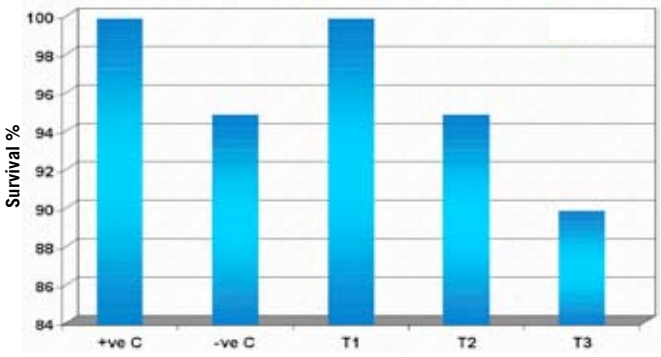


Figure 3. The efficacy of control (not injected), control (saline injected), immersion vaccinated (test 1) and vaccine injected (tests 2) in juvenile sea bass.

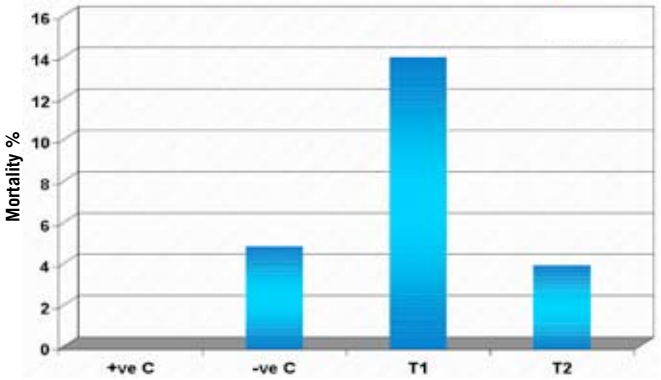
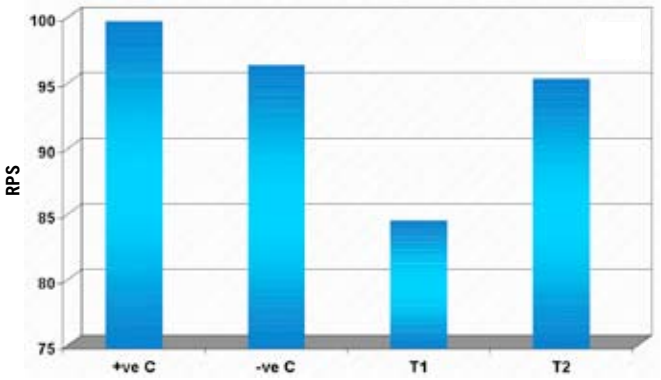


Figure 4. RPS of control (not injected), control (saline injected), immersion vaccinated (test 1) and vaccine injected (tests 2) in juvenile sea bass.



was no significant difference in mortality rate of experimental groups compared with the control groups.

The results from the efficacy study showed vaccinations have the potential to reduce fish mortality by *S. iniae*, and that intra-peritoneal administration via 0.01 ml injection is the optimal route. The injection of 0.01 ml (T2) conferred significantly lower mortality rate then other treatments. It should be noted that, immersion (T1) also induced higher survival rates, approaching 90%. Even if T1 groups had significantly higher mortality rates than T2, this is not viewed as negative, in that in European vaccination strategies an immersion vaccine primer is usually followed by an injectable booster dose. This may be applicable for vaccine used in commercial farms (Dunn et al., 1990) in Asian rearing conditions. Commercially, fish have been vaccinated by immersion at 1g size, then injection vaccinated at 5g or 20g depending on farm preference. Injection volume in such cases is 0.05ml and 0.1ml respectively.

This experiment proved that this vaccine was effective in reducing mortality rate of juvenile sea bass infected with *S. iniae* and was safe to use on the commercial production of juvenile sea bass

Reference

Dunn, J., Polk, A., Scarrett, J., Olivier, G., Lall S. and Goosen. F.A. 1990. Vaccine in aquaculture: the search for an efficient delivery system. Aquaculture 9: 23-32.

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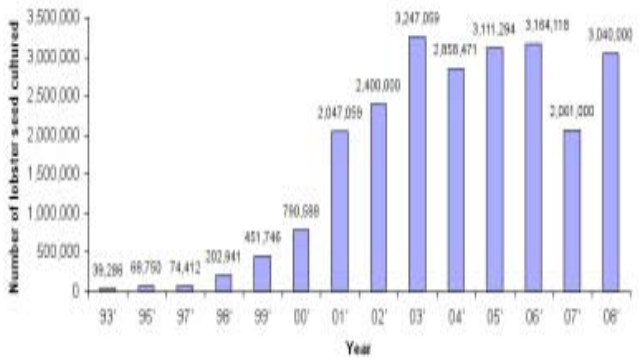
Spiny lobster farming in Vietnam and the role of probiotics during production

By Nguyen Thi Bich Thuy, Olivier Decamp, Sander Visch and Nguyen Quang Hanh

A thriving industry in Vietnam is threatened by diseases and bacterial infections. A national project shows the potential of using probiotics to alleviate bacterial infections. However, further investigations are required on the mode of application.

Among the seven spiny lobster species found in the waters off Vietnam, *Panulirus ornatus*, *P. homarus* and *P. polyphagus* have been selected for farming because of demand, high prices and abundance of wild seeds. Currently, lobster production has extended to five central provinces Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan and Binh Thuan. The waters off these provinces are characterised by year round water currents of 2-4 cm/s, water depth of 9-20 m, salinity of 30-34‰, water temperatures of 22-32°C and protection from rough weather conditions.

Figure 1. Annual number of lobster seeds cultured in lobster farms in central coastal provinces



The culture of lobster in the central provinces of Vietnam is valued annually at USD 100 million (MARD 2007). The breakdown of the cultured species varies with each coastal province (Table 1), but, generally *P. ornatus* is the most commonly cultured species, averaging at 74%, followed by *P. homarus* (20%) and *P. polyphagus* (6%). Vung Tau province, with its muddy seabed is more favourable to the species *P. polyphagus* which accounts for 80% of the lobster production in this area. The culture period varies with the cultured species. *P. ornatus* takes about 20-24 months to reach the commercial size of 800-1,000g/piece, whereas the other species require 12-15 months to reach 200-300g/piece.

Table 1. Percentage of lobster species cultured in the different provincial coastal zones.

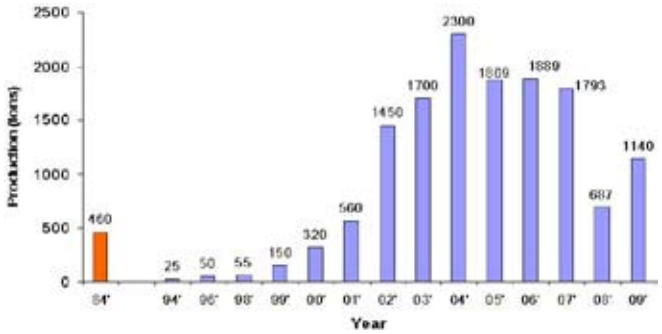
Coastal zone / Species	Percentage (%)					
	Binh Dinh	Phu Yen	Khanh Hoa	Ninh Thuan	Binh Thuan	Vung Tau
P. ornatus	70	75	85	70	70	10
P. homarus	30	20	10	25	15	10
P. polyphagus	0	5	5	5	15	80

Lobster farming today

The production relies on the collection of wild seeds, using seine-nets, traps and divers from as many as 30 sites from Thua Thien Hue in the north, to Vung Tau in the south. The seeds (post larvae) ranging from 7 to 15 mm carapace length, depending on the season and the equipment used, are sold to the lobster nursery and grow-out farms. The annual seed harvest for the three main species increased from over 39,000 in 1993 to over 3 million post larvae in 2006 with *P. ornatus* comprising 70% of the total.

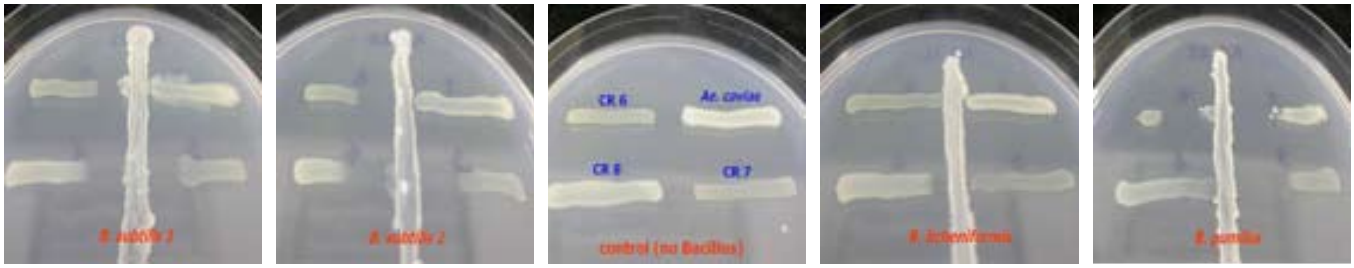
The milky disease that appeared in late 2006 affected seed populations in 2007, which declined to around 2 million but then recovered to about 3 million in 2008 (Figure 1). We estimate that seed numbers in 2009 would be approximately the same as 2008.

