MAY/JUNE2014
Volume 10 Number 3

AQUA CULTURE

Asia Pacific

Amidst EMS, success against all odds

Shrimp entrepreneurship in India

Bacterial chatter – Quorum sensing

Polychaetes: evolution or revolution

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MICA (P) 008/10/2013 PPS1699/08/2013(022974)

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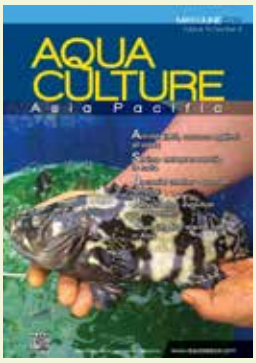

Hybrid grouper, picture by Ku Azhari Ku Baharum, Malaysia

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OUR MISSION

- We strive to be the beacon for the regional aquaculture industry.
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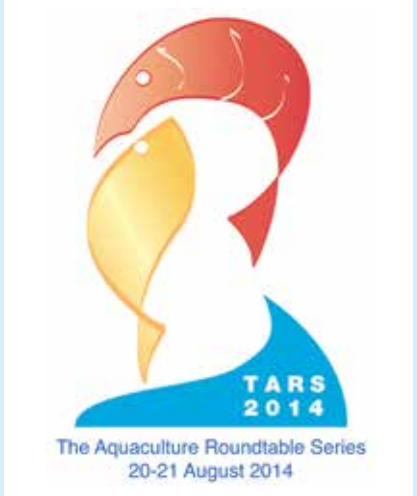
- We strive to be the forum for the development of self-regulation in the Industry.



TARS 2014

The fourth of the Aquaculture Roundtable Series (TARS 2014) will be held in Thailand from 20-21 August 2014. It will focus on **Shrimp Aquaculture: Recovery • Revival • Renaissance.** For more information and updates, visit www.tarsaquaculture.com

See program details on pages 58-59

From the editor

A sense of urgency

Since 2010, international prices of shrimp have jumped by 100 percent, prompting many Japanese restaurants to take shrimp off the menu. In the US, mid-level dining and chain restaurants are finding it increasingly difficult to offer shrimp on their menu without increasing prices. Even in the common 'pad thai' and everyday meals in Thailand, the number of shrimp is decreasing in each serving.

The driving factor for this is purely demand and supply. While demand has stagnated, the supply of shrimp has fallen significantly. Between 2010 and 2013, there has been an estimated global shortfall of 500,000 tonnes of supply per year due to massive production losses from China, Malaysia, Vietnam and Thailand during the same period. The crunch came in 2013 when major buyers realised that Thailand's crop was expected to fall by 50%.

Will this situation be the new normal and should we accept it? Will shrimp become a luxury item to be served in high-end or fine dining restaurants?

The causative factor has, of course, been the early mortality syndrome (EMS) or AHPND, which is due to a specific strain of *Vibrio parahaemolyticus*. As a result, a quick PCR (polymerase chain reaction) test was developed to (within limits) ascertain if the shrimp stock was infected with AHPND. It is interesting to evaluate what has been done by various segments of the industry to combat APHND.

The breeding companies have now put more selection pressure on the robustness of the shrimp and less on growth potential. In selective breeding, robustness and growth are opposite traits and hence selecting for one will have a negative effect on the other. Hatcheries have started reviewing their broodstock diets and are looking at compound diets as an alternative to natural (such as polychaetes) diets. This brings new issues with the poor attractability of compound feeds versus natural diets. While farms have continued with biosecurity, more farmers are now trying biofloc technology based on the principle that the floc of good bacteria will exclude the proliferation of *V. parahaemolyticus*. However, it must be emphasised that lined ponds and increased paddlewheel use are prerequisites. The former brings in higher capital investment and the latter is required both for increasing aeration and ensuring correct water circulation. Feed companies are proposing functional feeds with a complement of probiotics and immune enhancers to stimulate and improve the shrimp's own immune system. The question arises now - where are the animal health companies? While it is recognised that the shrimp has a primitive immune system, recent work has shown that the immune system has some 'memory' which could be the starting point for research on 'vaccine like' preventive medication.

The commercialisation of research has proven to be both positive and negative to the aquaculture industry. The positive is that research is driven by needs of the industry and the potential commercial benefits. However, the negative has been that researchers have not been willing to share information to quicken the process of finding a solution. This is akin to many players working on the same jig-saw puzzle but no one is willing to piece it together to obtain the big picture.

There is no doubt that solving the APHND problem requires a holistic approach and perhaps the public sector should be encouraged to take the lead. Three years have passed since EMS was first detected. There has to be a sense of urgency to act now.

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More tilapia from China in 2014

Production will be an improvement over 2013, encouraged by better prices and increased demand.

Cui He

The higher tilapia prices towards the end of 2013 are encouraging farmers to restock ponds and China Aquatic Products and Processing and Marketing Alliance (CAPPMA) estimated a production of 1.50 million tonnes in 2014. In 2013 production was 1.46 million, lower than the 1.5 million tonnes produced in 2012 but higher than that in 2011 at 1.33 million tonnes.

However, rains and cold weather in March have delayed stocking. A report in China Fisheries Network said hatcheries have reported a high demand for fingerlings in early 2014. In mid-March, it reported that prices in Hainan, Guangdong Zhanjiang, Maoming and Yangjiang were CNY12/kg (USD 1.9/kg) and CNY14/kg (USD 2.23/kg) in the Pearl River Delta. Prices are expected to remain firm but unfortunately, farmers are compensating for the downturn in 2012 and 2013 by increasing stocking density. Disease outbreaks and higher cost of production since 2011 have dampened the demand for fry from tilapia farmers and this has led to hatcheries cutting back on capacity.

In November 2013, during the 10th International Tilapia Industry Forum in Dalian, farmers were still not interested in the tilapia industry because of low prices even though these were better than in 2012. This situation forced some tilapia farmers to switch species, according to Dr Cui He, vice president and secretary general of CAPPMA, a non governmental association. By region, volumes in 2013 were down by 7% in Hainan and 9% in Guangxi but up by 17% in Guangdong and 42% in Fujian.

Cui He added that China's international trade in tilapia is heavily influenced by the white fish market. Tilapia prices were affected by the low offer prices for pangasius from Vietnam in 2013, even though pangasius production was down. The other factor was lower prices of cod with higher supply and consumers shifted to buying cod. With regards to consumption, in the US, China's major tilapia market, high prices in 2013 for tilapia reduced consumption by 4%, from 15 lbs/person to 14.6 lbs/person which is the lowest in 20 years.

Aside from the prospect of low prices in early 2013, production was further aggravated by higher feed and labour costs, bad weather and diseases, mainly *Streptococcus* infection. Production for local markets also came from shrimp farmers shifting to tilapia because of outbreaks of early mortality syndrome. The export volume of tilapia for the first nine months in 2013 was 268,000 tonnes, which was 6.73% higher than in the same period in 2012. CAPPMA estimated the volume will reach 370,000 tonnes for the whole of 2013. In the same period in 2013, exports to Mexico increased by 34%, sales of fillet increased in the EU by 32% and to Asia (Malaysia, Vietnam and Thailand) and Iran by 138%. Cui He also said that although the export volume and value have been rising over the last ten years, the growth rate for exports has been slow in the last few years.

Industry stakeholders realise that to move forward, upgrade and transformation in tilapia production are imperative. Moving forward, another strategy is to develop the domestic markets, which Cui He said is already consuming 50% of production. Globefish (March, 2014) also reported that alternative markets such as Africa are being explored due to the stringent quality requirements for exports to the US and EU. CAPPMA has also proposed steps in improving quality of production, building up traceability and branding.

Certification and quality tilapia

During the forum Wang Lin, vice president of Baiyang Aquatic group, a leading producer and exporter, said that the future requires a strict control on quality as China competes with several countries. In the case of Baiyang, which is in the entire supply chain since 2000, these include innovations to build a good brand. As the tilapia production and export business is highly competitive, certification is a trend for the future.

"Certification and accreditation is not only a requirement by law but also a threshold of market access. HACCP gives access to EU and US markets. In 2006, we started with HACCP certification and subsequently added others such as ISO9001, NSF, BRC, QS and CNAS. The company has 3-star ACC/BAP (Aquaculture Certification Council/Best Aquaculture Practices) in 2009. In my opinion, effective implementation of certification can reduce trade costs and give confidence to the public. With new certifications, we have new orders and our sales have been increasing.

"Certification also increases our brand value, allows the company to stand out and consumers to have a better understanding of the company. In the past seven years, Baiyang has not received complaints regarding our products. Within the company, a major advantage of certification is that it requires maximum participation and responsibility from all departments," added Wang Lin.

Green supply chain

The EU is a major importer of Chinese tilapia at 10% in 2013 and is expected to import more. The Aquaculture Stewardship Council (ASC) launched its tilapia standards in 2012 and since June 2013, together with CAPPMA and WWF, it began training certifiers and auditors on the tilapia standards in China. This is part of the joint EU funded initiative to promote responsible tilapia farming in China. "The ASC wants to

Henry Chen of Hainan Qinfu Foods was marketing tilapia from a BAP certified farm at Seafood Expo Global in May 2014

Stakeholders at the forum. From left, Zhou Enhua and David Li, ASA International Marketing, Shanghai and Xiao Yu Hong, China Catfish Association

improve access to EU and US markets when tilapia producers achieve ASC certification," said Esther Luiten, ASC's manager Commercial Marketing. She added that for the producers in China to have access to new markets, they need to meet buyers' preferences, ensure product and market differentiation, as well as product traceability.

Yujing Zhou from WWF China presented a paper on the progress of the project in 'greening the supply of tilapia from China' and said that the idea is to use market forces to promote certification for China's tilapia. In the pre-assessment stage, they have conducted training for eight farms, comprising of five farms utilising pond culture system and three farms in reservoirs utilising pond hybrid, pen culture and cage culture systems in Guangdong, Hainan and Guangxi.

Zhou said that in the pre-audit exercise, WWF noted that all farms comply with local and national laws and are tax compliant. Nutrient use is efficient and farms do not use therapeutics. Farms appear to comply with biodiversity requirements where they prevent escapees, although this aspect was not well monitored. Farms comply with using the 95% all male standard. The negative points are that farms lack data on oxygen fluctuations and water quality. Farms also lack data for the calculation of phosphorus and nitrogen used. In feed and energy use, data is lacking from feed companies on the use of wild fish/fish meal and oil inclusions. In terms of disease management, the team noted that there should be better records on fish mortality.

"We have recommended that feed companies should be engaged closely to provide the required information for farms to meet the standard. In some cases the use of wild fish may cause farms to fail the certification requirements," said Zhou. "One conflicting issue is 'the freedom of association in ASC standards' which is contrary to national laws. A further review of the standards is necessary prior to more benchmarking."

Multi stake collaborative mechanism

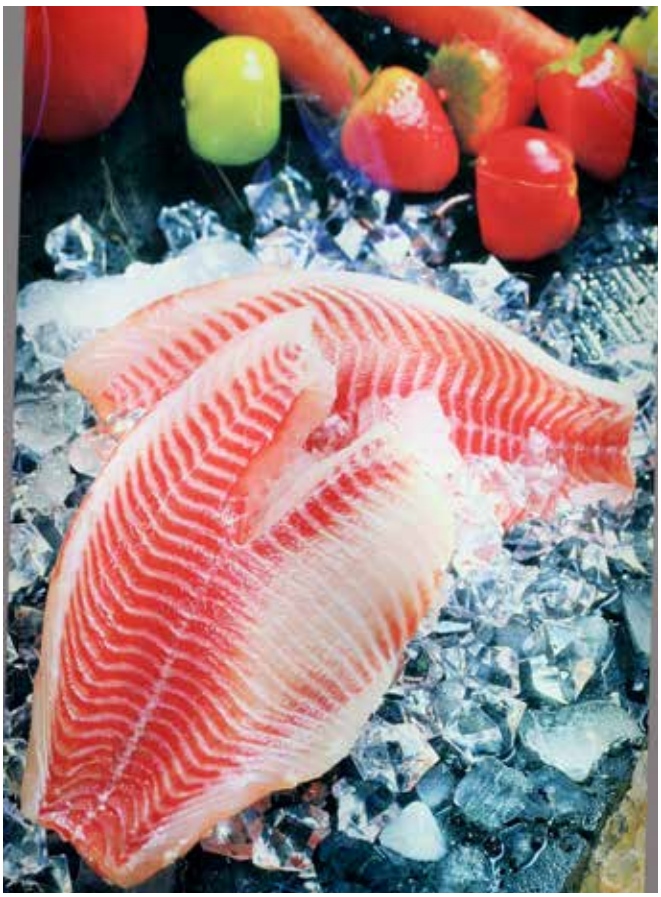
Li Jian, president of Hainan Aquaculture Kingwin and Han Han, China program manager at the Sustainable Fisheries Partnership Foundation presented their work to develop a regional collaboration mechanism for sustainability. According to them, the industry in Hainan face the following: increasing production costs from feed, labour, land, electricity and disease treatments; difficulties in export as buying power of the key importers shrank; rising competition from other emerging producers; more requirements for certification; degradation of the environment-lack of clean water resources; extreme climate change and increasing frequencies on disease outbreaks. Thus, the industry needs a multi prong collaborative approach. Pioneering efforts on this collaborative efforts are being developed in Hainan.

Poorly educated farmers need the support from big players including those from hatchery, feed mill, processor, large farms and service providers. A service provider such as Kingwin can help farmers achieve sustainability via understanding their needs and shortfalls and working with them to build trust and influence farmer's practices. Li Jian provides guidance to enable farmers to carry out water monitoring, maintain records and reporting on diseases. It can also monitor and assess farmers' performances and collect basic data on production. Training sessions help to disseminate ideas.

Targeting domestic markets

Fan Xuebing, managing manager of Seabridge Marketing discussed the domestic trade in tilapia. Seabridge is an agri-food products and seafood marketing promotion company. In his presentation, Fan looked at the global marketing position of tilapia from China. He said that the chilled tilapia competes with cod; frozen tilapia with pollock; frozen tilapia fillet with pangasius and chicken for animal protein. Fan suggested a change in strategy from mainly export to an equal ratio on export and domestic consumption. For the export market, he said that producers should focus on safety and quality of products. Producers should also be competent with crisis management and learn from the marketing experience of the Vietnam pangasius in exporting to Europe. In the domestic market, the strategy is to publicise and promote tilapia consumption. Fan also said that according to his online research at search sites such as Baidu, the tilapia is a popular fish among Chinese households. The product forms for the tilapia in the domestic markets include fresh, frozen whole, and processed products such as collagen and fins.

Cui He expects the tilapia industry to follow the same trend as that of the marine shrimp where imports may surpass exports. With the tilapia, the focus is to develop the domestic market first.



News in Brief

Vietnamese shrimp faces antibiotic tests in Japan

From March, Japan is testing all shrimp imported from Vietnam after two shipments were found to contain the antibiotic oxytetracyline (OTC) in February. Consequently the Vietnam Association of Seafood Exporters and Producers (VASEP) has authorised all exporters to check on the OTC content in their shrimp. In recent years, Vietnam has often been warned by Japan on shrimp shipments having higher than permissible antibiotic residues. Japan would initially test 30% of a batch, proceeding to test the rest if a large amount of the sample is contaminated. In 2012, all imported shrimp from Vietnam were tested for the antioxidant ethoxyquin and herbicide trifluralin but Japan stopped checking for the latter in May 2013. The Japan Ministry of Health, Labour and Welfare in early February raised the permissible level for ethoxyquin from 0.01 ppm to 0.2 ppm, allowing more Vietnamese shrimp to enter the market.

Kit that detects shrimp virus

Mangalore-based College of Fisheries has developed a diagnostic kit for detecting white spot syndrome virus (WSSV) in shrimp, called the RapiDot kit. Ideal for diagnosis at the farmer's level, this kit will only cost farmers INR 40-50 (USD0.8), compared to INR 500 (USD8) for a test at a laboratory level. K M Shankar, dean of the college, explained that since WSSV is contagious and kills shrimp quickly, the kit will be an early warning device. Shankar also said WSSV is widespread and in India, it causes the shrimp culture industry an estimated annual loss of INR 500 crore (USD 81 million). The technology has been tested out in shrimp farms in India and abroad since 2006. Funding assistance was given by the Indian government's Department of Biotechnology. The technology has been transferred to a French multinational company, Virbac Animal Health Care, in Mangalore.