Figure 2. Annual production of cultured lobsters in the central coastal provinces.



Annual lobster production reached around 2,000 tonnes in 2006-2007, which is more than 4 times the peak yield in 1994. This was an 80 fold increase after 13 years. Only 25 tonnes were produced in 1994 when lobster culture started. In general, the milky disease brought production down to about 700 tonnes in 2008 and which gradually increased to over 1100 tonnes in 2009 (Figure 2).

Figure 3. Inhibition zone of each pathogenic bacteria by Inve probiotic *Bacillus* strains on PYE plates.



Culture systems

Culture systems in each coastal zone have been adapted to the specific topographical features of each area. Suspended cages have the cage framework made of iron with each of the 6 sides covered by a nylon net of 5-15mm. These are hung up into the chambers of a raft made by wooden stakes. The cage dimensions vary with lobster size and are either 0.8x0.8x1.0m, 1.5x1.5x1.5m, 2.2x2.2x1.5m or 2.7x2.7x1.7m. This rearing technique is selected for shallow areas with strong waves.

Floating cages consist of a wooden raft kept on the surface by a buoy frame and nylon net chambers. The bottom of the chambers is fixed by an iron frame. The chamber dimension is 3x3x6m or 4x4x7m or 4x4x8m. This model is selected for deeper areas with strong waves. Finally, suspended pens are used for shallow areas which are protected from wind and waves. The pen framework is made of salt-resistant wood with the 5 sides covered by nylon net. The dimensions are 5x5x6m or 6x6x6m or 5x6x6m. The bottom net is suspended 1 to 1.5m above the seabed.

Threats of diseases

Ten years after the first production of these lobsters in 1991, disease problems started to appear. The main diseases include red body, black gill, necrosis tail and white antennae or loose head. The fungus *Fusarium solani* was identified as the causative agent of black gill disease. At the end of 2006, a new disease, called 'milky haemolymph disease' appeared in numerous lobster production sites. In 2008, the disease led to a reduction in production to 700 tonnes produced and losses were estimated at USD 10 million. This was a disaster for lobster producers in these central provinces of Vietnam.

In mid 2007, The Ministry of Agriculture and Rural Development funded a project called 'the milky disease campaign' with the objective of treating this disease. Within a period of three months, local and foreign pathologists identified Rickettsia-like bacteria as the causal agent of the disease. Subsequently, a survey from some lobster farms in Phu Yen and Khanh Hoa provinces in 2008-2009 confirmed the prevalence of diseases such as milky haemolymph, red body and black gill.

Suspended 1.8x1.9x1.2m cages at Cam Ranh Bay for carrying out the experiment

The milky disease was reported from lobsters weighing 300-700g/piece. Interactions between these diseases have not been detected. However, the infection rate varied, with the highest rates reported for the milky haemolymph and the lowest being reported for loose head (Table 2).

Table 2. Percentage of cage-cultured lobsters affected by the major diseases at Khanh Hoa and Phu Yen provincial coast in 2008.

Cultured species Disease name	Infection percentage (%)	
	P. ornatus	*P. homarus*
Milky haemolymph	14.17 ± 9.1	13.26 ± 8.1
Red body	10.33 ± 10.0	7.75 ± 2.4
Black gill	8.04 ± 4.2	6.37 ± 5.7
Loose head	6.71 ± 4.3	4.50 ± 13.3

To overcome disease problems, some farmers turned to antibiotics. They would mix trash fish with antibiotics such as streptomycin, tetramycin or doxycycline at 12g per kg of feed for up to 3-4 times per month according to the prevalence of diseases in the surrounding area. Alternatively, farmers inject oxytetracycline at 10 mg/kg lobster into the abdominal muscle or haemocoel at the first signs of milky disease. However, antibiotics are expensive and their effect has been variable and limited. Furthermore, there is the impact of antibiotics on the culture environment which is yet to be evaluated.

Pathogen free brood stock

To deal with this situation, the Vietnamese government has approved a national project for full-cycle *P. ornatus* lobster culture, with the objective of producing pathogen-free *P. ornatus* broodstock. This was supported by Ghent University and Inve Aquaculture. The research group also included Wageningen University, NCAFE (National Center for Agriculture and Fisheries extension) and RIA3 (Research Institute for Aquaculture No.3). The team carried out experiments on cage culture of brood stock culture *P. ornatus* lobsters at Cam Ranh Bay, Vietnam.

Based on the challenges facing the lobster industry and the limitations of antibiotic treatments, it was also decided to evaluate the effects of probiotics, breaded to trash fish, on the lobster *P. ornatus*. The parameters were growth, spawning activity and bacterial populations, determined from blood specimens.

Effect of probiotics

An experiment with three treatments in duplicate was carried out for five months in net-cages (1.8x1.9 x1.2 m) in Cam Ranh Bay. The selected *P. ornatus* lobsters, with carapace length of 98.1± 3.8 mm and weight of 866.7 ± 95.6 g, were fed daily with trash fish (small fish and crabs) that was mixed with Sanolife probiotics (Inve Aquaculture) at either 4 g/kg or 8 g/kg feed prior to feeding. The control treatment lobsters were fed trash fish without probiotics. Measurements of weight and size and blood analyses were carried out before the start of the experiment and on a monthly basis.

Table 3. Microbial variance in lobster blood during the experimental time from May to September 2009.

Time	Control					4 g/kg food					8 g/kg food				
21 May	TSV	WSSV	RLB	TCBS	TSA	TSV	WSSV	RLB	TCBS	TSA	TSV	WSSV	RLB	TCBS	TSA
	_	_	_	_	+++	_	_	_	-	+++	_	_	_	-	++
22 June	TSV	WSSV	RLB	TCBS	TSFGA	TSV	WSSV	RLB	TCBS	TSFGA	TSV	WSSV	RLB	TCBS	TSFGA
	_	_	_	-	+++	_	_	_	-	++	_	_	_	-	++
20 July	TSV	WSSV	RLB	TCBS	MA	TSV	WSSV	RLB	TCBS	MA	TSV	WSSV	RLB	TCBS	MA
	_	_	_	_	+	_	_	_	_	+	_	_	_	_	+
23 August	TSV	WSSV	RLB	TCBS	MA	TSV	WSSV	RLB	TCBS	MA	TSV	WSSV	RLB	TCBS	MA
	_	_	_	_	++	_	_	_	_	++	_	_	_	_	+
22 September	TSV	WSSV	RLB	TCBS	MA	TSV	WSSV	RLB	TCBS	MA	TSV	WSSV	RLB	TCBS	MA
	_	_	_	_	++	_	_	_	_	_	_	_	_	_	++

Blood samples were analysed for total bacteria, *Vibrio*, Taura and White spot syndrome virus (TSV and WSSV), and Rickettsia-like bacteria (RLB) at the Biotechnology Institute, Hanoi. The specific and numerous colonies from the agar plates of TSA, TSFG or MA were sub-cultured and then sent out to Inve Technologies for inhibition tests with the Sanolife *Bacillus* strains.

The results of the trial are summarised below:

- Analyses of blood samples. There was no difference between control and treatment in the concentration of total bacteria. The analyses for *Vibrio* (TCBS plates), TSV and WSSV (PCR) and Rickettsia-like Bacteria were negative (Table 3).
- Inhibition test in the laboratory. Cross-streaking inhibition test using PYE (Peptone Yeast Extract agar) confirmed the ability of the Sanolife *Bacillus* strains to inhibit the bacteria strains that had been isolated from the blood samples (Figure 3).
- Performance of lobster. The delivery of Sanolife probiotic (8 g/kg food) led to significant difference in moulting cycle, carapace length and spawning rate. Compared to the negative control, the moulting cycle was 81 days (versus 120 days), the increase in carapace length was 3.6 cm (versus 2.3 cm) and the spawning rate was 25% (versus 0%). The survival rate of 25% in the treatment (4 g probiotic/kg food) is thought to be due to milky disease. However, the animals were negative for Rickettsia-like bacteria (Table 4).

Table 4. Growth (Carapace length, CL), survival and spawning rate of the experimental lobsters from May to September 2009.

Experiment	Parameters					
	CL (mm)		Moulting cycle (days)	CL average growth (mm)	Survival rate (%)	Spawning rate (%)
	Initial	Final				
Control	96.13 ± 2.86	98.43 ± 2.36	>120	2.3 ± 0.58	75	0
4g/kg food	99.15 ± 4.25	101.87 ± 4.20	>120	2.7 ± 0.44	25	0
8g/kg food	99.02 ± 3.14	102.62 ± 3.50	81 ± 0.05	3.6 ± 0.24	75	25

However, the mode of delivery of the probiotics requires further discussion. For example, do probiotics remain in the trash fish until they are ingested by the lobsters? Laboratory experiments showed that the *Bacillus* concentration was highest when the coated trash fish was kept for one hour prior to immersion in water (Table 5). Provided the initial coating was good, there was no difference in the *Bacillus* concentration after suspension of the coated trash fish in water for 5 or 30 minutes. The *Bacillus* were not leaching out of the trash fish.

The next step

The lobsters that were fed on trash fish mixed with 8 g of Sanolife probiotics per kg within an hour before feeding showed shorter moulting cycles, higher growth rates and improved spawning rates. The ability of Sanolife *Bacillus* strains to inhibit bacteria isolate from lobster blood has been confirmed in the laboratory but not confirmed in the field. An ongoing project is now aimed at improving the culture of lobster by a combination of probiotics and immunostimulants.

Table 5: Count of *Bacillus* when coated on trash fish.

Treatment	Time after coating before immersion	Immersion time in water (minutes)	No. of average Bacillus in trash fish (CPU/g)
Control		0	8.33×10^3
1 g Sanolife per kg trash fish	0	5	1.34×10^5
		30	8.83×10^4
	1 hour	5	1.87×10^5
		30	1.81×10^5
5 g Sanolife per kg trash fish	0	5	8.77×10^5
		30	4.90×10^5
	1 hour	5	2.47×10^6
		30	1.94×10^6

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Aquaculture Department of MARD (Ministry of Agriculture and Rural Development) 2009. Annual report on Aquaculture status in Central provinces. MARD Hanoi. 11 pp.

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Nguyen Quang Hanh

NIFTDC and the establishment of simple aquaculture protocols in the Philippines

Prior to the introduction of the *Penaeus vannamei* shrimp to the Philippines, the National Integrated Fisheries Technology Development Centre (NIFTDC), Bureau of Fisheries and Aquatic Resources (BFAR), Philippines played a central role in the verification work for SPF/SPR post larvae performance before the post larvae were allowed into the country. Later it provided guidelines on the set up of new hatcheries for the shrimp. This work has been completed and the vannamei shrimp is now cultured in the country.

In general the Centre's work is to develop simple protocols for the commercial production of finfish and other aquatic species. It also provides laboratory, technical and extension services to the fisheries industry. At the recent ASAIM conference in Manila, Dr Westly R. Rosario, Centre Chief, listed some milestones for the centre.

Westly Rosario explaining to participants their El Nino watch program at the centre.

One significant milestone is to enhance milkfish seed production. The country has an annual shortfall of 3,580 million fry. Hatchery production at the Centre now stands at 50 million fry and 250 million eggs. The Centre sells eggs at PHP 6,000/million and larvae at PHP 7,000/million. Fry are sold at PHP0.23 each. Another milestone is the development of a gene bank for the freshwater prawn, *Macrobrachium rosenbergii* to improve growth performance and production.

Through a partnership with CIRAD and the French Government, NIFTDC now has saline (15 ppt) tilapia hybrids called the molobricus by crossing *Oreochromis niloticus* with *O. mossambicus*. Growth experiments at the centre showed that growth of the molobricus is higher than GIFT (Genetically Improved Farm Tilapia) or GET (Genetically Enhanced Tilapia) in high saline environments of 35 ppt. The second phase is the growth selection process. Saline tilapia is an alternative to milkfish in brackishwater ponds. This saline strain can optimise production in 200,000 ha of brackishwater ponds. It is important as the integration of shrimp and tilapia in intensive shrimp ponds helps to prevent diseases. More importantly, the availability of saline tilapia encourages brackishwater culture practices and prevents the need for conversion of areas currently used for rice and other crops for freshwater aquaculture production.

Sea bass fry on display for study tour participants during the ASAIM conference in August.

Molobricus broodstock

The development of hatchery seed production of the silver perch, *Bidyanus bidyanus*, sea bass, *Lates calcarifer* and siganids, *Siganus guttatus* and *S. vermiculatus* has given rise to commercial culture activities. Silver perch is cultured in waters of 16ppt salinity. The centre sells siganid fry at PHP5 each and the farmers grow the fish to a size range of 3-5pcs/kg which is sold at PHP 200-250/kg after a 6-month culture. Other projects include the hatchery production of sea cucumber.

NIFTDC is located in Dagupan City. It is a 24-ha facility with a wide-range of commercial hatcheries for various species, four laboratories and training and extension facilities. The four major laboratories provide facilities for microbiology, limnology (soil and water quality), biology/phycology and fish health studies. The phycology laboratory maintains live feed stocks for the centre's seed production work. Strains of microalgae are also provided to the private sector. The Asian Fisheries Academy is situated inside the NIFTDC compound. Training is provided to BFAR's Regional Fisheries Training Centres, non-government organisations and farmer groups. The most recent project is the Korea-Philippines Seafood Processing Complex with a processing capacity of five tonnes of raw materials per day. It is a modern processing facility that was designed and constructed to meet international requirements for export. It is open for use by producers in the region who plan to export their aquaculture products.

Asian Seafood 2010

Filling a gap in the industry

The inaugural Asian Seafood Exposition was held in the Hong Kong Convention & Exhibition Centre and featured six country and regional pavilions, one each from Malaysia, Taiwan, Japan, Australia and two from the US. Some 101 companies from 21 countries were exhibitors and visitors came from 82 countries. The organisers said that the Asian Seafood Exposition is already filling a gap in the industry, offering fresh, packaged and processed seafood, ready made products and industry related services to buyers from Asian retail and foodservice markets (seafoodsource.com). Hong Kong is home to more than 7 million people and imported about USD 2.1 billion worth of seafood in 2008.

Food safety first for Hong Kong consumers

Buyers of seafood at the retail and food service levels in Hong Kong and southern China consider food safety a priority in a survey presented during the Asian Seafood Exposition in Hong Kong. Other factors are freshness, hygiene and price. The online survey covered 867 seafood consumers in Hong Kong and Guangdong Province in southern China. The justification for an online survey is that 32% of households in southern China have internet connections and therefore the online survey can reach a large number of consumers.

The survey was conducted by the Perishables Group, together with Diversified Business Communications, organiser of the Asian Seafood Exposition. Cara Ammon, Manager of Research Services in her presentation on 'Analysis of the Asian Consumer Market' said that on a scale of 1 to 5, consumers indicated 4.5 for food safety and 4.2 for freshness.

In restaurants, food safety/hygiene is a major factor for 61% of the respondents. This is apt as live seafood is preferred by 58% whilst 31% preferred fresh and the rest frozen, dried and canned seafood. The top three types are shrimp, prawns and scallops.

Some 45% of consumers surveyed in southern China prefer to buy seafood in supermarkets. In Hong Kong, 50% buy from fish markets. In general, most consumers know what type of seafood to buy and the strong emphasis is on freshness followed by price. Purchasing behaviour is also influenced by special prices for some products, recommendations by family and friends and in Hong Kong by cooking shows. A majority indicated that seafood is consumed on the same day of purchase. When eating at home, the choice of seafood purchases is led by family preferences (66%), taste/flavour (50%) and price (40%).

Consumption is higher in Hong Kong with 90% of respondents eating seafood at least once a week. In comparison, in the US it is only 33% of consumers. Seafood consumption rises with age and purchasing power.

In the case of sustainability, one third of the group surveyed said that they are completely knowledgeable on sustainability and 77% defined this as 'farmed and does not harm the environment'. (www.perishablesgroup.com)

Yun Yu Yang and Lyndon C. Yeh at the Taiwan Pavilion

At the Malaysia Pavilion, Padmini Nagalingam, Blue Archipelago (right), shows the shrimp calculator to Grace Mercado, Intaq Feeds, Philippines

Cobia and tilapia from Taiwan

Various forms of products from tilapia and cobia from Just Champion Enterprises were displayed at the Taiwan Pavilion. It also markets sea bass and red drum fillet. According to Lyndon Yeh, the production of cobia is declining in Taiwan because of the high cost of production and low ex farm prices. At an ex farm price of cobia at USD7/kg, farming of the fish may be profitable as the fish is known to show very high feed conversion ratios at large sizes. Just Champion was established in 1987 and is a producer and exporter of frozen prepared eel and farmed fish fillet products. Value added products, such as prepared eel (unagi kabayaki), roasted eel (unagishirayaki), prepared tilapia belly meat, unagi slice for topping, Japanese sea bass slice for topping and tilapia slice for topping are directed at the Japanese market (www.just-champion.com.tw)

Malaysian seafood

There are 6 companies exhibiting at this pavilion wishing to expand markets to China, Hong Kong and the region. One of the larger integrated shrimp farming operations in Malaysia is Blue Archipelago which set up operations in 2008 producing *Penaeus vannamei* shrimp in fully lined ponds. This is the first time that the company

Ch'ng Chin Hooi, Ocean Pac, Malaysia

A group of buyers and processors from the Philippines

is participating in a seafood exhibition. The aim is to seek potential buyers. The marketing team has developed a shrimp calculator which enables buyers to convert processed size per kg of shrimp downstream to the size at harvest. The shrimp calculator was distributed at the show. (www.bluearchipelago.com).