All pangasius farms to adopt VietGAP by 2016

By 2016, it will be mandatory for all pangasius farmers and enterprises in Vietnam to adopt VietGAP (Vietnamese Good Agricultural Practices) and other standards such as ASC (Aquaculture Stewardship Council) and GlobalGAP. The requirement is stated in the draft decree on pangasius farming, processing and exporting by the Ministry of Agriculture and Rural Development (MARD). Since 2011, MARD has begun to apply VietGAP in pangasius production. Its target was that by 2015, at least 30% of fish farmers will comply to VietGAP, and 80 % by 2020. However, the Directorate of Fisheries reported that to date, pangasius farming area under VietGAP only accounts for a small proportion of the total farming area. Instead pangasius producers are applying different standards to meet the different requirements set by different markets. For instance, Hung Vuong Corp adopts ASC for fish exported to Nordic countries and Germany, and GlobalGAP for fish sold to other markets. According to MARD, in 2013, the total pangasius farming area in the country reached 5,950ha with an output of 977,000 tonnes.

Study on EMS in six countries

The Global Aquaculture Alliance (GAA) is spearheading a case study to identify the shrimp-farming practices that can prevent early mortality syndrome (EMS), also known as acute hepatopancreatic necrosis (AHPND). This will be a comprehensive survey of shrimp farms in six countries in Asia and Latin America that have consistently achieved good results even though neighbouring farms have EMS outbreaks. Identifying the common denominators of proper management will lead to better shrimp-farming practices world-wide. GAA president George Chamberlain said that the project involved leading researchers coming together to design a survey of farms that cover the entire range of the disease. A committee of 10 international experts is being set up to analyse the survey results and formulate the hypotheses for further testing in China, Vietnam, Malaysia, Thailand, Mexico and India, particularly in areas greatly affected by EMS. The results will be summarised in a report to be presented at GAA's GOAL 2014 conference to be held in Ho Chi Minh City, Vietnam from October 7 to 10. The project is being financed primarily by a USD100,000 grant from ALLFISH, a World Bank public-private partnership set up by the International Coalition of Fisheries Associations. The US-based Seafood Industry Research Fund and Thailand's CP are also sponsors.

Soon SPF monodon broodstock in India

The Rajiv Gandhi Centre for Aquaculture (RGCA), the R&D arm of the Marine Products Export Development Authority (MPEDA) has set up a nucleus breeding centre for the monodon shrimp in the Andaman. In 2013, India produced 50,000 tonnes of the shrimp which is dependent on wild broodstock for the hatchery reared post larvae. Thampi Samraj, project director RGCA, said with the nucleus breeding centre in the Andaman, RGCA is in the process of domesticating the shrimp with specific pathogen free (SPF) specimens. This Kodiaghat facility will supply germplasm of selectively-bred families to the broodstock multiplication centre at Thekkurichi in Kanyakumari district where mass production will be carried out and brood stock distributed to hatcheries across the country. The commissioning of the multiplication centre at Kanyakumari will facilitate the production and supply of 50,000 SPF broodstock per year to the industry, resulting in the production of nearly 100,000 tonnes monodon shrimp with a value of USD1 billion.

Soaring shrimp tariffs

The US Department of Commerce (DOC) announced in March the preliminary results for the eighth administrative review (POR8) on anti-dumping duties (AD) imposed on shrimp imports to the US between February 1, 2012 and January 31, 2013. The final results, in turn, are subject for appeal to the US Court of International Trade. In POR8, the AD duties on frozen shrimp imported from China, Vietnam, Thailand and India are generally higher than those of the seventh administrative review (POR7).

The dumping margins calculated by the DOC are a low of 1.10% for all Thai shrimp exporters participating in the review to a high of 9.75% for Stapimex, a Vietnamese shrimp exporter. The Indian exporter Falcon Marine received a preliminary margin of 3.01% which, if it is finalised, will be the highest AD duty rate for the company since the first administrative review.

However it is Vietnam which will be the hardest hit, if the preliminary reports are enforced. Vietnam's leading shrimp producer and exporter, Minh Phu Corporation, will be levied a duty of 4.98 %, Soc Trang–Stapimex Seafood Joint Stock Company, a 9.75% duty, and other participating companies, a 6.37% duty. The country wide duty will be 25.76%. In POR7, 33 Vietnamese shrimp exporters covered by the review enjoyed zero duties because the DOC concluded that they were not practising dumping in the US market. But now according to the POR8, the DOC has found evidence of dumping in the US market by Vietnamese shrimp exporters. Hence, the high anti-dumping duties. The saigontimes.com quoted lawyers representing the Vietnamese shrimp exporters as saying that the DOC used Bangladesh as a surrogate country for cost calculations. They pointed out that shrimp production costs in Bangladesh are quite different from those in Vietnam.

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Smallholder vannamei shrimp farming in raceway ponds

By Poh Yong Thong

A proliferation of vannamei shrimp farming on non-arable coastal land on the southern coast of Java, Indonesia demonstrates local creativity.

The sandy southern coastal land of Java, facing the rough seas of the Indian Ocean is non-arable and has been lying idle for decades. Since June 2013, a group of entrepreneurs led by Susilo Adi Mukamto demonstrated on a one hectare land with six raceway ponds in Pantai Pandansimo, Jogjakarta that vannamei shrimp farming can be successful and profitable. The stocking density was 200 post larvae/m^2 and they harvested more than 2.5 tonnes of vannamei from a 1,000 m^2 pond in 90 days at size 58/kg.

At the time of writing, in Feb 2014 at least 60 farmers and fishermen have joined Susilo and established 75 vannamei raceway ponds in the same area. During the same period, at least 150 farmers in the adjacent areas in Desa Malang, Desa Keburuhan and Desa Jati Kontal copied some aspects of this concept and are now farming vannamei. Many of these farmers were formerly farmers or fishermen with no or little knowledge of shrimp farming. Susilo's group pioneered and guided them on the construction, technology and environmentally-friendly concept in shrimp farming for the area.

A 1,000 m^2 raceway with the central divider

Susilo (left) showing Dr Slamet Subianto (second left) the buried outlet system at Pantai Pandansimo in Jogjakarta

The growth in vannamei farming in the area has been phenomenal. At least 210 farmers or fishermen have ventured into shrimp farming in a short span of 8 months. This J-curve development prompted Dwika Herdikiawan, director of production and Dr Slamet Subianto, director general of the Ministry of Maritime Affairs and Fisheries to visit the area on 14 and 22 Jan 2014, respectively. Furthermore, on 2 March 2014 the Minister of Maritme Affairs and Fisheries, Sharif C. Soetardjo together with I Made Suita, head of BPPAP (Centre for Brackish Water Development) Jepara inspected the project which is in line with the Ministry's Blue Economy Concept.

Design concepts

The design consists of raceway ponds, each of 1,000 m^2 to 1,500 m^2 with a sand bund plus asbestos divider in the middle. Seepage is prevented by thick polyethylene (PE) liners on the pond bottom and asbestos sheets on the sides. Supply of sea water (already filtered by the coarse sand) is from 8-inch (20cm) to 2-inch (5cm) tube wells with a depth of approximately 8 m.

The design for the outlet is very unique and ingenious. Agus Wahyudi explained that the outlet water passes through a buried 75-cm diameter culvert which is located 15 cm below the pond bottom. The buried outlet prevents unwanted contamination of the culture pond through wind or other carriers. The outlet water is connected to a treatment pond before being discharged into a river far away from the inlet. This sump receives outlet water from several ponds and these effluents are then discharged through the buried 75-cm diameter culvert.

2 inch (5cm) pump in 6 inch (15.2cm) casing

The drivers of vannamei shrimp farming on the southern coast of Central Java and Jogjakarta; Agus Wahyudi (third from left); Susilo Adi Mukamto (middle, right), Budiarto Eko (third from right) and Michael Toruhan (second from right). They are pictured with the Gold Coin team; from left, Eko Sudjatmanto, Ahmad Faridi, Poh Yong Thong (middle left) and Andri Utama (extreme right).

A 6-inch (15.2 cm) pump in an 8-inch (20 cm) casing at about 8 m deep supplying filtered sea water to the ponds

This sump receives outlet water from several ponds, the water then drains away via a 75 cm diameter culvert buried 15 cm below the pond bottom level.

All the ponds in one cluster share the same outlet canal but have different tube wells to supply the ponds. The ponds use minimal water exchange. Partial harvests of two to three times are carried out before the final harvest. As the ponds are lined with PE, pond preparation involves spraying the pond bottom with water and the bottom is manually swept when needed. Shrimp are fed four to five times daily. The system employs semi biofloc technology with occasional topping up with water after draining off the sludge trapped near the water gate. The survival rates are fairly high at above 80%.

Susilo explained that a cluster of ponds will have a maximum size of 10 ha and will be separated at sufficient distance from the next cluster. Environmentally friendly features and sustainability are the hallmarks of their design.

As stakeholders, we salute the ingenuity and creativity of the group in spearheading the development of shrimp farming in the hitherto unproductive land in the southern coast of Java for the socio-economic benefits of the people living in that area.

Harvest in progress.

Poh Yong Thong is general manager, Nutrition and Technical Service in PT Gold Coin Indonesia. Email: yt.poh@goldcoin-id.com or poyoto2002@yahoo.com

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Driven by market demand

By Zuridah Merican

Entrepreneurs in India have the opportunity to increase volumes by overcoming hurdles in the supply chain.

As shrimp farmers in India become more familiar with vannamei shrimp farming, their next course of action is to increase production. This is now led by several enterprising farmer groups. With a global supply gap, it is an opportunity for enterprising farmers. Shrimp production in India has already escalated from 142,000 tonnes in 2010 to 292,000 tonnes in 2013 (Yellanki, 2014).

Naturally, the current high prices are fuelling a fast and furious expansion, the momentum which industry leaders caution may impact the future of the industry. For several years, shrimp farmers in India, mostly smallholders, were struggling with farming the mondon shrimp amidst threats of white spot syndrome virus (WSSV) and other diseases either concurrently or successively.

In Andhra Pradesh, the new shrimp consortium comprises Royale Marine Impex Pvt. Ltd., Aqualife System and Gayaathri Biosystem group. Their combined expansion plans include more ponds and a high capacity processing plant to meet future demands. The modus operandi is farming a cluster of 12 farms covering a total area of 150 ha of ponds in several locations in Prakasam and Guntur district. To standardise farming technologies and ensure traceability, consultants under the Royale Marine Impex advise farmers and monitor farm performances.

The group operates two hatcheries; ALS Uday Hatchery located in Ongole, Prakasam District has a production capacity of 300 million post larvae (PL)/year and Gayathri Hatchery in Adivipallepalem Village, Pandurangapuram, Bapatla in Guntur District has a capacity of 1 billion PL/year. They produce PL10-PL12 for sale to farms around Ongole and Guntur districts and to farms in Tamil Nadu. Both are registered with the Coastal Aquaculture Authority (CAA) to import vannamei broodstock, undertake maturation and post larvae production. In India, pond salinity can range from 1 to 30 ppt and the hatcheries prepare post larvae according to the desired stocking salinity.

Ponds with 15-18g shrimp at DOC83. The pond water is green which Kumaresan explained as high green algae density of Chlorella due to low saline water of 5ppt.

The directors of Royale Marine Impex group from left Vijaykumar, V. Narendra Varma Raju (Gayaathri Bio Systems) and M. Sudhakaran (Aqualife System)

Production chain

Four of these farms are fully owned by Aqualife System, whereas the rest are leased for 10-15 years. The group is led by Marimuthu Sudhakaran, originally from Tamil Nadu and a Masters of Science graduate from Tuticorin Fisheries College. After a 4-year stint with CP India, Sudhakaran started his own consultancy company, Aqualife System. He started shrimp farming in 2000, constructed a hatchery in 2011 and in 2012, began expanding farming operations. He has settled in Andhra Pradesh for the past 18 years and is one of four partners in the group.

"We have been in shrimp farming for 10 years and switched to vannamei shrimp farming in 2011. We are actually planning for another 100 ha of ponds and today some of these are under construction. Up to November 2013, we have harvested 1,200 tonnes and in 2014, we expect to double this to 2,500 tonnes. Our target is 5,000 tonnes in 2015," said Sudhakaran during a visit to two of the 12 farms in Chinnaganjam, Ongole district. These have 11 ponds with a water area of 10 ha over a land area of 33 acres (13 ha) and 15 ponds over a water area of 13 ha and land area of 40 acres (16 ha).

"In 2008, when Moana of Hawaii had a multiplication centre in India, we used their post larvae and continued with monodon shrimp. Production was 7 tonnes/ha of sizes 14-16/kg. We discontinued with this shrimp in 2010. If we are able to get specific pathogen free monodon post larvae, we may consider farming this shrimp again but of course, we will still plan to farm vannamei shrimp in some farms," said Sudhakaran.

Better prices but higher costs

During these times with high shrimp prices, the objective is to be able to harvest successful crops. In the ponds managed by Ravichandran, consultant for Aqualife System farming operations, the average tonnage is 10 tonnes/ha/crop. The average survival rate is 70%. The schedule for partial harvesting depends on the situation with regards to farm conditions and shrimp prices. In 2013, it was 20 g (size 50/kg)

Sudhakaran (third right) with Ravichandran (second right) and shrimp pond consultant Kumaresan (fourth from right) and rest of the team at one farm.

to 40 g (size 25/kg). Prices were good at INR 550/kg (USD 9/kg) for size 50/kg and INR 780/kg (USD 12.8/kg) for the larger shrimp. These farms use feed from UPEC, the Indian subsidiary of Uni President Vietnam as Aqualife System is the feed distributor for the company. Ravichandran said that the feed conversion ratio is 1.2 for 20 g shrimp at a stocking density of 60 PL/m^2.

"Now with higher prices, we will be harvesting these shrimp at size 50-60/kg and when we have problems, we will carry out emergency harvests at size 100/kg.

"In general our cost of production was INR 200/kg for size 50/kg and INR 210/kg for size 40/kg, but we are also experiencing slow death or what some farmers call 'running mortality' where the survival rate drops to 40%; in that case the FCR can rise to 2.0-2.5 and cost of production will go up even to INR 350/kg for 40 count. Another outbreak can be from WSSV which may result in mass mortality at 30 days."

Running mortality disease was described by Srinivas Rayaprolu (Fishing Chimes, 2014) as a syndrome where shrimp die after 60 days of culture (DOC). The drop in survival rate can be 50% for size 40/kg after DOC120. The possible cause was attributed to various factors: low quality post larvae, insufficient mineralisation of pond water, insufficient dissolved oxygen, deaths from moulting and over or under feeding.

The costs of production have been rising; feed costs for example, rose by 15% to INR 65/kg. The other increases are in energy costs which saw a 40% rise. Although electricity from the national grid is much cheaper, the farm has to depend on the more expensive diesel because of frequent brown-outs. The cost of post larvae is higher during the first 2 months of the culture season (February and March), at 70 paisa/PL and by April, the price will be lower at 50 paisa/PL.

"Our ponds have been constructed in various shapes, following the shape of the land available. We use bore water. This suits us. They are not lined but we are looking at investing in HDPE liners for the ponds which will cost USD15,000/ha. We use autofeeders in some farms which is a labour saving step. In India, barely 5% farmers practise autofeeding," said Sudhakaran.

Hurdles in hatchery

At the hatchery in Bapatla, the approval by CAA to import vannamei broodstock required the set-up of separate maturation facilities which comprise 8 tanks of 40 tonnes volume for maturation and 18 tanks of 5 tonnes volume for spawning. During the peak demand season, the hatchery produces 25 million nauplii/day.

Ravichandran (left) with Sudhakaran

"Each female broodstock can produce 200,000 nauplii and we use each female 10-12 times. This means that they are used 4 to 4.5 months after eyestalk ablation. Fecundity will drop in the fourth month and females are discarded after 120-135 days. The CAA will check on this," said Sudhakaran

"During the peak season, we pack 3-4 million post larvae a day. The demand is 500 million/year from our hatchery and that of our partners and in 2014, we expect this to rise to one billion/year.

"In our case, we have to ensure that the post larvae pass our quality control tests. This is the usual PCR tests for WSSV and other OIE listed diseases, as well as the formalin tests. The farmer will again run these tests in the hatchery or send samples to private laboratories. We cannot afford to sell inferior quality post larvae as it will affect the harvest success of our associated farms, our feed and sales of farm products and also our consultancy business. Aqualife System is a distributor for INVE Aquaculture, Thailand's farm input products for Andhra Pradesh. Anyway, when farmers come to buy post larvae, they observe closely the post larvae performance, before we can begin to pack. In cases where the farms report mortality in ponds within a month, we compensate farms with a discount for future sales."

A major problem at this hatchery and that of other hatcheries in India is the zoea2 syndrome. Here there is no metamorphosis and in one instance at this hatchery, 4 out of 12 tanks were affected. The survival rate from nauplii to PL10-12 was also low at only 10%. Ravichandran compared this to 40-50% obtained when all is well.

"With this low survival problem, our production costs in the hatchery have increased by more than 100%. In addition, recent increases in production costs have been due to higher costs of broodstock; from USD 46 to USD 59 to the current USD 63. We use local sources of wild polychaetes which are cheaper but in future, we may need to looks at imports. These have been tested free of WSSV but we do not know whether they are free of the Vibrio strain causing EMS," added Ravichandran.

Entering the processing sector

In Andhra Pradesh, there are several integrators with hatchery, farm and processing plant. The BMR group is integrated with hatchery, farm and a seafood processing plant. The Sharat group started with seafood processing and integrated upstream into farming and hatchery production whereas the Munnagi group is into processing and farming. It is planning a hatchery. The Apex group has farms and processing facilities. Royale Marine Impex is the latest company to diversify downstream, with a large capacity and state-of-the-art processing plant.

During the visit, the four partners under the Royale Marine group described their plans in the shrimp processing sector. The infrastructure for the plant is almost completed and all equipment are ready for installation. This plant should be operational in June 2014. The large 10 ha complex has the following capabilities: 50 tonnes/day of processed shrimp; 25 tonnes/8 hour shift; state-of-the-art cold room and storage facilities with mobile racking to optimise storage; 4 large ice flake machines at 3 tonnes/hour and initially one of the two shrimp graders from Yantai Moon, China. The processing plant will employ 1,500 workers from the local community and has housing for 300 staff.

"Our forward planning is linked to this new processing plant located in Kavuripalem Village, Prakasam district. In 2013, at the group level, we harvested 2,300 tonnes. The overall target of the group is to process 10,000 tonnes of shrimp where 50% of raw material will come from our own farms using post larvae produced at our own hatcheries and managed by our consultants to ensure traceability. The rest will come from associated farms which have procured post larvae from us."

In India, most farmers follow the pre-set farming cycle. In February, when temperatures are ideal, almost all farms stock their ponds and harvesting will begin from May until August. Because of this practice, the demand for processing facilities is only high during these months and farmers are at the mercy of processing plants which depress the prices for raw materials.

"Until the group's processing plant is up, we have to send our shrimp to plants some 200-300 km away. Daily we will check on offer prices from 4-5 plants for the next day's harvest. We know that once the capacity of the plants has been filled, the prices for our shrimp will be lower. Andhra Pradesh is where most of the shrimp farms are located and have two of the largest shrimp processing plants. When plants on the east coast are full, the alternative for farms is to transport shrimp all the way to Mumbai, Kochi and Mangalore some 1,500 km away. To alleviate this problem, farms are trying to stock all year round but for the moment they are restricted by the availability of post larvae," said Sudhakaran.

"We realise that the capacity of this plant is huge. This is because we needed to plan for the influx in demand for the harvesting in June/July. With regards to exports, in the first few months, we will target the Middle East, Southeast Asian countries and Japan for our shrimp products; we will also target the US and EU markets after we have

The Gayathri hatchery showing the maturation tanks in the broodstock maturation area, separated from other areas as per the requirement of the CAA, larvae rearing tanks and packing area.

View of the new processing plant and inside; a shrimp grader and the large capacity store equipped with mobile racks.

Sample of 15-18g shrimp at DOC83

completed the required certification process. We have planned not to disturb the environment here. The effluents from the plant will be treated with a sophisticated ETP (effluent treatment pond) system and will be used to irrigate vegetable gardens and plantation crops in and around the facility," said general manager of Royale Marine Impex, Ramakrishna.

Looking forward, Sudhakaran is preparing to improve farm production efficiency. Currently the farm uses probiotics during farming and he is investigating biofloc technology at the hatchery and farm. Sudhakaran also wants to increase market access for the group's shrimp production.

"In the future, we anticipate that the hatchery, farm and processing plant can be ACC (Aquaculture Certification Council) certified for the American market; EU certification will be pursued for the processing plant and Global Gap for the EU market."

Amidst EMS, success against all odds

By Soraphat Panakorn

For some Thai shrimp farmers, success is through innovating and changing culture practices

Today, after more than four years of outbreaks of the early mortality syndrome (EMS), the industry here in Thailand and elsewhere are still at a loss as to the solutions needed to overcome the disease. Although the causative agent has been identified as a strain of *Vibrio parahaemolyticus*, the lack of a single treatment protocol to address EMS indicates that it is a result of multifactor causative agents rather than a single one. None of the shrimp diseases occurring in the past, such as taura syndrome virus (TSV), white spot syndrome virus (WSSV), yellowhead virus (YHV), or others, have caused as much damage to the industry as EMS.

Over the last four years, many farmers have blamed EMS for their crop failures without carrying out the necessary checks to ascertain the true cause of these failures. As a result, there have been numerous occasions where EMS has been used as a scapegoat for management failures. On the other hand, however, the outbreak of EMS has also led to a re-examination of the professionalism of the shrimp industry. This has resulted in some positive outcomes, such as improvements in pond management in most countries.

The situation of Thai shrimp farming in 2014

At the beginning, when EMS outbreaks were first reported, the shrimp industry in Thailand was confident that it could deal easily with this disease. However, after two years with the disease, the industry has realised not only that this is an uphill battle, but also that it is not sure how to handle the disease. From around 500,000 tonnes of annual production prior to the outbreak, EMS has reduced production by half to 250,000 tonnes. Industry is still in shock and farmers do not know what to do. However, with prices soaring to all time highs, they are taking risks by continuing to farm the shrimp.

This situation is very similar to what happened in China; farmers took risks by continuing to farm shrimp as they only needed one out of several crops to be successful. In Thailand, several campaigns were conducted by industry, such as 'big hatchery clean up' where the hatchery is required to stop operations and clean all facilities for one month. This was expected to completely remove the Vibrio bacteria. Another proposal was to change farming practices to break the EMS cycle. In almost every district in Thailand, farmers who were successful in staving off EMS shared the techniques they used with others. Laboratory tests were proposed to check on several physical, chemical and microbiological parameters to provide a more scientific basis to management practices. Despite these efforts, however, during the first quarter of 2014, only half of the volume of the corresponding period in 2013 was produced.

In addition to the above difficulties, shrimp farmers in Thailand were also impacted by adverse climate conditions, including sudden drops in temperature to as low as 24°C, followed by heavy rainfall in mid-March and then hot weather at 35-36°C throughout the country. Shrimp mortality reached as high as 40% and WSSV also occurred in combination with EMS. By the end of March, international shrimp prices came down and this discouraged farming and again causing farmers to lose hope.

Amidst EMS, some success stories

However, among the many farmers that reported failed crops, there are some who have continued to produce successful crops. Although small in number, around 10%, these farmers have developed culture practices which continue to produce successful crops. One farmer is using an 'intensive care unit' or ICU to nurse the shrimp for a certain period (such as for 30 days) before releasing the shrimp into well prepared grow out ponds. Another technique involves stocking directly right from the beginning into semi-biofloccs ponds. Another farmer uses a clear water system, while another technique is to go through completely the nitrogen cycle in the pond system.

A shaded nursing unit on the pond dykes using semi-biofloc technology

Overall, these techniques used are different from normal practices but all share three critical similarities which may account for their success: stability, enrichment and attention.

Stability

The technical guide for shrimp farming proposes a range of standard water quality parameters that farmers have to control. However, with frequent outbreaks of EMS, some farmers have come to the conclusion that the range of these parameters are too wide. Successful farmers have found that the narrower the range or gap, the better. For example, in the case of temperature, farmers found that they have less problems if they can control fluctuations, such as by setting up shades. In general, farms that manage conditions carefully to avoid any sudden swings or changes for all parameters will have higher chances of success.

Among the various parameters to be accounted for, pH is perhaps one of the most important. In the past, pH can fluctuate between 0.5-0.7 during the day without farmers encountering problems. However, it was found that one common factor stood out among successful ponds: during EMS - the pH range during the day which was only 0.2-0.3. To explain this, we can draw upon the example of ponds using semi-biofloc technology in Indonesia, which routinely

show a narrow pH fluctuation and have remained free from EMS or other problems such as white muscle disease, poor feed intake or moulting. Other benefits are shrimp growing faster, stronger and easier to manage.

Systems to control pH

There are various ways to control pH, such as applying lime or microorganisms, controlling feed, exchanging water etc. These are described below.

Trat model

A farmer group has created this model which has been proven to be quite successful. Called the 'Trat model', the key in this model is to manage the system so that it runs completely on the nitrogen cycle by removing hydrogen sulphide (H_2S) from the system with applications of H_2S eradicating bacteria. Once the nitrogen cycle is complete, the result is a stable water colour, which then leads to a stable pH. In this system the farmers depend only on biological processes by using only probiotics and no antibiotics or disinfectants. Critical to this model is the application of good farming practices, including lime and mineral application and a good aeration system. The chairman of this group was able to harvest 26 tonnes/ha in earthen ponds which previously succumbed to EMS for three consecutive crops.

Semi-floc system

As mention earlier, the semi-floc system, which is a combination of phytoplankton and bacteria flocs, can help to control pH fluctuations. Farmers adopting this system tend to be more successful even though they need to pay more attention to the management of the flocs.

An ICU unit within a pond with an enrichment system

Clear water

Some groups of farmers who have been unable to manage phytoplankton well, have decided to employ this method to combat EMS. Here clear water is used right from the beginning with artificial colour application to block sunlight, along with controlled feeding. It was reported that even when the post larvae quality did not pass the safety criteria, they were still able to harvest successfully. Here, the pH was stable and fluctuated by less than 0.2 per day. An example of this from the TABA EMS training material is given in table 1.

Enrichment

According to many farmers, the overall quality of post larvae is poorer than before. When there is a supply shortage or high demand, or when

Table 1: Water parameters adapted from the TABA EMS training material

pH	7.7-8.0
Alkalinity	100-160 ppm
Calcium	15-16 times salinity in ppm*
Magnesium	37-40 times salinity in ppm*
Potassium	8-12 times salinity in ppm*
Ammonia	0.5 -1 (>0.3) ppm
Nitrite	0.5-1 ppm
Nitrate	> 10 ppm
DO at sludge edge	> 4 ppm
*The salinity range is 5-35 ppt. Thus when the salinity is 10 ppt, the Ca level should be 150-160 ppm	

A nursery within a pond

shrimp prices are high, farmers are of the opinion that post larvae from all the hatcheries are equally of lower quality. However, often farmers have no choice but to take any available stocks.

In such a case, the best option is to nurse the post larvae in a nursing unit called an ICU unit to strengthen quality prior to stocking. This is a technique whereby post larvae are stocked in a cage lined with a PE sheet within the grow-out pond and enriched with feed supplements such as amino acids, protein extracts, vitamins and selected minerals. During this time, farmers also use various probiotics to improve health, remediate water quality, clean up organic matter and control Vibrio bacteria. The ICU unit can take any form but there should be an adequate supply of aeration with air bubbles using air blowers. To control temperature, some ICU units are shaded with perforated sheets.

By using this technique, with the right management protocols, weak shrimp can recover within 7 to 10 days. However, most farmers operating these units will transfer post larvae to the main grow-out pond after 30 days of culture, just to ensure that the post larvae will be free of EMS. In this system, the farmers can easily clean up the small area of water in the nursing unit if something goes wrong, instead of cleaning up the whole pond.

Attention

Last year, during several EMS outbreaks, we found that 70% of shrimp production of Thailand came from small farms. This was contrary to the years before the EMS outbreaks when most of the production were from large farms. Today, during visits to shrimp farming areas, the

empty ponds are in big farms with more than 30 affected ponds. In contrast, small farmers with smaller number of ponds are still running aeration systems, harvesting and re-stocking. The first conclusion is that smaller farmers could overcome EMS better than large farms.

I attribute this to the attention given to the ponds as the owner is on site at the farm twenty-four hours a day, seven days a week. During this time, they follow up on any occurrence minute by minute and respond to it immediately, when required. We can call this 'real-time handling' or taking care of the pond 'like it is their own baby'. From these cases, it is clear that farmers that are able to give their full attention to their ponds have a greater chance of success.

In addition to the above the following factors are also important.

- Prior to stocking, each farmer should test for post larvae quality with the salinity stress test. This is done by dropping the sample of 100 post larvae to water of 0 ppt (must use water that contain some minerals) and leave for 30 minutes. The post larvae are then transferred to water of 30 ppt for another 30 minutes. The post larvae sample passes this quality test when there is no mortality. An acceptable level can be 95% survival but any higher mortality means that the farmer must implement the intensive care unit to enrich and further strengthen the post larvae before stocking.
- Control the population of harmful Vibrio which should always be 100,000 times less than that of total bacteria count.
- In pond preparation, it is important to note that the harmful bacteria content in the soil is many times higher than in the water. Thus fast removal of the bacteria from the soil at the bottom of the pond is critical.
- The transfer process is a critical step. It is important that all water parameters inside the nursing unit and outside must be almost equal.
- In the ICU, staff must give full attention. Experienced staff from a hatchery have shown that they have better success than those from grow out culture.

In conclusion, proper pond management techniques which work to stabilise pond conditions, water parameters and shrimp health are essential for success in an environment where EMS outbreaks occur frequently. Second, it is important to provide a good nursing environment where post larvae can be enriched and strengthened. Third, adequate attention by the pond owners is essential. Even if a farm has the best systems and operations, this cannot replace the dedication and attention to detail required to make the business successful. Finally, it is clear that a holistic approach is needed to combat EMS, as single solutions have proven to be ineffective.

Covered nursery ponds

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(Editor's note: At TARS 2014 to be held in Phuket, Thailand, 20-21 August, Soraphat will be providing more information during his presentation on proactive management to keep diseases away).

The snakehead fish: a success in Myanmar

By Bai Haiwen, Huang Shaoyu, U Than Lwin, U Tint Swe, Dong Qiufen, Zhang Song and Yang Yong

Myanmar scores breakthroughs in fry breeding, commercial farming and extruded feed development for the snakehead fish.

The snakehead *Channa striata* is a popular freshwater fish in Asia due to its delicate flesh, well-accepted flavour, and its high nutritional and unique medicinal values. In the past years, some farmers in Southeast Asian countries such as Vietnam, have begun to farm the snakehead, feeding it with trash fish. However, with the development in extruded feed technology and since 2009 with technical support from China's Guangzhou Hinter Biotechnology Co Ltd (Hinter), several feed mills now produce specialised extruded feed for the snakehead in Vietnam. These feeds have shown excellent results and brought enormous economic benefits to farmers. In addition, there was the development of artificial propagation techniques for the snakehead which has reduced the dependence on wild caught fry and fingerlings for farming.

The snakehead is widely available in Myanmar. In local markets, the fish fetches a price from MMK (Burmese kyat) 3,000 to 3,500/kg (USD3.16 - USD3.69/kg). But in recent years, the natural snakehead population has declined rapidly due to over fishing. However in 2012, there was a breakthrough in fry breeding, and the farming technology of the common snakehead has drawn wide attention for its fast growth and adaptability in Myanmar.

In 2012, Hinter, which provides aqua feed premixes and integrated solutions in China, signed a strategic co-operation agreement with Htoo Thit Company (HT), an aquatic feed company. HT ranks among the top 3 in the feed industry in Myanmar and it also owns more than 200 ha of freshwater ponds for R&D and fish farming in Yangon, Myanmar.

In 2012, the artificial breeding of *C. striata* was carried out and extruded snakehead feed was used under the guidance of Hinter experts for the first time in Myanmar. Through these co-operative undertakings, HT's technical team has been able to accumulate some successful experiences and made revolutionary headway on larvae breeding and extruded snakehead feed.