At the booth of Penang based Ocean Pac (www.oceanpacseafood.com), Ch'ng Chin Hooi, Managing Director, said that the seafood processing and export industry in Malaysia faced an upheaval in 2008, following a self imposed ban on exports to the EU markets. Sales to the EU dropped by 87%. However, many companies have diversified to markets in China, Japan, Korea, Middle East, South Africa and Taiwan. The EU markets still remains a preferred market. Currently, only 15 aquaculture farms have been approved to export to the EU and existing seafood processing have been asked to upgrade their facilities to meet EU standards.

"The last two years have been extremely difficult for the processing industry in Malaysia. There is a lack of local raw material for processing as most of the fishing vessels and farms are not approved for export to the EU. I am currently exporting frozen shrimp, all of which are from aquaculture. Malaysian producers usually market head-on as we are less competitive to embark on value added products," said Ch'ng.

Red claw crayfish

The intensive culture technology for the red claw crayfish or Australian freshwater crayfish *Cherax quadricarinatus* was developed by Aquology in 2002 and has been adopted in a farm in Myanmar. In this closed water system, there are 120 ponds of 100m^2. The potential for farming is great as the live crayfish, can be sold at USD42/kg in China and Euro 35/kg in Europe, said Ran Margolin, CEO. The Japan market requires larger and uniform sized animals and the price is USD54/kg. Animals are marketed live, packed in sawdust.

The company also offers high quality red claw crayfish juveniles produced at its R&D and production facilities which has a capacity of 100 million juveniles/month. The R&D and production lines are based in Kfar Monash, Israel. This is an intensive recirculation indoor system comprising a hatchery and grow-out facilities. The technology for the hatchery is proprietary as the company has selectively bred broodstock for high growth performance.

Aquology is offering the technology for grow-out modules with consulting on site location and other relevant components as well as management and supervision of the production facility. The cost of construction of each module is estimated at USD 1.3 to 2.0 million. Two cycles are possible to produce 100 tonnes/year, at production costs ranging from USD 2-3/kg, depending on the feed used. Stocking density is 20 pcs/m^2. The marketable size is 80g per animal. Optimal farming conditions are at 26 to 31°C water temperature and dissolved oxygen, 4-5.5mg/l although the crayfish can also survive at 2.2mg/l of dissolved oxygen.

"The red claw is a premium seafood in many countries and has a large potential as a new species in Europe, US and Japan. The taste and texture is equivalent to the rock lobster. It has a much higher percentage of flesh in relation to body weight, with more than 40%. Growth is also much faster for this species as compared to the lobster," said Margolin. (www.aquology.com).

Ran Margolin with red claw crayfish.

Cara Ammon, Perishables Group (right) with Hilary Manning and Mary Larkin (left), Diversified Business Communications.

A myriad of new innovations

With 23 new innovations and 11 new patents, Wenger Manufacturing, USA is once again living up to its marketing slogan, 'Inventing the new original since 1935'.

This time, the new originals include an innovative High-Intensity Preconditioner for improved pasteurisation and sanitation; a new series of Thermal Twin Screw Extruders that permit up to four times greater steam injection; a revolutionary Enhanced Sanitary Dryer that substantially reduces the risk of contamination and a long list of innovations and systems designed to improve hygiene and food safety.

"There are a number of trends, which are currently impacting the food industry, that affected the design process behind each of these new innovations," says Galen Rokey, Process Technology Manager for Wenger. "Among them are higher energy costs, concerns about water availability and the current economic recession, which is impacting consumer buying habits. Consequently, manufacturers desire the ability to react quickly to new market directions.

"At the same time, the FDA has told the industry that it is the manufacturers' responsibility to produce salmonella-free food, and that even pet food is considered 'adulterated' if it contains salmonella," Rokey added. "So food safety was at the forefront of product design in every case."

As an example, Wenger's design criteria for the new Sanitary Dryer stated that no internal horizontal surface could be larger than five by five millimeters unless absolutely necessary. The design also called for a minimum 30-degree slope on all internal ledges, as well as the elimination of cracks and crevices in which fines and material could collect.

Likewise, the new High-Intensity Preconditioner (HIP) not only offers adjustable mixing intensities, but it enhances food safety in the process. Part of the design is a new hygienic beater that eliminates all threaded shafts, and a slide gate that reduces discharge of under-processed material and manages water flow during the sanitation cycle.

"A new series of single screw extruders are even based, in part, on hygienic features, including a stainless-steel frame that has no seams and minimal surfaces for product accumulation. Additionally, the SX Series, comprising models from 6 to 17.5 tonnes per hour, features arcuate screw elements for more positive conveying when compared to traditional single screw extruder designs."

On the other hand, the new Thermal Twin Screw Extruders are ideal for manufacturers that want to shift their process to more favorable energy sources. Unique in the industry, the Thermal Twin not only provides exceptional performance with a broad range of raw materials, but offers a thermal to mechanical energy ratio of 14 to 1, a level previously unheard of in the industry. Capacities range up to 12 tonnes per hour.

"Wenger's new innovations also address recontamination risks," he adds. "Knowing that fugitive dust is one of the greatest sources of recontamination, we have introduced a full line of hygiene products, including a hygienic pneumatic conveying system, a preconditioner slide gate and dust-tight downspout, a new hygienic pneumatic hood and more remote control and sensor systems that provide traceability and help decouple personnel from direct product contact.

"The ultimate goal in every case is to help our customers meet requirements and regulations while reducing production costs and increasing flexibility," Rokey concludes. "We look at it as 23 more examples of Wenger's desire to solve customer challenges."

Wenger Manufacturing, Inc., headquartered in Sabetha, Kansas, USA, is a global designer and manufacturer of extrusion processing systems. Wenger offers a full product line including single and twin screw extruders, snack extruders, forming extruders, conical co-rotating twin screw extruders, universal pellet/cookers, dryers and flavor coating and enrobing systems for aquatic feeds, pet foods, textured vegetable proteins and snack and cereal foods.

More information: Web: www.wenger.com; Doug Baldwin, Tel: +001 785 284 2133 Email: info@wenger.com

Alltech®
Nutrition, health, performance ...naturally

A sponsor at GOAL 2010 in Malaysia

Alltech announced that it was a silver sponsor at the Global Outlook for Aquaculture Leadership (GOAL) held in Kuala Lumpur, Malaysia from 17 to 20 October. This aquaculture business event organised by the Global Aquaculture Alliance was extremely successful with over 300 business leaders attending from around the globe. The theme 'Feeding the Rising New Middle Class' addressed how the aquaculture industry can evolve sustainably and profitably while meeting world seafood demand.

This sponsorship is considered part of Alltech's industry involvement program and reflects the commitment towards supporting sustainability projects in aquaculture development. With this, Alltech can further the relationships with aquaculture leaders.

Dr. Jorge Arias, Global Aqua Director, Alltech, said, "Alltech's plan is to produce sustainable products to create and maintain a sustainable aqua industry. We developed a line of products that include natural additives and ingredients for aquaculture species, our Aquate® line of products. Our goal is to focus on healthy alternatives to non-sustainable ingredients, such as fish meal and fish oils. The recent acquisition of the algae production plant, the second largest in the world, in Winchester, Kentucky will help us accomplish those goals."

The fishmeal shortage is here to stay and the industry needs to develop a long term strategy to deal with this. "With the increasing pressures on fish meal usage, Allzyme® SSF allows producers in the region greater flexibility when it comes to the use of plant proteins in the diet. In some instances fish meal usage has been reduced by up to two thirds of its normal levels," said Max Purser, General Manager of Southeast Asia, who is based in Malaysia and attended the meeting.

From left; Dr Jorge Arias, George Chamberlain and Max Purser.

The disease challenge poses another big threat to aquaculture producers and is causing massive loss affecting bottom-line performance every year. Purser added, "Improving immunity is a critical factor in our region and in particular improving the ability to deal with the challenges within the environment. We have seen significant increases in mucus production in fish with the use of Bio-Mos® in the diet. By improving this mucus layer we see major improvements in health status and as such growth performance. In fact what we are doing here is significantly reducing the risks in the growing cycle."

More information: web: www.alltech.com

ASC appoints ASI as their accreditation body

In September, the Aquaculture Stewardship Council (ASC) announced the appointment of Accreditation Services International (ASI) as their independent accreditation body.