Huang Shaoyu injecting HCG into a female brood stock for artificial spawning

The hatched one-day old larvae (DAH1) of C. striata

12-days post hatch fry

Juvenile C. striata (one day after weaning)

Larval rearing

In May 2012, with the local resources from HT, Hinter assigned Huang Shaoyu, its technical manager and Dong Qiufen, its vice-marketing and technical director, both experts in the breeding of the snakehead fish, to carry out some breeding trials. This was initiated at two fish farms located in Bago and Yangon provinces. The farms enabled HT to score a breakthrough in larval rearing of snakehead for the first time with excellent water quality parameters and appropriate temperatures (26-32°C) and using wild-caught broodstock of *C. striata* from south Myanmar. However, during the trial, there were

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Hand feeding extruded feed

Monitoring fish growth

some difficulties with local conditions - a harsh rainy season and high temperatures in summer. In addition, initially, local labour were not experienced enough to handle the fish and even some breeding tools required for the breeding work needed to be imported from China. Finally, the team managed to successfully produce one million juveniles.

A year later, in 2013, HT together with Huang Shaoyu and another expert, Bai Haiwen, carried out more snakehead breeding trials. Learning from the successful experiences in 2012, remarkable progress were made in larvae hatching and snakehead feeding. This time round, 20 million snakehead eggs were hatched and 6 million juvenile snakeheads were produced. During the tough two years of learning and practice, HT has achieved success in the propagation technique of snakehead, with the fertilisation rate of snakehead eggs and the survival rate of larvae before first feeding at more than 90% and 99% respectively. Within 45 days post hatching, the fingerlings body weight reached 16~20 g.

Extruded feed

The carnivorous snakehead fish require high levels of dietary protein. Hinter is a subsidiary of Guangdong Haid Group, one of the first feed companies to manufacture extruded snakehead fish feeds in China and which has considerable knowledge and experiences with this fish in China and Vietnam. In 2009, Hinter assisted a Vietnamese feed company, Con Heo Vang Company, to be the first to produce extruded snakehead feed in Vietnam. In 2012, HT successfully produced extruded feed for this fish using local raw materials with assistance from Hinter, specifically, Dr Zhang Song, vice president and Tian Pengfei, production director. The first batch of high quality extruded snakehead feed with 40% crude protein was manufactured in July. Up to the end of 2013, HT was able to produce all kinds of high quality extruded snakehead feed using local raw materials and Hinter premix A701.

Pond production techniques

For two consecutive years. HT carried out breeding trials and experimented with production techniques. Gradually it succeeded in snakehead fish breeding and farming in earthen ponds. It has also learnt to overcome difficulties; Myanmar's changing climate, poor hardware and other farming conditions. Furthermore it could testify that extruded feeds resulted in rapid growth, lower feed conversion ratio (FCR) and lower incidences of diseases.

In 2012, HT stocked 540,000 snakehead fingerlings (size 160/kg) in their 18 ponds with an area of 2 MMR-mu each (1 Myanmar mu equals 0.8 ha). After a successful acclimatisation, the fish were fed with 62.5 tonnes of extruded feed with 39~43% crude protein for a year. In July 2013, the first batch of farmed snakehead was sold to the local market. Besides a FCR of 1.30, survival rate of 85.3%, minimum fish weight of 500g/fish and a harvest of 48.03 tonnes, HT was able to record an impressive gross and net profit.

Motivated by these favourable farming results in 2012, the company has expanded its snakehead farming area since 2013. Thus far, 1.2 million juvenile snakehead fish have been stocked in 40 earthen ponds with an area of 2 MMR-mu each. Workers from the company fed fish with 119.01 tonnes extruded feed for six months in these ponds. With FCR of 1.11, survival rate of 91.5%, fish weight of 500-800 g/fish, and a harvest of 107.02 tonnes, HT again achieved good farming results.

Table 1. HT: Results of two years of snakehead farming with extruded feed

Parameters	2012	2013
Culture area (ha)	14.4	36
Pond depth (m)	1.0	1.0
Size of juvenile fish (pcs/kg)	160	160
Stocking density (pcs/m^2)	3.75	3.75
FCR	1.30	1.11
Feed frequency (times/day)	2~3	2~3
Feed rate (% body weight)	3~5	3~5
Culture duration (days)	342	182
Body weight at harvest (g/fish)	500-1,000	500-800
Survival rate (%)	85.3	91.5
Yield (kg)	48,032	107,020
Price (USD/kg)	3.51*	4.24**
Unit production (kg/ha)	3,335.56	2,972.78
Benefit/Cost (B/C) (%)	123.34	153.81
Prices were on 13 July 2013* and 5 December 2013*		

Table 1 verifies the positive benefits of snakehead farming for the company. Results showed improvements in the benefit and cost ratios of 123.34% in 2012 and 153.81% in 2013 There was also increases in net incomes, as well as FCRs of 1.30 in 2012 and 1.11 in 2013. As

Checking health status of fish

a result, HT has earned accolades such as government recognition, awards and authorised patents.

All these successes have not only established a solid theoretical and practical foundation for the commercialisation and large-scale production of *C. striata*, but also laid a firm foundation for the subsequent application and promotion of extruded snakehead feed.

Outlook for snakehead culture

Myanmar is blessed with abundant water resources with excellent water quality. It also has moderate aquaculture and developed river systems which enable a natural water exchange for most ponds. Adding to these favourable factors, are the low labour costs and pond rentals. With the development of technology and excellent wild broodstock, the breeding density and unit production of snakehead will be greatly enhanced.

HT's pursuit of snakehead farming in 2012 has become the precedent and milestone of *C. striata* farming in Myanmar.

However, at present there is a limited supply of both farmed and wild-caught snakehead despite an insatiable appetite of the Burmese people for this fish. The demand is expected to remain for quite a long time into the future and this will ensure attractive price prospects for the fish in Myanmar. These breakthroughs achieved by HT in the breeding, farming and development of extruded snakehead feed have broken new barriers in the aquaculture industry in Myanmar. We expect that the high profit margins will continue to drive the growth in snakehead farming and with this, the demand for extruded feed. It is reasonable to believe that the snakehead will be a promising farmed freshwater fish in Myanmar.

Bai Haiwen

Huang Shaoyu

U Than Lwin

U Tint Swe

Dong Qiufen

Zhang Song

Yang Yong

Bai Haiwen, Huang Shaoyu, U Than Lwin, U Tint Swe, Dong Qiufen, Dr. Zhang Song and Dr Yang Yong are experts in aquaculture nutritionand health from Guangzhou Hinter Biotechnology, China. U ThanLwin and U Tint Swe are aquaculture experts and chairman and general manager of Htoo Thit Company, respectively. Email: qiufendong@gmail.com (Dong Qiufen).

Polychaetes: evolution or revolution?

A evolution in feed alternatives today but with time, the start of a revolution in economic and sustainable aquatic feed development, says OddGeir Oddsen

Hidden away in a quiet corner of Wales is a farm established to provide a basic raw material that will cause a small, 'green' evolution in the world of aquatic feed production. This ingredient is polychaete, or precisely, *Nereis virens* and *Hediste diversicolor*. These marine worms, commonly known as ragworm, are found in the shallow, sandy shores around the United Kingdom and have long been prized by anglers as high-quality bait, able to attract some of the best fish in the sea.

ProChaete Innovations Ltd is now growing these worms in commercial quantities at its dedicated farms in Wales – thousands of miles away from any shrimp farm, and therefore free of any of the diseases that affect shrimp. We produce feed for all stages of shrimp farming, ranging from larvae feeds (from first-feeding upwards) through grow-out, and also a range of maturation feeds. The company also produces polychaetes-based feed additives and fishmeal replacements aimed at the finfish farming market.

Harvesting polychaetes and Nereis virens (insert)

A sustainability issue

It has long been known that good nutrition is vital in the production of healthy, high value and high quality animals. Currently, feed constitutes about 40-50% of the production cost of fish such as salmon and trout. Economics dictates that farming companies need to maximise the nutritional input with converted 'flesh on the bone'. Most of the protein and oil elements in commercial aquaculture diets come from fishmeal and fish oil extracted from pelagic stocks, caught in vast quantities in the great southern oceans and then traded globally as any other commodity. With each year, prices for these commodities increases and there are ongoing debates on the viability of this level of fishing against the background of the target species' ability to reproduce in sufficient quantities to be self-sustaining.

These questions on the sustainability of industrial fishing have led to a plethora of research projects aimed at identifying alternate protein sources, as well as other feed ingredients to promote health and growth in farmed aquatic species.

'less fish to feed fish'

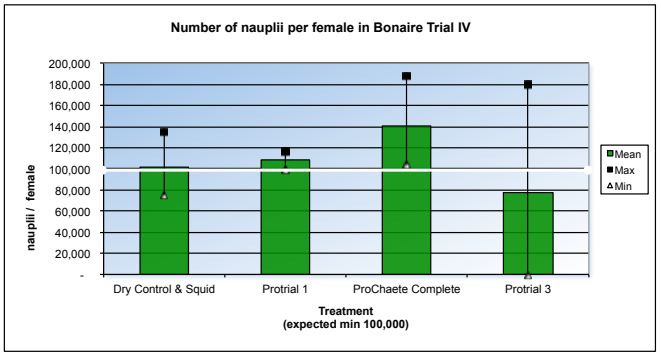
The bottom line is that every seafood farmer needs cost-efficient and digestible feedstuff. This is what prompted the genesis of ProChaete. We believe that we have not only created highly beneficial feed enhancement materials that promote good growth and well-being, but can also reduce the quantity of wild capture fish protein required by aquaculture. Our message is therefore: 'less fish to feed fish'.

In 2013, ProChaete Innovations was started by a small group of like-minded individuals, with long track records in the seafood sector, looking to find innovative solutions for the production and sustainability of commercial aquatic diets. The three years pre-start up were very busy. During this time, we carried out a broad spectrum analysis of the aquaculture feed market for various commercial species, worldwide. We then trialled feed containing polychaete-derived enhancements. Based on these studies and our management team's strong competency in feed processing as well fish farming, we have started to produce the first speciality feeds at our purpose-built feed mill in South Wales. As we are still a small company, we can produce tailor-made diets for different species and different stages. For example, our range of shrimp feeds can start at first-feeding larvae to final grow-out, as well as providing the full range of speciality maturation feeds for shrimp brood stock.

Improved biological performance

Our commercial trials have centred on sea and freshwater trout and warm water shrimp and looked at both improved biological performance as well as final product quality and taste. The growth in trout using polychaete based feeds was better than with commercial trout diets, giving good muscle texture and pigmentation. Fish grown in these trials in the US and UK were tried by leading chefs and professional taste panels. The results were better than we could have hoped to the extent that our ProChaete-fed trout came out top in terms of flavour and texture. Fish have been sold to leading UK restaurants. We have also sent fish to Paris and again received very positive feedback from that most discerning of markets.

With regard to warm water shrimp *Peneaus vannamei*,trials have taken place in Asia, Central America and UK with semi-moist and dry feeds for maturation and larvae diets, again with positive results. In the maturation feed trials more nauplii were produced per female, with higher survival rates than with producers' current feed supply; in the larval phase, strong growth and low mortality were also reported.



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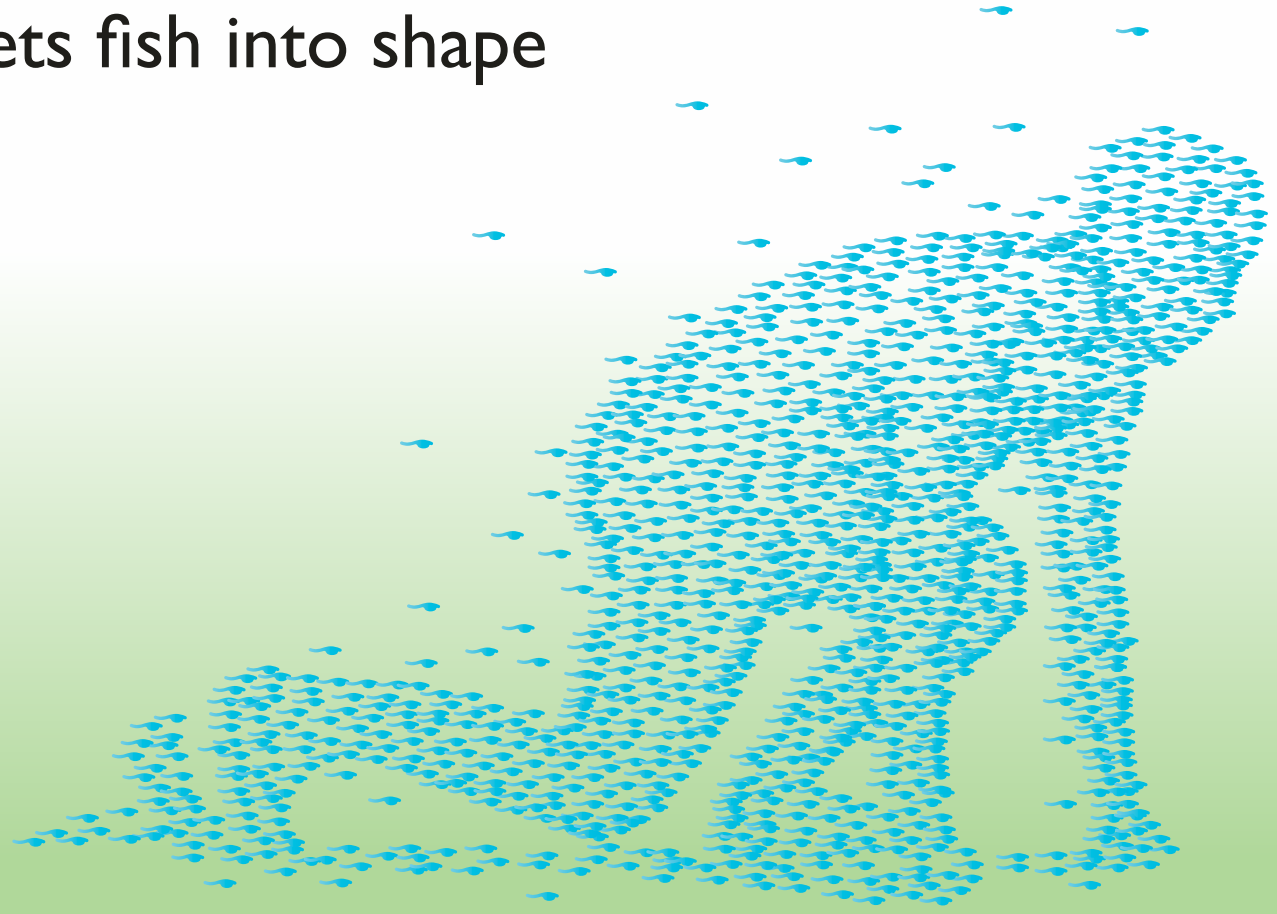

Reduces deformities in larvae and fry

LARVIVA ProStart™ is the first early weaning diet with a unique probiotic approved by the European Food Safety Authorities for its documented effect in reducing the occurrence of vertebral deformities in fish larvae and fry.

BioMar

Feed mill

Table 1: Proximate and amino acids composition of the ProChaete semimoist shrimp maturation feed.

Nutrients (% on dry matter basis)			
Crude protein	40.0%	Ca	1.0%
Crude lipid	10.0%	P	1.4%
Carbohydrate	4.0%	Mg	0.2%
Ash	7.7%		
Amino acids (% of protein on dry matter basis)			
Methionine	0.6%	Phenylalanine	1.5%
Lysine	0.8%	Leucine	2.2%
Arginine	1.3%	Isoleucine	1.1%
Threonine	0.9%	Valine	1.7%
Histidine	0.7%	Cystine	0.2%
Tryptophan	0.3%	Tyrosine	0.4%

So what does the inclusion of polychaete actually bring to the table? Polychaetes are a natural part of the diet of fish and shrimp in the wild and therefore have strong digestibility traits. They offer good levels of lipid, protein and fatty acids. To a limited extent, the worms also offer enhanced pigmentation. We believe there is great significance in their relatively high bromophenol content, which is retained in the fish or crustacean flesh to enhance the flavour of being 'ocean fresh'.

Another advantage is being able to offer customers polychaete-assisted sand filtration systems. These are excellent for cleaning effluent water created in land-based agricultural systems, with the further added advantage that worms harvested from these systems can be converted to feed enhancers.

The company has secured all production from polychaete farming in South Wales for conversion to feed enhancing products, which currently could create in excess of 50,000 tonnes of feed per year, with plans for further expansion and diversification. The polychaetes are grown in large-scale, biosecure shallow ponds. The disease-free status is tested out by the University of Arizona Aquaculture Pathology Lab for the shrimp viruses on the OIE list. As an additional precaution, in January 2014, ProChaete also asked the same laboratory to test for AHPND/EMS. To date, all tests have been negative.

Polychaete ponds in Wales

From first seeding with nectochaete, the first harvest of adult worms can take 8-12 months later. After harvesting the worms are either frozen or hydrolysed and then processed into the various feed enhancement products for use in the feed mill or for sale to others.

Currently, the product range covers all feed requirements for shrimp and farmed crab, as well as trout and salmon. Prochaete is also participating in wrasse-farming trials, in co-operation with Stirling University's Institute of Aquaculture, Marine Harvest and Scottish Sea Farms. We will expand to cater for other commercially grown species following specific trials in those areas. We also envisage that economically produced algae oil and its derivatives will be available for feed inclusion.

This is a small evolution in feed alternatives, but we firmly believe that in time this will be seen as the start of a revolution in economic and sustainable aquatic feed development.

OddGeir Oddsen is managing director, Prochaete Innovations Ltd. He has an MSc in Molecular Biology from University in Bergen, Norway and started work with feed production and sales within Skretting, developing some unique processes which were patented. He built and ran a state –of – the art feed technology facility and as technology manager, led the integration of Skretting Technology Development into Nutreco's Aquaculture. In fish farming, he was CEO of the re-born Pan Fish as CEO in Scotland which was floated on the Oslo Axess as Lighthouse Caledonia and CEO of the international salmon breeding company SalmoBreed. Email: Oddgeir@prochaete.com

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A valued partner for growth

By Zuridah Merican

In the mature aquafeed business in Thailand, the TRF feed mill gains market share with strong teamwork and trust of customers

The TRF team, from left; Surapong Harnikrivilai, Warrawut Prugsisakorn, consultant, Suphot Wanitkitkourpol, Preecha Ekatumasuit, Anon Prugsisakorn, consultant and Narath Plyhirun

Thailand's newest aquafeed mill, TRF feed mill sits on a 70 rai (11.2 ha) land in Tambol Nakok in Samut Sakhon province. It is part of the upstream integration of the 30 year-old Thai Royal Frozen Foods Co Ltd which is a major seafood exporting and processing company in Thailand established in 1980 by the Harnikrivilai family. This new feed mill will supply the demand of Thai Royal Shrimp Farms comprising 150 shrimp ponds of 300 rai (48ha) in Ratchaburi and Suphanburi in the central region, 1,700 rai (272ha) of ponds in Prachuap Khiri Khan and Chumphon in the south as well as some of the recently acquired 2,000 rai (320 ha) of ponds.

TRF feed mill was formed in 2011 and in August 2013 rolled out its first production of shrimp and fish feeds. Joining the Harnikrivilai family, as partners in this new feed mill company are aquafeed industry stalwarts, Dr Preecha Ekatumasuit and Dr Suphot Wanitkitkourpol. Preecha qualified with a veterinary degree from Kasetsart University and spent several years in the animal and aqua health sector before he joined DSM. He then went on to join and set up Lab Inter, an internationally known supplier of feed additives to both aqua and livestock industries which went on into shrimp and feed production. Preecha is managing director, Suphot, the deputy managing director and Surapong Harnikrivilai is also managing director.

"My background is in both livestock production and aquaculture. But livestock production, for example, the swine industry has already reached its maturity stage. Despite its existence for 25 years, the aquaculture industry is still on the learning curve. This is where I know I can make a large contribution. Furthermore, it is the area of growth; more fish production will be required globally," said Preecha.

Sharing a vision

Preecha's vision of becoming a leading supplier of quality feed for a sustainable aquaculture business is shared by Suphot, a well-recognised shrimp nutritionist in Thailand as well as by other dedicated staff. Together the management team has a total of 20 years in aquaculture and feed milling, accumulated through tenures in some of the top aquafeed companies in Thailand. TRF's production capacity is 96,000 tonnes per year (tpy) with 65% shrimp feeds and 35% fish feeds. The feed mill is accredited with GMP, HACCP and ISO9001 and the plan is to seek 3-star BAP certification for farm, processing and feed mill for the group.

In April, prior to the Thai New Year and three-day holiday, the feed mill was in full swing, running on three shifts. Currently, it produces shrimp feeds comprising 70% vannamei shrimp feeds containing 38% crude protein (CP), and 30% monodon shrimp feeds with 40% CP. Fish

Shrimp feed crumbles

Filling up the feed storage are various bags of feeds for vannamei shrimp, Cusko S and ABI brands, monodon shrimp feeds, TRF brand, feed for carnivorous and herbivorous fish under the Cusko brand and sea bass under the Kapongngern brand.

feeds are mostly for the tilapia with CP ranging from 32% down to 30% for tilapia farming in cages and 25% CP for pond culture.

"Vannamei shrimp may constitute 90-92% of Thailand's shrimp production but we still have demand for monodon shrimp feed. Farmers use this higher quality protein feed when they want a faster shrimp growth," said Suphot.

On the floor

There are two lines for shrimp feeds and one extrusion line for fish feeds. The key performance target for factory manager Narath Plyhirun is not only production of quality feeds using industry norms but to keep a control on operation costs. In the first year of production, output was 5,000 tonnes per month (tpm) for shrimp feeds and 3,000 tpm for fish feeds.

"We give emphasis to quality raw materials. We follow strict guidelines on the freshness of raw material and in this case, here in Thailand, we are lucky to have local fishmeal with 60-65% CP with a low inclusion rate of ethoxyquin. Raw materials are stored separately; a temperature control room is used to store premixes and micro ingredients such as vitamins and open storeroom for main ingredients such as fishmeal and soybean meal. Ingredients are locally sourced as well as imported. Pest control is in place in all areas.

"However, feed quality also depends on customers' perception. If the fish pellet is 3 mm, the particle size of ingredients should be one-third but there are instances, where the farmer is more concerned with the text of the feed and then we will need to make further adjustments to the processing. This is a demand that we need to work with, although with fine grinding using pulverisers, we already have 96% of 80 mesh size," said Narath.

"The two Muyang pellet mills for shrimp feed production is the most modern in Thailand with 4-pass conditioners which is a cost saving feature as we do not need binders. We can opt for long term conditioning. But we can also cut down on the energy costs of using steam with binders but this will depend on the formulation. Pelleting temperature is 90 °C and pellets are autoclaved for 30 min to meet feed safety and hygiene standards.

"In feed processing, the raw materials constitute 60-70% of the production cost. We use a twin screw extruder for our fish feed production which was easier to fine tune and we managed to reach our

With Preecha and Suphot, Decha Buranatecha, sales manager (left) and Dr Apirux Kimawanit, technical manager (right).

Bagging and QC

specifications within a day. Although our twin screw extruder does not use raw materials different from that for a single screw, the efficiency is higher as shrink loss is less than 2%," added Preecha.

Around Samutsakorn, only 60 km away from Bangkok and which is fast becoming urbanised, the communities are concerned with the odour and dust pollution from feed mills. There is an industry requirement, regulated by the Pollution Control Department that feed mills in the district must install air quality and pollution control systems.

"The air cleaning and environmental improvement system used by TRF is a large investment but it does ensure that clean air is released back into the atmosphere," said Narath. In addition, for a new factory such as TRF the inspection is twice a month.

Market recognition

The Thai aquafeed industry is mature with efficient players and economies of scale. Aquafeed quality of the top players are quite standard. Feed specifications are standardised and controlled by the Department of Fisheries (DOF). The shrimp feed business is also very competitive, based on services provided rather than on feed prices. TRF has also entered the feed market during a downturn in demand for shrimp feeds due to outbreaks of early mortality syndrome (EMS) in most farms.

Preecha said, "Shrimp feed sales are mainly to farms in the south and eastern provinces. Fish feed sales are mainly to the southern, northern and eastern provinces. Our competitive edge will come with services from sales and technical staff. Furthermore, as a new player in the industry, we know that we cannot expect to compete with the big boys with the supply of short term credits to distributors and large farms. We can only depend on farmers buying our feeds initially for 5-6 ponds and then increasing to more ponds when they are satisfied with the feed performance."

"The peak demand for shrimp feeds is usually the August/September months but now with EMS there is no fixed pattern. In April, farmers were still waiting to stock the ponds as the weather has been too dry and hot. Pond water salinity rose to 40 ppt and it was difficult to control the colour of pond water. Thus there is a delay in this year's crop," explained Suphot.

Benchmarking of the feed is carried by the technical team. Having affiliated ponds help. According to Suphot they can collect data from 20-30 farms to analyse average daily growth (ADG) and feed conversion ratios (FCR) under actual farming conditions. The average FCR is 1.4 for size 65 to 70/kg shrimp.

"To sell, our only recourse is marketing the feeds well. The farmer wants quality, consistency and good service. Today, our farmers are more concerned with survival than FCR. Actually, with the threat of EMS, they are happy if they can manage a size less than 100/kg after 3 months of culture. At high prices such as THB160/kg for size 90/kg shrimp, even a survival rate of 50% can generate profits. However, farming amidst the threat of EMS also meant that farmers are adjusting the farming methodology and we also have to keep up with their needs," said Suphot.

"As a new player, we can also feel the effects of EMS on the feed market in Thailand. Today, we are probably in seventh position in the shrimp feed market. However, we have the advantage that we are still a small producer with small volumes and that the TRF team in the field is well trusted. Our shrimp feed volumes are growing monthly," said Preecha.

The bottom line is to help farms achieve consistent results and TRF provides support to farms by training small groups of farmers and encourages them to share knowledge. This is in addition to services such as monitoring water quality and shrimp health in ponds. The team is also involved with the activities of the Thai Shrimp Association. Preecha said their key success factor is how well farmers trust the team of qualified technical staff.

"Our success will not just be through a continuous improvement and use of technological advances in feed production, strict control in production and traceability but also with the dedicated and expertise of staff in the feed business. We are committed to continuous training and improvement in knowledge so that our team can keep up with the latest in the industry and meet the expectations of farmers," said Preecha. "Farmers are our valued partners for a sustainable growth and our goal is to work together with them for their success."

In the next five years.

Both Thai Royal Frozen Foods and TRF feed mill have lateral and vertical expansion plans. With the recent acquisition of Golden Frozen Foods, Thai Royal Frozen Foods will export monodon shrimp to Japan and China. The raw material for processing will come from independent farms. The existing processing facility covering 150,000 m^2 with 10,000 tonnes of cold storage in Samut Sakorn now produces frozen raw shrimp and ready to eat shrimp products.

Production manager, Prasert Keatrojanakij (left) overseas the totally computer controlled feed production process, from raw material to finished feed

The two pellet mills

Its expansion is expected with production from recently acquired shrimp ponds. There are no plans to enter into fish farming although there will be an option of exporting frozen fish products.

Fish feeds production is now limited to the tilapia and catfish feeds but Preecha does not exclude the possibility of producing feeds for the sea bass by the end of 2014. With the twin screw extruder, there is a possibility of venturing into feeds for cobia and grouper, once the farming for these two species expands in Thailand.

"In the next 3-5 years, we would like to consider setting up a vannamei shrimp hatchery. We cannot do this for the mondon shrimp because of the bottleneck with domesticated brood stock. However, I am not sure whether we should enter the broodstock breeding program as for me, any misdirection will bring a dilution of efforts.

"Today, we have completed our first phase of the feed mill and soon we should be looking at the second phase where we aim to expand production to 200,000 tonnes per year. Of course, this will depend on the situation with the shrimp farming business but we could bring a new line of fish feeds. We have already started exporting small volumes of shrimp feed at 150 tpm."

Salmon boosts shrimp feed attractiveness

By Ian Wright

The hydrolysate from Scottish salmon by-products can be cost effective against fishmeal

Fishmeal was once the cornerstone of high quality shrimp diets, but increasing prices and limited availability has forced a re-think. As a result fishmeal is being increasingly replaced with lower cost vegetable and animal by-product proteins. When high levels of inherently unpalatable vegetable proteins such as soybean are used, effective attractants which boost consumption take on particular importance. Whilst feed manufacturers are able to least cost formulate for an optimised nutritional profile, such a formula is of limited use unless shrimp can locate and rapidly consume the feed. Rapid feed consumption will improve shrimp feed conversion ratio (FCR), reduce nutrient leaching and minimise the deterioration in the pond water environment.

Attraction to feed

Shrimp have poor eyesight and are initially attracted by particular chemicals released into the surrounding water. Chemoreceptors located on their antennae initiate feeding arousal and help gauge the distance to food. Different contact chemoreceptors on their mouthparts and legs are involved in food seizure and ingestion. Effective feed attractants are characteristically water soluble and closely related to the chemical compounds that are released from potential prey. Thus, substances that elicit strong feeding behaviour are protein derived amino acids such as taurine, proline, glycine, arginine, glutamic acid, and alanine together with other organic compounds such as peptides and nucleotides. In contrast, studies have shown that whilst fish oil tastes and smells fishy to humans, shrimp take a long time to detect it because oil is largely immiscible in water.

So where do we find effective attractants that fit the above criteria and do not involve non-renewable resources from marine environments? Fish by-products and trimmings left over from human consumption are the obvious answer. Some of these are the very same raw materials that would be traditionally converted into fishmeal. From a feed attraction stand point the most cost effective approach is to convert these fish by-products into fish protein hydrolysate to better mimic the attractant compounds found naturally in the shrimp's diet. The enzyme hydrolysis process digests large insoluble fish proteins into an abundance of more soluble amino acids and peptides, known to elicit strong attractant responses.

Salmon hydrolysate

A company producing such a fish derived hydrolysate is Rossyew Ltd, which produces hydrolysates from Scottish salmon by-products. The by-products are mostly viscera and liver which are acidified by the salmon processors before being processed by Rossyew. The salmon viscera are first hydrolysed using natural enzymes and then excess oil is removed by centrifugation. The hydrolysed protein fraction is concentrated by low temperature vacuum evaporation to produce a thick sticky liquid called Salmon Pro hydrolysate.

On a dry matter basis Salmon Pro is more cost effective than fishmeal and the hydrolysis process offers additional advantages. The salmon by-products are sustainably sourced and produce an attractant with functional advantages which deliver extra benefits to the shrimp producer. These benefits include heightened attraction, improved pellet quality and enhanced shrimp performance.

Typical amino acid composition (% of protein)			
Lysine	7.8	Histidine	1.5
Arginine	6.4	Aspartic acid	9.3
Threonine	3.8	Serine	6.0
Glutamic acid	14.0	Proline	4.5
Glycine	6.0	Alanine	6.0
Cysteine	0.7	Valine	4.9
Methionine	3.1	Isoleucine	3.9
Leucine	7.5	Tryosine	3.4
Phenylalanine	3.8	Tryptophan	1.2
Taurine	0.3		

The enzyme hydrolysis process effectively chops up large insoluble protein molecules into much smaller soluble amino acids and peptides which are able to rapidly diffuse into the surrounding water, so less fish derived protein is needed in the feed formulation. Salmon Pro is also a relatively rich source of the amino acids, taurine and glutamic acid both of which are known to trigger chemoreceptors that facilitate shrimp finding the feed. Taurine in particular is deficient in plant proteins, so high vegetable protein diets are likely to benefit from salmon hydrolysate supplementation.

The attractant effect can be clearly seen in experimental shrimp diets with low, or no fishmeal. In paired tray shrimp trials at Bangor University, Wales extreme diets with either zero (0%), or very high levels of fishmeal (40%) were used. In both diets, Salmon Pro was omitted or added at 5% by weight. It was found that the addition of the hydrolysate to the zero fishmeal diet produced the same attractant effect as using 40% fishmeal. This demonstrated that the hydrolysate

has an equivalent fishmeal attraction ratio of 1:16, giving considerable scope for fishmeal reduction in the formulation whilst retaining high levels of palatability. A combination of the hydrolysate and a higher percentage of vegetable proteins offers considerable formulation cost savings. Alternatively when added to the very high fishmeal trial diet, the attractiveness was further enhanced indicating that it is providing additional soluble attractors not present in fishmeal alone. Commercially, this hydrolysate is added into typical shrimp diets at just 2-3%.

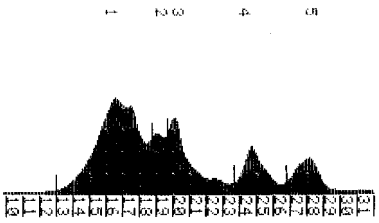
Pellet quality

This Salmon Pro has been shown to improve pellet quality. This is because hydrolysates contain partially digested peptides which are inherently sticky and which help to bind pellets. When the hydrolysate is added into the feed mixer the feed particles become coated in the hydrolysate and show better binding properties during the pelleting process. This Salmon Pro mixing method also gives a 'phased release' attractant effect which means that the soluble and emulsified hydrolysate nutrients diffuse out over a longer period of time resulting in more of the feed to be located and consumed.