This demonstrates the ASC's progress towards its core task, the management of the ASC standards, developed by the Aquaculture Dialogues and the implementation of a world class certification process for aquaculture. Philip Smith, CEO, ASC said, "The appointment of ASI as our independent accreditation body marks an important milestone in our development. We are pleased that we can start working on the implementation of the Global Standards for Responsible Aquaculture in close cooperation with ASI. We are now in a position to set up an independent third-party verification scheme and work with producers and certification bodies to develop robust processes for certification against the standards."

Three sets of Global Standards for Responsible Aquaculture have been completed by the Aquaculture Dialogues so far: tilapia, pangasius and bivalves (clams, mussels, oysters and scallops). Standards for six other aquaculture species (abalone, freshwater trout, salmon, shrimp, *Seriola* and cobia) are expected to be finalised towards the end of 2010 or early 2011.

After evaluation of the available options, the ASC Supervisory Board decided ASI was the right accreditation body for the ASC. ASI is an independent accreditation body which delivers accreditation and other services to the Forest Stewardship Council (FSC), the Marine Stewardship Council (MSC) and other certification schemes worldwide.

Sam Ponder, ASI Managing Director said, "By including independent third-party accreditation as an oversight process the ASC is demonstrating the maximum credibility and effectiveness of its verification system. One of the important outcomes of the implementation of standards by applicants for certification is that they assist in creating a benchmarking culture with the ultimate benefit of continuous improvement."

ASI is an Associate Member of ISEAL and operates according to the international ISO/IEC 17011 general requirements for accreditation bodies accrediting certification bodies (also called conformity assessment bodies).

ASI's aim will be to ensure that the ASC standards are implemented in line with their design. ASI is a proven leader in quality assurance; it sets and oversights procedures, evaluates and accredits certification bodies to assure that they are qualified to hold their clients in line with standards developed by the scheme owners.

More information: www.ascworldwide.org

Related article: Aqua Culture Asia Pacific, July/August, Volume 6 (4): p45

In site event!

The new filling station for liquid silage additives and the upgraded FORMI NDF production unit was shown for the first time to Addcon's partners at the recently held in site! event. The company invited suppliers and customers to see this new Addcon in site! at the factory in Porsgrunn, Norway in September.

In his welcome speech, Bernd Kochannek, CEO and founder, shared his views on green chemistry and Addcon's LEG Principle (Low dosage & Effective Green Products).

"The LEG Principle is always in the focus when we innovate for new products and applications. We are going for the most effective products."

Kochannek also announced that Addcon and some of its industry partners will host the 'International Acidifier Summit' in Bangkok in March 2011. During this summit, the company, its partners as well as academia will elaborate on the most effective use of acids for feed preservation and in animal diets. Details on the program will be announced soon.

Geir Sundmark, one of the driving forces in the upgrading of the facilities in Norway presented facts and figures on the site in Norway. Dr Horst Auerbach, Chief Research Officer of the Addcon group presented the main products which are produced and filled in the new production lines namely Formi NDF and GrasAAT. Guests had the opportunity to tour through the production site where attention was not only on the new and upgraded production lines, but also the storage tanks.

More information: www.addcon.net

Diformates (Formi, Formi NDF, Aquaform) plant

Liquid filling station for canisters

GLOBALG.A.P SUMMIT2010

Record gathering in London for the tenth conference

Close to 500 delegates from more than 50 countries gathered for this event which provided a unique networking opportunity for all those involved in primary production and retailing. There were 55 expert speakers covering key aspects of Good Agricultural Practice Implementation and their certification.

This summit in 2010 also marked milestones in GlobalGap's history as it is the organisation's 10th global conference as well as the launch of the Fourth Version of its Integrated Farm Assurance Standard.

The revised standard has built upon practical experience of over 10 years and in more than 100 countries worldwide where GlobalGap is implemented on more than 100,000 farms. The consultation process for the revision has been the most extensive ever managed: round table discussions at the GlobalGap conference held in Cologne, Germany in 2008 and at the 5 stakeholder dialogues in Nairobi, Kuala Lumpur, Montevideo, Washington DC and Athens in 2009. Further stakeholder participation was also encouraged through 3 public consultation periods with more than 700 comments being evaluated.

Comments were received from a wide range of stakeholders from the private/public sectors as well as civil society. These comments reflected the different cultural and agronomic situations where the GlobalGap standards are implemented, but in general they have led to even clearer requirements as well as deletion of duplication. This version has been subjected to worldwide testing with local adaptation through the network of National Technical Working Groups, many of whom were represented at the Summit and who are working to the principal of 'Think Global, Act Local'.

Nigel Garbutt, Chairman of GlobalGap said, "By incorporating this feedback, the Fourth Version is more user friendly, better adapted to global agriculture as well as reflecting emerging issues such as the growing challenges of responsible water usage and ensuring the microbiological safety of fruits and vegetables. Producers who consistently show high performance against the standard will be rewarded by a reduced audit in future years as well."

As for aquaculture, the base document underwent a complete restructuring to cover as many of the common control points for finfish, crustaceans and molluscs as possible. Crustaceans are completely covered by the aquaculture base module, whereas additional modules for finfish and molluscs were introduced. Also now all species can be certified and the limitation to salmon, pangasius, tilapia and shrimp has been removed.

GlobalGap standards are available in 22 languages and are free to download at www.globalgap.org.

More information: Nigel Garbutt, email: garbutt@globalgap.org

Biomin Launches new corporate website

The new website offers new features such as dynamic recommendations and a new multimedia knowledge center on a completely redesigned and user-friendly platform.

With a fresh design and numerous new features, visitors can expect major improvements in terms of usability and functionality. In addition to product information and well-known sections such as news and event calendar, visitors will find useful information on animal health and nutrition as well as solutions to the challenges associated with this topic.

One of the highlights of the new webpage is the "Knowledge Center", a new, fully integrated multimedia platform featuring technical articles, trial reports, magazines, pictures, videos and other assets, replacing the Biomin Download Area.

Registered users will benefit from the new platform due to an improved profile management with detailed preference settings allowing a more accurate and selective information transfer. Supporting the company's international market presence, Biomin's corporate webpage is available in six different languages: English, German, Spanish, Mandarin, Russian and Portuguese.

Visit www.biomin.net and read about Mycotoxin Risk Management and get to know the equally strong portfolios in the field of acidifiers, probiotics, phytogenics and feed preservation.

World Nutrition Forum 2010

A resounding success for animal health and nutrition

Top international animal-health specialists and feed-industry experts met at the World Nutrition Forum 2010 to exchange knowledge on key trends in animal production, discuss Biomin's NutriEconomics® program and debate the major scientific, environment and leadership issues confronting the sector.

This 4th World Nutrition Forum took place in Salzburg, Austria from October 13-16, 2010 and brought together more than 700 delegates from over 70 countries for wide-ranging discussions and expert talks on the most important trends in animal husbandry, nutrition and feed.

As one of the industry's most prominent scientific and opinion-leading events, the WNF is a platform for stimulating debate on the challenges encountered in global animal production, shedding light on new scientific developments, as well as encouraging discussions on global animal-husbandry and feed-sector strategy.

"This is a platform for exchanging knowledge and building long-term, sustainable relationships," said Erich Erber, the Chairman of Biomin in his opening speech at the forum. "We are inviting industry representatives, scientists and others to work together in shaping the future of our industry here."

The main highlights of the discussions included keynote speeches by Erber and Red Bull Air Race World Champion Hannes Arch, who detailed how they deal with risk and uncertainty (Expect the Unexpected); followed by a session on corporate responsibility and global food-supply security (the Dilemma of Responsibility), featuring World Bank Economist Jim Smith. The first day ended with a panel discussion on the unseen threat of mycotoxins and expert talks on key industry trends.

The second day focused on the scientific developments shaping the future of animal nutrition and production (Breaking New Ground) and Biomin's NutriEconomics® Program, which is designed to raise efficiency by concentrating on effective nutritional strategies, good business practice and sustainable resource use.

The 2010 Forum not only talked innovation, but showcased it directly with the presentation of the B.R.A.I.N. (Biomin Research and Innovation Network) Award to Todd Applegate, Professor and extension poultry specialist at the Department of Animal Science at Purdue University, USA. There was also a session presenting more than 120 posters featuring the work of scientists researching in the animal nutrition field. More information: www.worldnutritionforum.info

9th Asian Fisheries and Aquaculture Forum (9AFAF)
21st – 25th April 2011, Shanghai, China

Organized by the

Asian Fisheries Society & Shanghai Ocean University

with support from the 4th International Symposium on Stock Enhancement & Sea Ranching (4ISSESR), the 9th International Symposium on Tilapia Aquaculture (9ISTA), AquaFish CRSP and the 3rd Global Symposium on Gender in Aquaculture & Fisheries (GAF3) supported by FAO, UN

The forum will be held in the new campus of Shanghai Ocean University, Shanghai, China

IMPORTANT DATES

Abstracts due date:	*November. 20, 2010*
Acceptance notification:	*December. 20, 2010*
Full paper due date:	*February 1, 2011*
Forum, Trade Exhibition + post-forum tours:	*February 1, 2011*
Early bird registration date:	*December 31, 2010*

Come and join us at 9AFAF

For further information, go to our website: www.9afaf.org or contact Tina Zhou: ttzhou@shou.edu.cn or 9afaf@shou.edu.cn

Fast tracking aquaculture

As aquaculture is projected to be a major source of protein for the future, Novus Aqua wants to participate in this growth with total management solutions.

There may be opposing views on the role of aquaculture in feeding the world between aquaculture industry insiders and outsiders. However, Thad Simons, CEO Novus International says that the projections for aquaculture production show that it will exceed that of poultry. It is the fastest growing animal food production industry in the world and has great potential to become the world's leading source of animal protein. Thus, definitely aquaculture will have a growing role in sustainable food production for the global population as the industry continues to overcome real and perceived financial, social and environmental issues.

"Today the challenge is to increase the production efficiency of aquaculture while meeting environmental challenges, species diversity, culture systems and the complexity of the animals. Optimising aquaculture is a rich and exciting area for Novus to be involved. Our vision as a company is 'To help feed the world affordable, wholesome food' and the goal of improving quality of life, through aquaculture is possible."

For the past 20 years, US based Novus International has been synonymous with land animals as a leading provider of feed additives and management solutions. Novus entered aquaculture several years ago and since then industry analysts have been following their operations; as a partner not only to feed suppliers but also to farmers.

"Based on the nutritional understanding and strengths we have developed in livestock and poultry production, it seemed that aquaculture shares many of the same challenges that we have addressed in other areas. For example, a major challenge today is the increasing cost of fishmeal. Our solutions help the farmer to produce fish in a more environmentally and financially sustainable manner.

In 1979, the company introduced Alimet, to balance plant proteins with amino acids, so that poultry rations could do without fishmeal. The Novus R&D strength in animal nutrition will be applied in aquaculture nutrition. However, in aquaculture, the difference will be the many species and respective life stages and ecosystems.

"Our recent research has focused on technologies in mineral nutrition. In poultry, our scientists have clearly demonstrated the ability to reduce mineral inclusion rates by replacing salts with minerals chelated to essential amino acid analogs. The exciting findings reported at the Europe Aquaculture 2010 conference suggest that with increasing fishmeal replacement more anti-nutritional factors are being added into diets. Antagonists such as phytic acid tie up the minerals in the diet. For shrimp, we have demonstrated that at current levels of copper in commercial feeds, most may be significantly copper limited with important consequences to shrimp health. Using chelated minerals in aquatic species increases growth and animal health. This is what we have learned from poultry nutrition and brought over to aquaculture,"

Thad Simons, CEO (centre) with Dr. Craig Browdy, Senior Manager, Aquaculture Research (right) and Francisco Saraiva Gomes, Global Aquaculture Manager.

says Dr Craig Browdy, Senior Manager, Aquaculture Research.

Set with five strategies

The Novus solutions fit into five strategies: feed cost reduction, health through nutrition, optimised feeds and quality raw materials, functional feeds and sustainable practices. This means that basically Novus is covering the entire supply chain and the objective is not to rule out any products.

According to Francisco Saraiva Gomes, Global Aqua Manager, "We are looking at where Novus is today in aquaculture and where we want to be in five years time. Projections suggest that we can grow very rapidly. In fact, during this last year we have more than tripled our revenue and become a truly global player in the aquaculture industry. We have spawned from a regional business in Asia, and now Asia Pacific accounts for 45 % of our total revenue."

In Vietnam, Novus Aqua Research Centre (NARC) set up in collaboration with Nong Lam University in Ho Chi Minh City is spearheading *in situ* research on nutrition and health management strategies for fish and shrimp farming and developing products based on science.

"Arising from the work here is new information on pangasius catfish. The studies are providing basic and applied information which can allow formulators to develop feeds based on amino acids requirements. We are taking these findings to the field by working with feed millers," says Browdy.

The new blending facility in Singapore also produces supplements for aquaculture. New products include reformulation of mineral

20 years on in Kochi, India

In 2011, Novus celebrates its 20th anniversary. As the Gold Sponsor at the Asian Pacific Aquaculture 2011, to be held in Kochi, India in January, the aqua team from Asia and North America have lined up a series of events. Ramakanta Nayak, Marketing Manager and Dr. Jesus Venero, Technical Manager for Novus Asia Pacific Aquaculture team will be coordinating and chairing sessions on marine shrimp culture.

"We are investing in efforts to work with the industry in India as it matures, contributing to improving sustainability and consistency of production. The dynamic pace of development in India is yielding some specific technologies which we can also use for the benefit of other markets. We are certain that India will be a focus of future product development and application," says Simons.

"At the species level, we will examine how Novus can contribute to the ongoing evolution for Indian carp farming from extensive to intensive culture methods. Focus will also be on the growing shrimp culture sector and increasing yield in pangasius catfish. Finally, we are working closely with research institutions in India on marine fish culture and other important emerging sectors. For the last three years, we have research collaboration with Pukyong National University (PKNU) in Korea and through this, we are linking with Kerala University."

premixes based on chelated minerals incorporating information on requirements for Zn and Cu in shrimp, new gut health blends and functional feed premixes to improve health or meat quality with pigments and minerals.

Acquisitions, collaborations and new business

The aquaculture product portfolio is expanding. IQF Carotech, Spain and IQF Enamex S.A. in Mexico, acquired in May 2010, bring with them carotenoid pigments and new gut health environment modifiers, respectively. From the Animal Nutrition Division of Albion Laboratories, acquired, in early 2010, Novus expanded its existing chelated trace minerals to those with glycine adding chromium, iron and others to the portfolio.

Although Gomes expects the full supply chain coverage to be completed by the end of next year, he anticipates more technologies will be added through acquisitions and in-house R&D. The objective is to be present in all segments of aquaculture, focussing on the premixers and feed milling businesses. With the right combination of products, Novus is shifting to be a market driven rather than a product driven company.

"We have recognised that the hatchery life stage is a specialty segment in itself and Novus will form a new hatchery business. This will cover probiotics and larval diets to live feeds. We also intend to be a major player in the hatchery business."

Just returning from Uganda, Simons sees that emerging markets will require attention with feed issues because of the lack of standards and analytical capacity. "Working with local institutions like Egerton University in Kenya and across species, Novus is developing collaborations which apply science-based solutions for some of the common challenges in the feed industry."

The aqua team from Thailand, Vietnam and India with guests at the dinner as part of the activities of the European Aquaculture 2010, held in Porto, Portugal where Novus sponsored the nutrition session.

Modelling for the long term

Today in the market, the company has several short term solutions, in each of the five strategic areas of concern. In the medium term, blending these to function synergistically will make a bigger difference in animal productivity.

"In the long term, investments in R&D will focus on areas where we perceive needs will arise. We are working on building experimental models which facilitate further research efforts. For example, in pangasius catfish where basic knowledge of the physiology of the species is limited, we are investing in longer term research to explore genetic and metabolic markers for nutritional and immune responses.

Indian aquaculture awaits you in Kochi...

By C. Mohanakumaran Nair and K.R. Salin

The Indian fisheries sector has grown tremendously since the 1950s to the present annual production levels of over 7 million tonnes of fish and shellfish from capture fisheries and aquaculture. India currently produces nearly 7% of the global aquaculture production. The potential for growth in aquaculture is immense and the country is on the threshold of a massive production breakthrough.

India is presently the second largest food producer in the world. Seafood forms an important part of the country's food production sector. The Indian sub-continent has a promising future in aquaculture; it has a coastline of 8,041 km, 3 million ha of reservoirs and 1.2 million ha of brackish water.

Opportunities in aquaculture

Unlike marine fish production which has been growing slowly and even decreasing in some areas, inland aquaculture production in India is surging ahead. Species of major interests include the carps, catfishes including *Pangasius* sp, freshwater prawns, tilapia, coldwater fish, ornamental fish and freshwater pearl.

The marine shrimp sector is well developed with the presence of industry leaders. India is the world's largest producer of the black tiger shrimp, *Penaeus monodon*. The white shrimp, *P. vannamei* is a recent addition. The potential for open water cage and pen culture in the inland and coastal areas is also immense. A huge untapped potential lies in developing mariculture including the farming of mussels, oysters, marine pearls and seaweeds.

Several major feed plants have been established recently with overseas assistance as the demand for feed; particularly extruded feed for freshwater fish is on the rise. Additionally there is a large potential market for aquaculture husbandry and hatchery technical knowledge, particularly for tilapia, *Pangasius* catfish and *P. vannamei*.