Trials with the white shrimp *Litopenaeus vannamei* using trial diets with a range of fish hydrolysate concentrations (0-15% dry matter) found that low levels (3%) of fish hydrolysate are optimal for good growth performance and feed conversion efficiency. It appears that unidentified growth factors enhance growth even when used at low levels in shrimp feeds. It is thought that these performance improvements may be linked to diet digestibility improvement and/or enhancement of the immune response.

The use of fish hydrolysate attractants is likely to increase as the aquaculture industry uses more vegetable and non-fishmeal proteins. Adding low levels of fish hydrolysate to shrimp diets offers the feed formulator the opportunity of reduced feed formulation cost, improved feed conversion rates and optimal growth.

Molecular weight scan showing the range of peptide sizes



Legend:
Peak 1 – MW 4012 Daltons
Peak 2 – MW 1483 Daltons
Peak 3 – MW 950 Daltons
Peak 4 – MW 151 Daltons
Peak 5 – MW 38 Daltons

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Bacterial chatter – Quorum sensing

By Barbara Weber

Bacteria were once primarily considered as simple unicellular organisms which do not interact with each other. Today, many bacterial species are known to coordinate their behaviour at a multicellular level and not as single cells.

Quorum sensing, or bacterial cell to cell communication, in general describes the regulation of gene expression according to population density. Quorum sensing is mediated by small, diffusible signal molecules that can be viewed as languages. These molecules are continuously produced by bacterial cells. As the population grows, the concentration of the molecules increases and upon a certain threshold concentration triggers changes in gene expression and consequently the behaviour of the population.

Why would bacteria need to work as groups or employ communication and decision making processes?

Communication helps bacteria to decide whether it is worthwhile to invest energy in expression of genes for traits that put a high metabolic burden on the cells (Figure 1). Processes such as expression of virulence genes, biofilm formation, light emission, DNA uptake, production of antimicrobials and exo-enzymes and many other traits are costly and might only be successful under certain conditions, for example if the population is large enough to buffer losses due to the attacks from the host's defense system. Especially in terms of virulence, efficient and timely expression of virulence factors is crucial for a successful infection. But quorum sensing also provides information on the metabolic state of a community, species composition and competitors for nutrients in a certain niche.

In nature bacteria do not exist as pure cultures; they coexist with a plethora of other microbes, protozoans, higher organisms, etc. Thus, it is of advantage to know what other organisms are out there, how many they are, and what the 'neighbours' might be up to. Communication and coordination will aid the survival of the group and help populations to overcome obstacles.

Signal molecules - the different languages of bacteria

Signal molecules can be viewed as languages and during the last decades, researchers have identified and isolated a plethora of different signal molecules. The most common signal molecules are acylated homoserine lactones (AHL) for gram-negative bacteria and small peptides for gram-positive bacteria (Figure 2). Modifications such as variation in the length of the carbon side chain of AHLs, confer species-specificity.

Independent of gram classification, numerous species respond, detect, or produce the universal signal molecule AI-2. AI-2 represents a universal language comparable to English that allows transfer of information within a multispecies community. Some genera, for example, *Vibrios* have their own language that is not specific for a distinct strain, but specific for a group of related species. An example for such a molecule, was originally identified by Bonnie Bassler and her co-workers in *Vibrio cholera* and named cholera autoinducer 1 (CAI-1). Consequently, these genera can have several language levels: AI-2 for universal communication over species and genus boarders, CAI-1 for chatter within different *Vibrios* (certain language area), AHLs to talk within a certain species (regional dialect). All these molecules provide information on environment, species composition, presence of competitors for nutrients, and metabolic status of the community.

The basic system for AHL signalling is made up of a synthase for AHL production and a cognate cytoplasmic transcription factor for AHL detection (Figure 3). The AHLs diffuse from the cell into the surrounding environment and back. When they bind to the detector, expression of target genes is activated or deactivated. In *Vibrios*, researchers have discovered variants of these simple systems (Figure 4). Again, the different signals are detected by their specific receptors. These receptors are located in the membrane and part of sensor kinase and response regulator systems. Binding of the AHLs to their cognate receptors induces changes and this information is transferred via a complex regulatory cascade that leads to activation or deactivation of target genes. Each signal has a specific regulatory channel and information from each channel is converted into the same signalling cascade.

Figure 1: Communication helps bacteria populations to coordinate and overcome barriers.

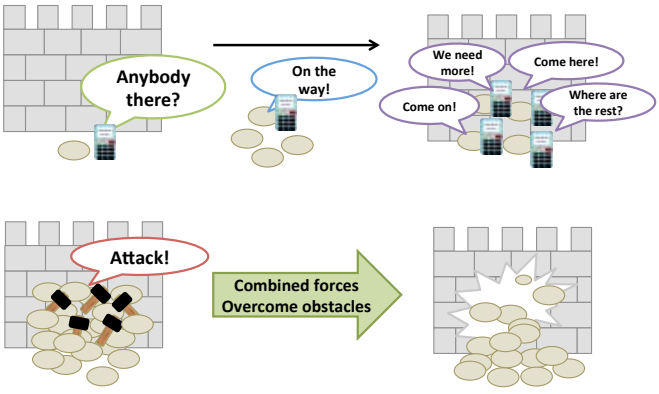
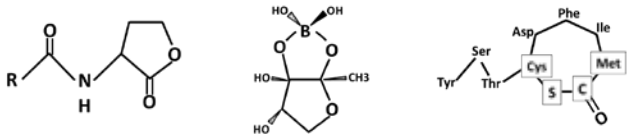


Figure 2: Signal molecules.



Cutting off communication lines – quorum quenching

Quorum quenching is the interruption or destruction of bacterial communication lines (Figure 5). Anything that disrupts or sabotages information transfer will interfere with group activities. When information is lacking or cut off, proper coordination of group activities is inhibited and thus traits regulated by quorum sensing do not function properly. In case of pathogens, quorum quenching could prevent outbreak of infectious disease, because the pathogens cannot arm themselves properly and are consequently more vulnerable and easier to kill. Deregulated expression of virulence factors is detrimental for the infection process. Additionally, quorum-sensing regulated traits that are important for survival are also disturbed and will repress the ability of the population to react to changes to their surroundings. Considering that microbial resistances towards antibiotics are increasing, quorum sensing, a mechanism not imminently connected to growth could provide a new target and means to control pathogens.

Targets for quorum quenching

The quorum sensing system provides several targets for sabotage – indicated as black stars in Figure 3. First, synthesis of signal molecules can be repressed or inhibited, thereby forcing cells to be silent and unable to talk anymore. Second, signal detection can be disturbed in several ways. Molecules that structurally mimic signal molecules bind to the detector and block access of the cognate signal molecule to its detector. Additionally these mimics will decrease the stability of the detector and often lead to its degradation. Third, signal molecules can be directly targeted. Signal molecules can be destroyed by enzymatic degradation, and thus, messages will never arrive at receiver cells. Not only enzymatic degradation, but also changing the pH or other environmental conditions will influence the stability of signal molecules. AHLs for example are sensitive to basic pH and undergo lactonolysis, whereas they have increased stability under acidic conditions. Depending on the structure of the respective AHLs, the optima can vary.

Naturally occurring quorum sensing inhibitors

Quorum quenching has evolved alongside quorum sensing systems and nature has already developed a variety of inhibitory mechanisms. Plants, algae, bacteria, etc. have developed strategies to spy on bacterial chatter or to sabotage communication. Plants such as garlic, ginseng roots, or vanilla beans contain compounds that block information flow. Essential oils or phytogenics such as tea tree oil, rosemary oil, cinnamaldehyde and even complex mixtures like honey harbour quorum quenching properties. One of the first molecules that could quench quorum sensing was discovered in a red macroalgae. *Delisea pulchra* produces halogenated furanones that mimic signal molecules and prevent access to the receptor. With the help of furanones, the macroalgae antagonises bacterial colonisation of its surface and thus prevents surface fouling.

Not only eukaryotes but bacteria as well have developed mechanisms to destroy and degrade AHLs. Species, like *Ralstonia* or *Variovorax* produce AHL acylase/amidase enzymes that target the amide bond of AHLs. Several *Bacillus* sp. produce AHL lactonases, enzymes that hydrolyse the lactone ring of the AHL. *Bacillus* sp. are often considered as beneficial bacteria or probiotics. Thus, a probiotic *Bacillus* strain targets pathogenic gram-negative bacteria in two

ways: first, production of antimicrobial peptides would allow killing or growth repression of a pathogen; second, production of AHL lactonases will interfere with communication and coordination and thus keep the activities of pathogens under control.

Detection of quorum quenching and practical examples

Several biosensor strains are available to test quorum quenching. In the presence of signal molecules these strains induce light production, purple pigmentation, fluorescence, or other easily detectable traits. If, at the same time, an inhibitory substance or enzyme that destroys the molecules is present, these traits are quenched (Table 1).

Table 1: Various tools to measure production of signal molecules and quorum quenching

Biosensor	Read out	Signal molecule	Developed by
Chromobacterium violaceum	Purple pigment	AHL	McClean, 1977
Escherichia coli	Green fluorescent protein Light production	AHL	Andersen, 2001 Winston, 1998
Agrobacterium tumefaciens	Blue color reaction	AHL	Luo, 2001
Vibrio harveyi MM32 *mutant*	Light production	AI-2	Miller, 2004
Vibrio harveyi JMH626 *mutant*	Light production	CAI-1	Henke, 2004
Vibrio harveyi BB120 wild type	Light production	AHL,AI-2,CAI-1	Bassler, 1997

However, care needs to be taken when quorum quenching traits are analysed. Cell-free probiotic supernatants, plant and algae extracts often contain antimicrobial substances or reduce pH and thereby repress bacterial growth. Consequently the quorum-sensing related trait will not be produced. Thus, it is important to test a broad range of concentrations to find a concentration where quorum sensing is quenched, but growth is not affected.

In our laboratories we took advantage of the biosensors described in Table 1 and tested a variety of aquaculture pathogens for production of signal molecules, several *Bacillus* probiotics and also phytogenic substances such as cinnamaldehyde for inhibition of quorum sensing.

First we used different aquaculture pathogens and tested whether they were producing AHLs, AI-2 and CAI-1 (Table 2). All five pathogens produced AHLs and AI-2, though at different levels. Production of CAI-1 was only observed in *V. harveyi* and *V. parahaemolyticus*.

Extract of cell-free culture supernatant of several probiotic *Bacillus* strains was harvested and tested for quorum quenching and putative presence of an AHL lactonase (Figure 6). As shown in Figure 2 addition of the *Bacillus* supernatant extract to 10% did not affect growth but reduced light production, a trait regulated by quorum sensing. This was concentration dependent, as lower concentrations did not have a pronounced effect on light production.

In Figure 7 the effect of cinnamaldehyde at different concentrations was tested. At a concentration of 100 ppm, cinnamaldehyde was antimicrobial and repressed growth of the biosensor strains, at 10 ppm quorum quenching was observed and at 1 ppm cinnamaldehyde did not interfere with quorum sensing or bacterial growth.

Table 2: Presence of different signal molecules in representative gram negative aquaculture pathogens. Cell-free culture supernatants were mixed with biosensors and luminescence was recorded after 24 hours.

Pathogen	AHL	AI-2	CAI-1
Aeromonas salmonicida	+	+++	nd
Flavobacterium indologenes	++	+	nd
Vibrio harveyi	+	+++	++
Vibrio parahaemolyticus	+	++	+
Yersinia ruckeri	+++	+++	nd
Nd-not detected; + RLU < 50000; ++ RLU 50000 – 100000; +++ RLU > 100000			

Figure 3: Basic mechanism of quorum sensing in gram-negative bacteria. Targets for quorum quenching are labelled with a black star.

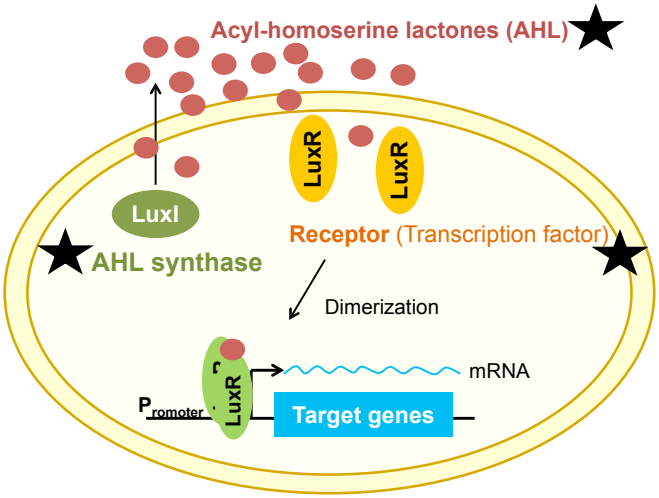


Figure 4: Possible quorum sensing circuits in *Vibrios*.

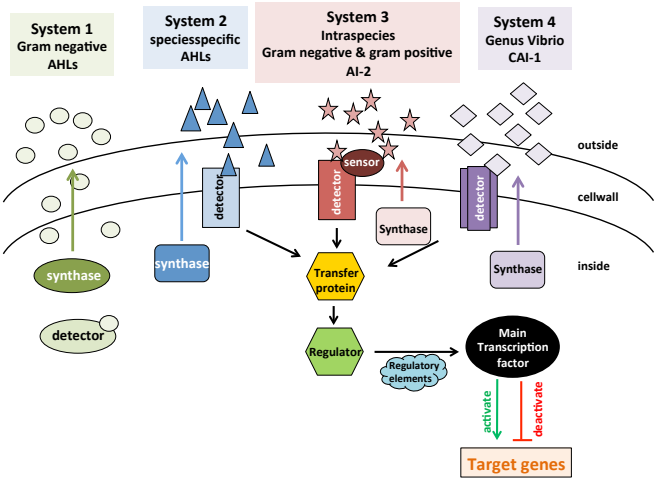


Figure 5: Quorum quenching will leave bacteria disoriented and vulnerable.

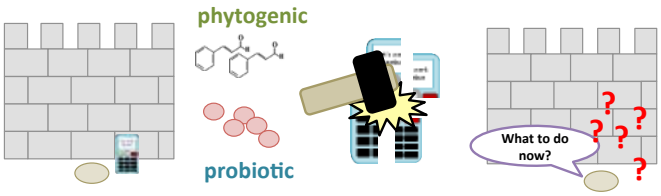


Figure 6: Supernatant of a probiotic *Bacillus* was tested for quorum quenching and potential production of AHL lactonase. First, light production was induced by a signal molecule. Second, probiotic supernatant was added at different concentrations. Third, light production and growth were recorded five hours later. The green star indicates quorum quenching.

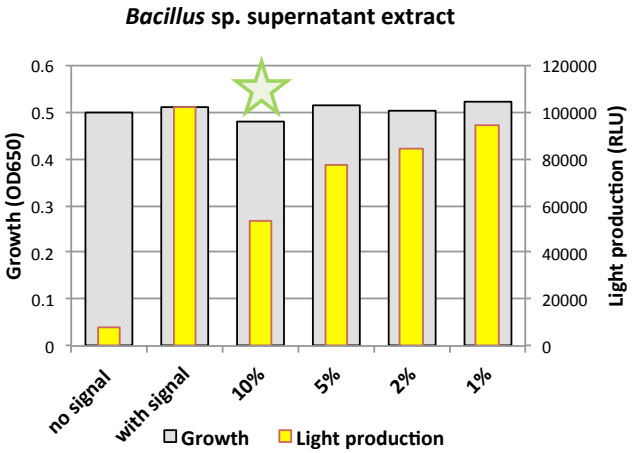
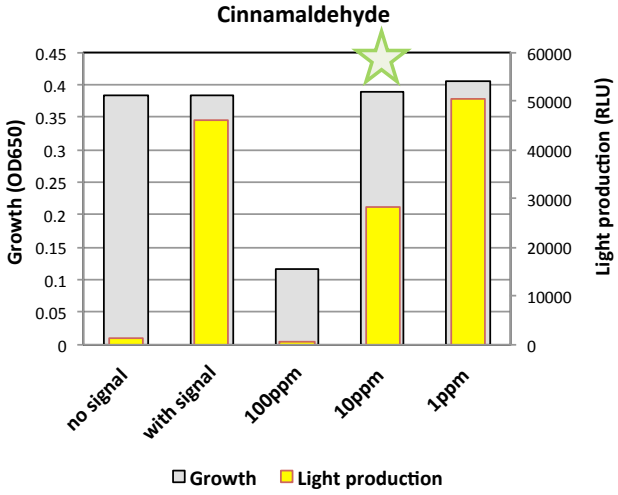


Figure 7: Different concentrations of cinnamaldehyde were tested for inhibition of light production. First, light production was induced by a signal molecule. Second, cinnamaldehyde was added. Third, light production and growth were recorded after five hours. The green star indicates quorum quenching.



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The fundamental role of peptides in fish and shrimp nutrition

A Pepti-day to share latest performance information in various aquaculture species.

Nguyen Ahn Ngoc (standing) with guests from Vietnam

From left, Dr Fuci Guo, Malaysia, Philippe Sourd, Vincent Percier and Thomas Wilson.

In December, prior to the Asian Pacific Aquaculture conference 2013 in Ho Chi Minh City, Vietnam, AQUATIV, producer of functional hydrolysates, and part of the Diana group, France held its first international conference in Asia. This Pepti-day was held to share the latest performance demonstration tests in various aquaculture species and to show how fresh raw marine proteins can be turned into highly valuable ingredients: bioactive peptides. The Aquativ team also made presentations on functional peptides, industrial processes and protein bioscience. The conference had participants from 10 countries.

Nguyen Ahn Ngoc, Technical sales manager Vietnam and Thomas Levallois, sales director, France, welcomed participants with a brief introduction on how Aquativ grew to be a world leader in the marine functional peptides sector. Levallois described how the company has built dedicated aqua teams across the world. Vincent Percier, general manager, Diana group, Thailand described Aquativ's partnership with TC Union Co, Thailand's leading producer of seafood. Through this, Aquativ manages to get the freshest and most reliable and traceable sources of marine co-products, via a very short supply chain and strong bonds with its raw material supplier. This strategy now allows the company to process raw materials from species as varied as tuna, krill, tilapia, shrimp, squid and hake across the company's worldwide industrial network.

Dr Vincent Fournier, head of R&D explained how marine hydrolysates are produced. He explained how the sophisticated controlled enzymatic hydrolysis process brings out the true potential of marine proteins. This is the only process that allows for a high level of product standardisation and associated performances consistency. The powerful techniques used to assess product profile, *in-vitro* anti-microbial and antioxidative performances were described. He also showed how it was possible to determine what the most active fractions are as well as their protein of origin within the co-product.

The benefits for fish and shrimp health and nutrition were discussed by Dr Philippe Sourd, fish health specialist, Aquativ. Short chain peptides and all other low molecular weight nitrogenous compounds concentrated in Aquativ's portfolio improve fish and shrimp growth as well as resistance to diseases. The claimed benefits include increased feed intake, better nutrition and enhanced animal health, and these benefits were qualified by tests results.

How hydrolysates enhanced non-specific immune system and pathogen resistance of marine finfish (Olive flounder, *Paralichthys olivaceus* and Red seabream, *Pagrus major* was described by Dr Kyeong-Jun Lee, University of Jeju, Korea. Lee showed results which highlighted the significant amounts of fish meal that could be replaced with functional hydrolysates without any adverse effect on fish health and gut structure.

Taking a step further into basic science, Dr Chantal Cahu, head of Aquaculture and Biotechnology, Ifremer shared her knowledge on larval nutrition with her many years of work in marine finfish larval development and nutritional requirements. She described the most modern investigation techniques that now allow scientists to better understand specific digestive physiology and nutritional requirements for fish larvae (lipid, phospholipid, unsaturated fatty acids, vitamins and peptides). She explained how this contributed to a complete replacement of live prey by compound diets and how this can be carried out in fish larvae as early as first feeding in several species.

Dr Sutep Luengyotluechakul, Business Development manager - Southeast Asia, Dr Orapint Jintasataporn, Kasetsart University (middle) and Nguyen Hong Chinh, R&D manager, Vina Dong Thap, Vietnam (right).

Kyeong-Jun Lee

The practical aspect of farming was provided by Warren Turner from Nam Sai Farm in Thailand. Based on his years in farming tilapia in Thailand, Turner explained that good care, quality feed and understanding nutrition of tilapia are keys to producing robust and healthy fry for markets. He highlighted that nowadays, there are many ingredients and additives available which can provide good growth performances. As such each person must decide and find the appropriate solutions to suit their needs and specific farming conditions.

Two aquaculture nutritionists presented on aspects in feed formulations, nutritional requirements and economical considerations. Dr Thomas Wilson, Thailuxe, Thailand gave a captivating presentation on amino acids, peptides and functional feeds, by describing fish amino acid requirements and the dynamics of models. Wilson illustrated how specific essential amino acids requirements can change through the life cycle of fish, with for instance requirements changing with mucus production or gut health. In the latter he described how diseases of the gut often increase metabolic demand for amino acids. Tissue damage reduces digestive and absorptive capacity and therefore use of hydrolysates is an effective way of providing the full complement of amino acids, peptides and nucleic acids needed to maintain animal health.

Dr Richard Smullen, Ridley Aquafeeds, Australia, stressed that least cost formulation is not always necessarily the right answer. He stated that appropriate formulation, wise use of ingredients and careful applications yield substantial benefits for farms and secure win-win relationship between farms and feed suppliers. Smullen's presentation on the use of peptides to bring about 'lowest cost of production' rather than 'lowest cost of feed' led him to give quantified details of improved growth, feed conversion ratio and health obtained in Tasmanian salmon farms following from the use of Ridley's formulas containing hydrolysates.

The Aquativ team, Paul Seguin, Thailand and Romy Tambunan, Indonesia explained in detail how functional hydrolysates could be used locally. While the local range of Aquativ ingredients and recommended uses were described, specific technical attention and details were given for using and applying hydrolysates in liquid and concentrate forms in feed mills.

Lastly, Levallois said, "We are extremely proud to have the support from several partners and customers amongst the speakers, who all gave truly brilliant, very illustrative and practical talks on fish and shrimp applied nutrition."

2014 Global feed survey

Highlights of the survey reveals a small increase in global feed tonnage in 2013 to 963 million tonnes

Since 2011, Alltech, the global animal nutrition company has conducted an annual survey on the global feed industry. The result of the third assessment carried out in December 2013 showed a one percent increase in compound feed production at 963 million tonnes, up from 954 million tonnes. The value of the industry at USD500 billion is higher than the previous USD350 billion.

In 2013, the global feed industry did not break the one billion tonne level in 2013, given the continued growth in the consumption of animal proteins, according to Aidan Connolly, vice president of Alltech and director of the annual Global Feed Tonnage Survey. He added that the slower growth in feed production was likely influenced by a series of droughts that has plagued more than 30 countries worldwide in 2012, which in turn, has driven up the price of raw feed materials and food prices.

Among the 130 countries assessed in Alltech's survey, the Asia Pacific region is the leading producer at 348 million tonnes. China was once again the number one country producing feed at 189 million tonnes from an estimated 9,500 feed mills. The US and Brazil ranked second and third respectively, with the US producing 169 million tonnes from 5,236 feed mills and Brazil generating 67 million tonnes from 1,237 feed mills.

Connolly showed that there was an observed decline in the number of feed mills in China, likely driven by government policy, which favours a smaller number of larger feed mills to facilitate traceability and improvements in quality, and the continued demand by urban consumers for further processed proteins from larger farms. The survey showed that Asia also had highest feed prices, averaging around USD524 per tonne for pig finisher diets and around USD480 to USD553 for laying hens and broiler finisher diets. With a significant drop in cereal prices during the final months of 2013, the respondents expect the feed prices will be lower in 2014, resulting in a year of recovery and a return to stronger growth in terms of tonnes of feed produced.

In terms of percent growth in comparison to the December 2012 figures, Africa was reaffirmed as the fastest growing region. Countries such as South Africa, Cote d'Ivoire, Senegal, Mauritius and Namibia all experienced production increases, boosting Africa's combined tonnage seven percent to just short of 31 million tonnes in 2013. The Asia Pacific region with one third of global animal feed production in 2013, did not grow in 2013.

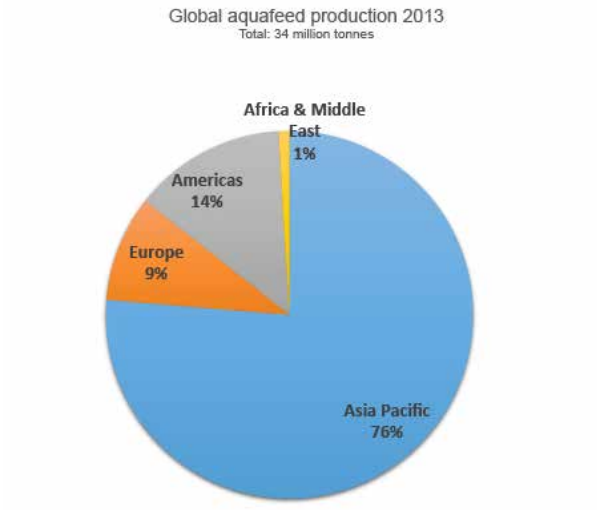
Globally, feed mills produced an average of 34,140 tonnes. The Middle East is estimated to have the largest feed mills by average tonnes per year at 176,189 tonnes whilst the lowest is in North America at 36,456 tonnes. About 60% of all feed produced is pelleted, and this is even more prevalent in Europe.

Fastest growth

Aquaculture was the star performer again, with a 17% increase in 2013 to 34 million tonnes. The Food and Agriculture Organisation of the United Nations (FAO) trends suggest that global consumption total of farmed fish and shellfish now exceeds beef on a weight basis. The survey listed the top 50 aquafeed producing countries producing 38.7 million tonnes with the most numbers in Asia, followed by Europe with 4.3 million tonnes. The top 12 countries in the Asia Pacific region produced with 31.03 tonnes. China led with 23.36 million tonnes, followed by Vietnam, Indonesia, India and Thailand.

2013 aquafeed production by the top 12 countries in the Asian Pacific region (million tonnes)

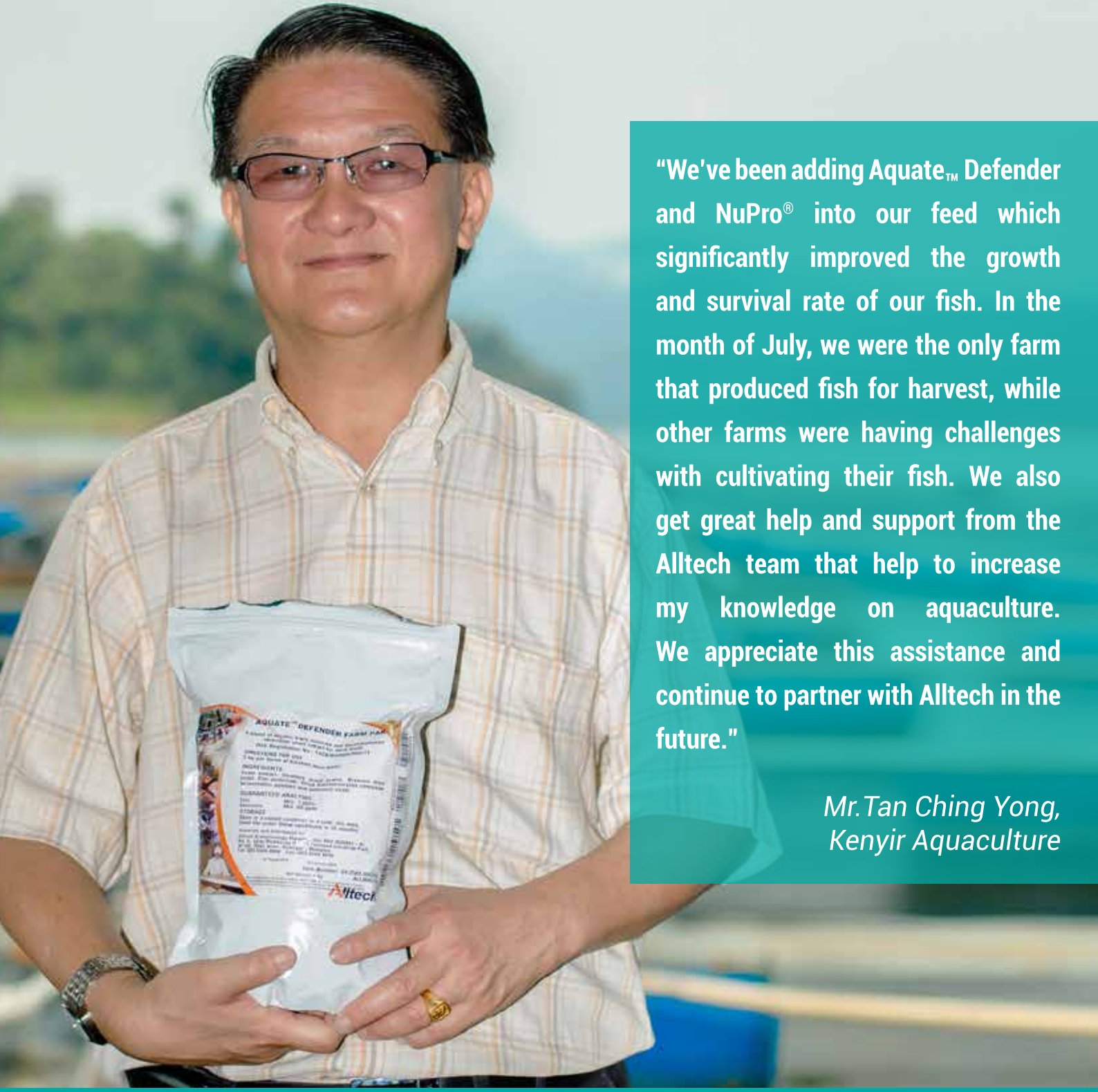
China	23.36
Vietnam	1.5
Indonesia	1.2
India	1.1
Thailand	0.9
Philippines	0.61
Bangladesh	0.6
Japan	0.4
Taiwan	0.4
Australia	0.375
Korea	0.3
Malaysia	0.16
Myanmar	0.128
Total	31.03



Alltech recognises that obtaining global feed production statistics have traditionally been difficult to quantify. In this survey, similar as in 2012, where possible, the company gathers information in partnership with local feed associations. In cases where this was not possible, it utilised information collected by the more than 600 members of Alltech's global salesforce, who visit more than 28,200 feed mills annually. When reviewing the data, there are two considerations to bear in mind. First, numbers for less developed countries may be less accurate, but given their size, this will have little numerical influence on the overall dataset. Second, the definition of feed, feed mill and species varies from country to country. Nevertheless, information from this third annual survey can serve as a more accurate estimate of the world's feed tonnage and trends.

The summary of the 2014 Alltech Global Feed Survey findings, including graphs, may be downloaded at http://www.alltech.com/sites/default/files/alltechglobalfeedsummary2014.pdf.

"Farming. It's what we do."



"We've been adding Aquate™ Defender and NuPro® into our feed which significantly improved the growth and survival rate of our fish. In the month of July, we were the only farm that produced fish for harvest, while other farms were having challenges with cultivating their fish. We also get great help and support from the Alltech team that help to increase my knowledge on aquaculture. We appreciate this assistance and continue to partner with Alltech in the future."

Mr.Tan Ching Yong,
Kenyir Aquaculture

It's what we do that makes it more profitable.

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Philippines target grouper farming for live fish exports

By Rafael D. Guerrero III

With a short transit time to China and Hong Kong markets, Philippine producers have an advantage for live fish exports.

Groupers are highly-valued for their exquisite taste and texture. In the Philippines, they are served in exclusive hotels and restaurants. In the waters around the country, there are 40 species of the fish known as 'lapu-lapu' but only three speices, the green grouper *Epinephelus coioides*, and the brown marbled grouper *Epinephelus fuscoguttatus* and red grouper *Plectropomus leopardus* are farmed in the country, either in brackish water ponds or marine net cages.

Green grouper fry are now produced all-year round by a local commercial hatchery. Brown marbled grouper fry and fingerlings are still gathered from the wild by fisherfolk from tidal rivers, estuaries and coastal bays during the spawning season from November to June. The fry are gathered in bamboo traps while fingerlings are caught by baited hook and line.