Seafood exports

The seafood business in India is booming. In 2009-10, Indian seafood exports reached USD 2.1 billion with 663,603 tonnes of seafood. This industry is poised to achieve USD 5 billion by 2012 with 75% contribution from value-added products. Consequently, processing and packing technology is widely sought by Indian processors.

There are about 800 seafood exporters operating in India, but the majority of the seafood business is presently controlled by 100 companies. Japan is the largest importer of India's seafood making up 22.6% of India's exports but quantities to the EU, USA and Australia are on the rise. Frozen shrimp, squid, cuttlefish and lobsters, live crabs, shrimps, finfish and lobsters, and ornamental fish are the main exports. Seafood exports comprise 3.32% of India's export, and rank as the fourth largest contributor of net foreign exchange in the country.

Freshwater prawns from paddy field culture

Aerators in shrimp farm

Road map for aquaculture

At the national level, the Government of India is planning to develop a road map to enhance fish production from the present level to 10 million tonnes by 2012. The government is also exploring avenues to meet domestic demand and to increase export earnings through value-added products and the ornamental fish trade.

C. Mohanakumaran Nair and **K.R. Salin** are with the College of Fisheries, Kerala Agricultural University, Kochi, Kerala, India.

Asian-Pacific Aquaculture 2011 (APA 2011), the Annual Conference and Trade Exhibition of the Asia Pacific Chapter of World Aquaculture Society (WAS-APC) will be held in Kochi from 17 – 20 January 2011.

Technical sessions

Together with the general APA 2011 technical sessions on aquaculture techniques and practices, processing, marketing, economics and trade etc, there will also be an exclusive conference on freshwater prawns, **Giant Prawn 2011 (GP 2011)**, organised by Michael New. Special sessions include: Economics for Sustainable Development, organised by the International Association of Aquaculture Economics and Management (IAAEM); Seafood Inspection, Certification & Human Health organised by the International Association of Fish Inspectors (IAFI); Climate Change & Aquaculture; Reservoir-Based Aquaculture; Recirculation Aquaculture Systems; Bioflocs; Aquaculture Policy & Regulations; Fisheries Education and Training; and Rural Aquaculture, Welfare & Poverty Alleviation.

Plenary session

Plenary speakers on 18 January 2011 include:

- **Dr. S Ayyappan**, Secretary DARE & Director General, ICAR, Govt. of India on the recent progress in India's fisheries and aquaculture sector
- **Dr. Jia Jiansan**, Chief of Aquaculture Service (FIRA) of FAO, Rome on the significance of aquaculture in feeding the world
- **Dr. P Krishnaiah IAS**, Chief Executive Officer of National Fisheries Development Board on the overall aquaculture scenario in India
- **Ms. Leena Nair IAS**, Chairman, MPEDA on the opportunities for marketing, processing and export of seafood from India
- **Dr. Francisco Gomes**, Global Aquaculture Manager, Novus International, USA, on challenges to global aquaculture from an industry perspective.

Farmers' Day

This is an industry-scientist interactive session to be held on 19 January 2011.This full-day event will be an opportunity for aqua-farmers in India to interact with international experts to resolve their concerns on production, husbandry, marketing etc. Farmers' Day is being organised with active cooperation and funding from the National Fisheries Development Board (NFDB) and various State Fisheries Departments in India. This session will open up the possibilities of new and emerging aquaculture species and production technologies to Indian farmers. Simultaneous translation in Indian languages will be provided for the benefit of aqua-farmers from the various states of India.

Shrimp and prawn farming in India: Prospects and emerging challenges

- Vannamei shrimp: Best management practices for hatchery & grow-out in India, by Dr. Chalor Limsuwan, Thailand
- Freshwater prawn hatchery and farming technology: Issues in India by CP Aquaculture, India
- Black tiger shrimp farming by Dr. Farshad Shishehchian, Asian Aquaculture Network, Thailand
- Role of nutrition on healthy aquaculture practices by Dr. Jesus Venero, Novus, USA
- Recirculation systems by AquaOptima, Norway

Fish farming in India: Technology and opportunities

- Pangasius hatchery & grow-out: Future technologies for India by Dr. Trong Hung, Vietnam.
- Tilapia culture by Ram Bhujel, Asian Institute of Technology, Thailand
- Cobia culture by Michael Schwarz, Virginia Tech, USA

Aquaculture industry development in India

- Standards and certifications, Global Gap (TBA)
- Fish promotion in India by Dr. Mukundan, State Institute of Food Technology & Management, India
- Exporting fish from India by Dr. Anwar Hashim, National President, Seafood Exporters Association of India
- Perspectives of importing countries by Dr. Mike Dillon/ Norm Grant

The Business Meeting for technology transfer on the evening of 19 January at the APA 2011 venue is the place for technology/service providers to meet their prospective clients for business development and technology transfer.

Student awards

APA 2011 encourages students to actively participate in the Conference. The best student abstract presented at APA 2011 will receive the Yang Yi Memorial Student Award by WAS. Abstracts designated for this Award will be presented in the APA Student Gathering on 18 January for selection by an international jury.

Trade show

The International Aquaculture and Seafood Trade Exhibition of nearly 100 national and international booths as part of APA 2011 will be a boost to the Indian industry by showcasing their products and services to the world, and to know the best the world industry can offer to India.

More information:
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Ananda Group sponsors President's dinner

U.K. Viswanadha Raju

The President's Dinner at APA 2011 will be sponsored by U.K. Viswanadha Raju, Group Chairman, Ananda Group, Bhimavaram, Andhra Pradesh, India.

The Ananda group, established in 1942 is a conglomerate of agro-based industries producing quality rice, poultry, fish, shrimp and freshwater prawns for the local and international markets. It is led by U. K. V. Raju, a dynamic personality and a familiar name in Indian seafood industry. Raju has rendered valuable service to the agro industries. He is the only member from the fisheries sector nominated by the Government of Andhra Pradesh for the task force on 'VISION - 2020'.

Ananda Fisheries was established in 1988 as an integrated fisheries unit in India with shrimp and prawn hatcheries, 100 ha of grow-out facilities for shrimp, prawn and fish, two modern processing plants with one unit with an EU/USA approved IQF facility; an aqua and poultry feed manufacturing plant and a well connected shrimp feed distribution network. In 1993, Raju was awarded the 'Pioneer Award' for establishing the first commercial prawn hatchery in India.

The giant freshwater prawn (scampi) hatchery was set up in 1990. It was the first in India to start an annual commercial production of 40 million post larvae in Bhimavaram, Andhra Pradesh. The black tiger shrimp hatchery was set up in Kakinanda in 1994 and produces 100 million post larvae annually. It also runs a 40 million capacity hatchery named Bengal Scampi Tech in Digha, West Bengal. Led by U. S. L. Bhoga Raju, the hatchery has received a Pioneer Award from Kerala Agricultural University.

The fisheries unit of Ananda Group located near Bhimavaram under the management of U. Krishna Prasad, is involved in procuring and marketing freshwater finfish throughout India. Harvested fish in chilled form is transported mainly to West Bengal and the north-eastern states where demand is high.

The milestone for the Ananda group is the establishment of a 100% export oriented unit for the production of the tiger shrimp and freshwater prawn in the year 1994. This unit has its own hatcheries and grow-out farm of 50ha in Kovvada and Kakinada, feed processing plants in east and west Godavari Districts, and processing plants with a capacity of 37 tonnes/day. The company has an established market of its own brand ANAND in USA, EU, Australia, Japan, Canada and the Middle East. The Group's export business is led by U. Ananda Ramesh Varma.

Ananda Enterprises is an integrated fish project run by U. Murali Ananda Varma. It has a hatchery at Kovvada, near Bhimavaram which produces 7 million fingerlings, extruded fish feed factory at Losari which produces 20 tonnes/hour with an annual capacity of 62,400 tonnes of feed and a pre-processing centre at Losari. The fish grow-out ponds total 60 ha (150 acres) at Losari with production yields of 100 tonnes/ha/year during 2007-08 and up to 200 tonnes from 2008-2009. A fish meal plant converts by-products from fillet processing into fish meal.

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Targeting aquaculture professionals

On March 9-11 Aquatic Asia 2011 will be at the BITEC centre in Bangkok, Thailand. Aquatic Asia 2011 will showcase the industry's products, developments and innovations in the aquaculture business and focus on buyers and suppliers in the fish, molluscs, crustaceans and algae sectors.

Regional and international innovations

Even though Aquatic Asia is an inaugural event, the organisers are hopeful that it will be a platform for the launch of many innovations in the aquaculture and marine culture business. This is the first dedicated aquaculture event in the Asian Pacific region. Aquatic Asia gives the suppliers in this business the opportunity to present their products and services to a broad, yet dedicated audience.

Aquatic Asia offers visitors a dedicated selection of suppliers. So far, Aquatic Asia has attracted the interest of both regional and international buyers and suppliers in the aquaculture business. Sun Rise E&T Corporation for instance chose Aquatic Asia specifically to introduce their new products. "We are looking for a new market and expect to meet a large group of potential new buyers in the Asian Pacific region", said Eric Tung, Marketing Manager. "This will be a unique opportunity to meet our key contacts in the Asia-Pacific aquaculture business."

High quality conferences

Aquatic Asia strives to be more than just a meeting place for professionals in aquaculture. In addition to the exhibition Aquatic Asia offers a range of conferences. The Aquatic team has joined forces with several experts to guarantee an extensive range of interesting and informative topics related to the aquaculture business. Both Novus and Bayer have offered their knowledge in creating content of interest to aquaculture professionals.

The conference program will cover different aspects of this rapidly growing market, varying from marketing and R&D to feed, animal health and production equipment. Project manager Ruwan Berculo said, "The aquaculture business in the Asian Pacific region is in full development. It is our goal to support this development in every way we can. That is why the subjects of our conferences cover the complete process surrounding the business from feed to fish."

Co-location with VIV Asia 2011

The Aquatic Asia event is organised at the BITEC centre and will be co-located with VIV Asia 2011. Ruwan Berculo emphasises the independent position of Aquatic Asia. "Aquatic Asia is organised as a separate trade show. The Asian Pacific aquaculture business has earned a dedicated trade show. It has proven to be strong market on the rise."

Aquatic Asia visitors will have free entrance to the VIV Asia 2011 with their Aquatic Asia 2011 registration. This is also a unique opportunity to also meet key contacts active in multiple species groups.

More information: Leah Barsema, Campaign Manager VIV International, VNU Exhibitions Europe, Email leah.barsema@vnuexhibitions.com

Aquafair Malaysia 2010

Malaysia to increase ornamental fish output by 20.4%

In 2011, the ornamental industry will increase production to 963 million pieces, from the current output of 800 million, valued at MYR 820 million. In 2009, the Malaysian ornamental fish industry registered a production output of 632.2 million pieces valued at MYR 783.2 million.

Malaysia is one of the top producers of ornamental fish and aquatic plants and producers breed more than 250 species for the domestic and world markets. According to FAO, in 2006, the global market for ornamental fish and aquatic plants was estimated at USD 15 billion and is expected to grow between 10-15% annually.

To promote the industry, the Department of Fisheries will be hosting the biennial ornamental industry exhibition, Aquafair Malaysia 2010 to showcase the export potential of Malaysia's ornamental fish industry, aquatic plants and the whole range of supporting industries and services, from November 25-29. At a soft launch for the event, officiated by the Deputy Agriculture and Agro-Based Industry Minister Datuk Mohd Johari Baharum, Dato' Ahamad Sabki bin Mahmood, Director General of Fisheries Malaysia said that more than 100 local and foreign companies, including national groups from Thailand and China will be attending.

More than 60% of exhibition space will be local breeders, currently exporting to over 30 countries throughout the world.

Aside from the exhibition and fish completion, there will be a trade conference with speakers from Ornamental Fish International (OFI), UK, China and Europe. There will also be a half day workshop by Amano from Japan, who is also known as The King of Nature Aquarium.

More information: Web: www.aquafairmalaysia.com.my

Book review

Feed ingredients and fertilizers for farmed aquatic animals: Sources and composition

FAO Fisheries and Aquaculture Technical Paper No:540; ISSN 2070-7010; 209p.
Authors: Albert G.J. Tacon, Marc Metian and Mohammad R. Hasan

The nutritional well-being and health of farmed fish and crustaceans is based on the ingestion and digestion of food containing 40 or so essential dietary nutrients. These include specific proteins and amino acids, lipids and fatty acids, carbohydrates and sugars, minerals, vitamins, energy and water. The aim of this technical paper is to present an up-to-date overview of the major feed ingredient sources and feed additives commonly used within commercial aqua feeds. It also includes feed ingredient sources commonly used within farm-made aqua feeds, and major fertilizers and manures used in aquaculture for live food production.

Information is provided concerning the proximate and essential amino acid composition of common feed ingredient sources. It also gives the recommended quality criteria (when available) and relative nutritional merits and limitations (if any), together with a bibliography of published feeding studies for major feed ingredient sources by cultured species.

There are five main chapters. The first chapter deals with principles of feed ingredient and fertilizer analysis and includes; official methods of proximate chemical analysis, the analysis of amino acids, non-protein nitrogen, fatty acids, phospholipids, sterols, carbohydrates, sugars, energy, vitamins, minerals, the presence of anti-nutritional factors and contaminants and the analysis of the physical properties of feed ingredients and feed microscopy. The second chapter deals with methods of analysis for fertilizers and manures. A third chapter presents a glossary of major feed and feed milling terms, including methods for ingredient classification and description in numerical terms.

The main body (chapter 4) gives the nutritional composition and usage of major feed ingredient sources in compound aqua feeds, as well as the use of fertilizers and manures in aquaculture operations. Major feed ingredient and fertilizer groupings discussed include: animal and plant sources and single cell protein sources (algae, bacteria, and yeast), lipid sources and feed additives, including chemical preservatives and antioxidants.

This is followed by a chapter on contaminants which summarizes major published studies dealing with potential feed and fertilizer contaminants, including metals and mineral salts, mycotoxins, persistent organic pollutants, Salmonellae and other microbes, veterinary drug residues, other agricultural chemicals and solvent residues and transmissible spongiform encephalopathies.

The last chapter undertakes a comparative analysis of the essential amino acid profiles of the major reported feed ingredient sources for cultured finfish and crustaceans and presents average reported dietary inclusion levels of major feed ingredient sources used within practical feeds, including their major attributes and limitations. Finally, the importance of feed safety, traceability, and use of good feed manufacturing practices is stressed, as well as the importance of considering the long term sustainability of feed ingredient supplies and the need to maximize the use of locally available feed ingredient sources whenever economically possible.

(More information: http://www.fao.org/icatalog/search/dett.asp?aries_id=110959, USD30 for hardcopy)

Practical Short Course on Feeds & Pet Food Extrusion

January 30 - February 4, 2011

This is a one week Practical Short Course on Feeds & Pet Food Extrusion to be conducted from January 30 to February 4, 2011 at Texas A&M University, USA.

The program will cover information on designing new feed mills and selecting conveying, drying, grinding, conditioning and feed mixing equipment. Staff, industry representatives, and consultants will review and discuss current practices for production of pet foods, preparing full-fat soy meal; recycling fisheries by-products, raw animal products and secondary resources; extrusion of floating, sinking and high fat feeds; spraying and coating fats and digests and preservatives; use of encapsulated ingredients and preparation of premixes and least cost formulation. Practical demonstrations of pet food, vacuum coating and other processing are carried out with four major types of extruders; dry, interrupted flights, single and twin screw and using various shaping dies.

Reservations are accepted on a first-come basis. For more information, programs and application forms, contact: Dr. Mian N. Riaz, Food Protein R&D Center; 2476 TAMU, Texas A&M University; College Station, Texas 77843-2476, USA. Tel: +001 979 845 2774 Fax: +001 979 845 2744 Email: mnriaz@tamu.edu; Web: www.tamu.edu/extrusion

2010

November 25-28
Aquafair Malaysia 2010
Kuala Lumpur
Email: enquiry@aquafairmalaysia.com.my
Web: www.aquafairmalaysia.com.my

December 10-13
5th Shanghai International Fisheries & Seafood Exposition
Shanghai, China
Email: sifse@yahoo.cn (Wei zi qiang)
Web: www.sifse.com

January 17-20
Asian-Pacific Aquaculture 2011 and Giant Prawn 2011
Kochi, India
Email: worldaqua@aol.com
Web: www.was.org

February 6-8
Aqua Aquaria India 2011
Chennai
Web: www.mpeda.com

March 9-11
VIV Asia & Aquatic Asia 2011
Bangkok, Thailand
Web: www.vivasia.nl; www.aquatic-asia.net

March 31-April 1
12th Aquaculture Insurance & Risk Management Conference
Kinsale, Co Cork, Ireland
Email: info@aums.com
Web: www.aquacultureinsurance.com

April 21-25
9th Asian Fisheries and Aquaculture Forum & 9ISTA-International Symposium of Tilapia Aquaculture
Shanghai, China
Web:www.9afaf.org
Web: http://ag.arizona.edu/azaqua/ista/ISTA9/ISTA9.htm

May 3-5
Victam International 2011
Cologne Germany
Web:www.victam.com

June 6-10
World Aquaculture 2011
Natal, Brazil
Email: worldaqua@aol.com
Web: www.was.org

2011

June 14 - 16
International Scientific Conference on Probiotics and Prebiotics - IPC2011
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