According to the Philippine Bureau of Fisheries and Aquatic Resources, the suitable sites for cage culture of grouper are lagoons, coves and bays that are free of pollution and protected from strong winds and currents. A salinity range of 25 to 35 ppt for grow-out is desirable. The water transparency should be higher than 3 m and water depth should not be less than 3 m during the lowest low tide.

From the wild, the fry measuring 2 to 3 cm in body length are first conditioned for a month in plastic or concrete tanks at 20 to 30 ppt and fed with minced trash fish, small shrimp *(Acetes)* or *Artemia* three times a day at 0600, 1200 and 1800 hr. To avoid cannibalism, the fry are sorted by size every two weeks to separate out the fast growers or 'shooters.'

After conditioning, the 3 to 5 cm juveniles are stocked at 60 to 100 fish/m^3 in 2m x 2m x 1m nursery net cages with a mesh size of 2 to 5 mm and submerged in the pond 0.8 m below the waterline. Shelters made of bamboo tubes that are 5 cm in diameter and 15 cm long are tied in a triangular bundle and suspended inside the cages to allow the fish to hide. The juveniles are fed with finely chopped trash fish, small shrimp and/or formulated feed to satiation three times a day as in the conditioning tanks. Sorting of the fish by size every two weeks is also carried out. After two months of rearing, the 8 to 10 cm long juveniles are stocked in grow-out cages in the sea.

Farming groupers in sea cages

Green grouper, picture courtesy Finfish Hatcheries, Inc.

Grow-out cages are made of 2 to 3 cm mesh size polyethylene nets with bamboo or wooden planks and plastic drum floaters measuring 2 m x 2 m x 1 m to 6 m x 6 m x 3 m. Cages with double layered nets (to prevent escape of the fish) are stocked with juveniles at 10 to 30/m^3 for the 4 to 6-month culture period with feeding of the formulated feed at 5% of body weight per day or with chopped trash fish fed to satiation every other day. Shelters made of bamboo tubes that are 10 cm in diameter and 30 cm long are also placed in the grow-out cages and the nursery cages. The anchored cages are checked regularly for tears and cleared of fouling organisms.

Production efficiency

While many grouper farmers still rely on trash fish as their main source of feed, there is a growing trend in the use of formulated feeds for efficiency and economy, according to Daniel Cabrera, market creation manager at Tateh Feeds, a subsidiary of Santeh Feeds Corp, Philippines. In a comparative study using formulated feeds and trash fish in the culture of the green grouper in 6 m x 6 m x 3 m sea cages, it was shown that the fish fed with pellets only had higher final body weight and survival and lower feed conversion and feed cost than fish given trash fish only (Table 1).

Table 1: Production costs for the culture of green groupers in sea cages

Parameters	Pellet-fed fish	Trash fish-fed fish
Stocking density	10	10
Initial body weight (g)	25	25
Final body weight (g)	563	532
Days of culture	180	180
Biomass/cage in kg	369	326
Survival (%)	91	85
Feed Conversion Ratio (FCR)	2	8
Feed cost (USD/kg fish)	2.90	3.70

Source: Daniel V. Cabrera, Multi species profit evaluation of Philippine aquaculture: Santeh 25 years of experience, presented at the Asian Pacific Aquaculture 2013, Vietnam, 10-13 December, 2013.

Collecting fingerlings, picture courtesy of Finfish Hatcheries, Inc.

Live markets, domestic and export

The main market is that for live fish, either domestic or export. The grouper is marketed at sizes of 0.4 to 0.6 kg/fish. The domestic market is primarily the big hotels and seafood restaurants in cities particularly Metro Manila, which pays 3-5 times the normal price for live grouper weighing between 400-1,000 g body weight. Farm gate prices can range from USD 9.30 for the green grouper and USD 13.95/kg for the red grouper depending on the size of the fish.

At harvest, the fish are not fed for 24 hours and kept in conditioning tanks for 1 to 2 hours with a water temperature of 18 °C before being transported live. Two to three fish are placed in oxygenated double-sheet plastic bags with 3 to 5 cm of water and packed in styrofoam boxes.

In his presentation, Cabrera said that the Philippines has a good potential to expand production. The government is promoting culture of the groupers and other high value marine fish and shellfish in some 66 mariculture parks all over the archipelago. Aside from producers in Taiwan, Philippines producers have the advantage of a short transit time to the live fish markets in China and Hong Kong. The transit time is only 3 days in comparison to 5-13 days for other producers in South East Asia - the fastest being those in East Malaysia, followed by West Malaysia, Vietnam, Thailand and Bali, Indonesia.

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Live fish trade in Asia in 2013

By Fatimah Ferdouse

Price fluctuations seen with the demand and supply of mainly hybrid groupers.

Tropical finfish such as several species of the grouper are popular in the producing countries in East Asia and also in the import markets namely Hong Kong, China and Singapore. The region's largest live fish market, China, is catered by local and imported supplies whilst Hong Kong and Singapore markets are heavily depended on imports. Supplies to mainland China are also channeled through Hong Kong which is the largest trading centre for imported live food fish in Asia. On the production side, Taiwan and Malaysia are the top suppliers to the live fish markets followed by Indonesia, the Philippines, Vietnam and Thailand.

Hong Kong imported more hybrid groupers as price softened

In Hong Kong, imports of all types of live groupers (foodfish) increased over the years from 9,400 tonnes in 2011 to nearly 12,000 tonnes in 2013. Grouper imports under the heading 'other groupers' category mainly consisted of farmed hybrid grouper for which supplies increased sharply by 52%.

Meanwhile imports of the expensive coral trout grouper posted negative growth (-4.1%) which could be linked with the cooling down of demand in main land China. Imports of other live marine food fish such as the snapper in this market were also significantly up (+19% in volume). Overall imports of live marine food fish in 2013 totalled 11,795 tonnes in Hong Kong valued at HKD1.06 billion (USD136 million), up by 10.0% in quantity and 3.6% in value.

As a market China is considered the largest for all types of live seafood, also catered for by the large domestic production. Notably, imports through Hong Kong is reasonably high. However, direct imports into mainland also increased over the years.

During the last one and a half years, demand for high value seafood including live grouper in China was affected by the government's drive to cut spending of public funds on banquets. Many upscale restaurant chains reported lower sales during late 2012 and in 2013. As a result, demand for the high range of groupers declined significantly from the restaurant trade. This also prompted a decline in prices of the cheaper range of hybrid groupers but created a larger demand in the market, particularly for locally farmed fish. At the same time grouper imports into China weakened from 16,500 tonnes in 2012 to 16,200 tonnes in 2013. Taiwan supplies more than 14,000 tonnes of groupers to this market in 2013.

Annual imports of live marine food fish in Hong Kong in 2012 and 2013

	2012		2013		Change (%)	
	tonnes	HKD1000	tonnes	HKD1000	quantity	value
High-finned grouper	0.3	83	0.9	103	+20.0	+24.1
Leopard coral trout grouper	3 111.2	491 973	2 983.6	464 555	-4.1	-5.6
Spotted coral trout grouper	37.2	5 730	20.6	3 099	-44.6	-45.9
Green grouper	3 355.2	187 811	3 373.4	194 309	+0.5	+3.5
Tiger grouper	580.7	42 253	494.7	30 140	-14.8	-28.7
Flower grouper	34.2	5 061	9.9	1 470	-71.1	-70.9
Giant grouper	0	0	197.7	15 603	+19.0	+24.7
Other groupers	1 317.5	136 444	2 084.5	160 111	+52.1	+17.3
Sub-total groupers	**8 436.3**	**869 355**	**9 085.3**	**869 389**	**+7.7**	**0**
Mangrove snapper	10.5	252	-	-	-	-
Other marine finfish	2 277.6	149 128	2710	185 941	+19.0	+24.7
Total Marine finfish	**10 724.4**	**1 018 735**	**11 795.3**	**1 055 330**	**+10.0**	**+3.6**

Source: AFDC, Hong Kong SAR

Pictures show hybrid grouper farming at SZ Two Enterprise, Tok Bali, Kelantan on the east coast of Peninsula Malaysia. The 10 cm fingerlings are from Singaraja, Bali, Indonesia. The feed conversion ratio is less than 1 when fed with feed from Taiwan mixed with trash fish. During the monsoon season, this hybrid grouper can tolerate low salinity such as 8ppt. The normal salinity is 26-28ppt. (Information and pictures by Ku Azhari Ku Baharum)

Taiwan

Grouper farming is one of the island's foremost aquaculture sectors, attributed to its mild climate as well as its advanced grouper breeding and farming techniques. Since 2010, Taiwan has been the top supplier to China through the signing of an economic cooperation agreement. This was then supported by the resumption of direct flights across the Taiwan Straits, the employment of vessels capable of transporting live fish as well as the Early Harvest List stipulated by the Cross-Strait Economic Cooperation Framework Agreement (ECFA). Under the agreement, China also granted preferential tariff for live groupers imported from Taiwan. In 2012, 70% of exports went to China, according to the Council of Agriculture.

The export value of Taiwan-bred groupers to the main markets Hong Kong and China, reached USD1,554 million in 2013, which was lower than in the previous years (USD 197 million) due to falling market prices. But the volume was higher from 15,500 tonnes in 2012 to 17,710 tonnes in 2013. The expansion of production in 2012 in Taiwan, brought down grouper prices by 23% in Taiwan and in the case of the green grouper to below cost of production. In 2012, Industry sources said their profits dropped between 10 and 20% due to competition from mainland farmers from Hainan Island which pushed down prices.

At the same time, Chinese producers expanded production in Fujian and Zhejiang provinces with the indoor culture for the tropical grouper. Hatchery reared fry and local production has brought down prices to an affordable CNY 60/kg in 2014 in China, according to China Fisheries Network. Hainan Island also raised Taiwanese species of groupers which they call 'dragon tiger grouper'.

In addition to the vast Chinese market, Taiwanese grouper farmers are now eyeing Europe and the United States, for recent developments in instant freezing technology now allows for live fish to achieve -70°C within 3 hours, a technological feat that can preserve and prepare fresh seafood for long-distance transport.

Malaysia

The situation in China also affected Malaysia's grouper exports to Hong Kong which declined from 8,000 tonnes in 2011 to 6,667 tonnes in 2012. The falling price however, created more demand from the medium range restaurant groups and exports increased to nearly 7,000 tonnes in 2013 from Malaysia to Hong Kong. Singapore is the largest export market for Malaysia's live food fish, (groupers and Asian sea bass). More than 1,000 tonnes of live food fish were also exported to Thailand from Malaysia in 2013.

Recently, fish prices have improved in the market benefiting grouper farmers in Malaysia. According to an industry source, the ex-farm price of hybrid grouper has increased to around RM 38-41/kg (USD11.9-12.8/kg) after dropping to RM30/kg in 2013 (USD9.4/kg). Improved demand in Hong Kong and China and low supplies from Hainan (China) seem to be the main reasons for the revival of prices. In Hong Kong, hybrid grouper of size 1.3kg/fish, popular for functions such as wedding banquets, are supplied by the fish farmers in Pulau Ketam and Penang.

The hybrid (tiger x giant) grouper is a favourite among producers in Malaysia because of the fast growth rate and high survival. The fish grows to one kg within 8 months in comparison to the tiger grouper which takes 1.5 years. The demand for the giant grouper is for sizes more than 3kg. Survival rates ranged from 70-80% in clean waters to as low as 30-40% in areas with poorer water quality. The fast growth allows for two crops but a shortage of good quality seed from hatcheries in Bali since early 2014 is expected to lower supply in 2014, said Ku Azhari Ku Baharum, a major supplier of hybrid grouper fingerlings in Malaysia.

Fatima Ferdouse is responsible for the trade promotion at Infofish. Based in Kuala Lumpur, Infofish is an intergovernmental organisation providing marketing information and technical advisory services to the fisheries and aquaculture industry in Asia-Pacific region. Email: fatimaferdouse@hotmail.com

The market for European bass and bream

By José Fernández Polanco

The 'Greek sea bream crisis' occurred when supply grew in an uncontrolled and unplanned way.

Harvesting seabass at the Pınar Balık-Çamlı Fish Farm, Turkey. Picture courtesy of Hasan Girenes, Yasar Holdings.

Gilthead seabream *Sparus aurata* and European seabass *Dicentrarchus labrax* are the two most relevant fish species farmed in the Mediterranean Sea. According to FAO, production reached 300,000 tonnes (48% seabass and 52% seabream) in 2011. However, some farmer associations raised this figure and provided different volumes according to their estimations. The European Union and Turkey account for 85% of the world production of these two species. However, despite the growth in production, bass and bream producers face periodical financial difficulties which are affecting the development of the industry.

Present status and brief industry timeline

Global production of European seabass in 2011 was around 144,000 tonnes, valued at €619 million. Turkey and Greece are the world leading producers with 33% and 31% of the weight and 29% and 31% of the value produced, respectively. The EU produced 73,000 tonnes, valued at €359 million, in 2011, accounting for 50.7% of the global weight and 58.0% of the value. Within the EU, the main producer is Greece with 44,100 tonnes, followed by Spain and Italy with around 17,700 and 6,500 tonnes, respectively.

Global production of gilthead seabream in 2011 was around 155,000 tonnes, valued at €667 million. Greece is the world largest gilthead seabream producer, accounting for 46% by weight and 43% by value. The EU produced near 99,000 tonnes, valued at €435 million, which represents 63.8% by weight and the 65.2% by value. In the EU, the main producer is Greece with almost 71,000 tonnes followed by Spain with more than 15,000 tonnes.

Wild bass and bream have been popular species for consumption all over the Mediterranean region since the ancient times. Early history of fattening seabream came from the late Roman Republic (I BC), reported by Plinius the Elder. Modern culture of bass and bream started in Italy during the 1970s, and resulted in an interesting and profitable industry for the national finfish aquaculture, focused on trout. Other countries started in the mid-1980s, with Spain being the second largest producer. In 1985 Greece entered into the sea bream business and with strong growth propelled the country into first position within five years, accounting for a 34.9% of the total production. During the 1990s, production increased 18 times, reaching a peak of 158,000 tonnes in 2000.

Greek seabream crisis

The trend continued during the last decade of the 20th century reaching a turbulent point, which was known, as the 'Greek sea bream crisis'. As the business was profitable, Greek farmers kept increasing production and supply grew in an uncontrolled and unplanned way during the decade, collapsing the market.

Turkey, with a potential for growth contributed to the increase in supply. When firms entered into periodical crisis of losses and financial difficulties, the EU financial crisis was a turning point which questioned the economic future of the industry.

The debt crisis is expected to negatively affect the European production of seabream and seabass in future years, especially in Greece. An absence of credit in the Greek economy is expected to further limit the production and at the same time force more concentration in the sector. Price is expected to be volatile as companies will be forced to sell livestock in order to acquire liquidity.

Sea bream in Spain

Marketing and retailing

As commodities, farmed bass and breams in the Mediterranean are sold under retailers' promotional effort, transferring their image onto the product. Store formats are reported to be a significant factor affecting the intensity of product labeling in Spain and Italy. In traditional stores the format for the regulatory label is often incomplete or non-existent. This issue makes the supermarket chains and hypermarkets a better place to market farmed species with assured traceability for end consumers. As a result of these differences in labeling practices, many consumers ignore whether they are buying wild or farmed sea bream, and farm raised species tend to be underestimated when compared with their wild equivalents.

Although some marketing initiatives, including processing and branding, were proposed in order to improve producer's margins, actions taken by farmers to control production supported by European and local governments, returned partial stability to the markets.

Farmed sea bream continued to be sold unprocessed and under an unbranded scheme. Attempts of branding local products were undertaken by Spanish and Italian producers, but they failed to secure a place in the stores. Lack of interest by retailers on seafood brands was the main issue pointed by Spanish producers when explaining this failure.

Despite initial failures, the industry continued with attempts to develop branding and consumer oriented value added products, which found some acceptance in the markets of Belgium and Germany. However, the expansion of the market outside the Mediterranean is not relevant enough and the bulk of the supply is still focused in the main producing countries where it is being sold unbranded and unprocessed by the majority of the retail firms.

Common in the Med

Within the Mediterranean markets, bass and bream are very common and available. According to the Spanish Panel of Food Consumption, the average prices do not differ too much from one retail format to another, where supermarkets are the cheapest place to buy the two species and traditional fishmongers, the most expensive.

In 2008 the average price per kilogram of sea bass and bream was, respectively, €6.47 and 6.31 at supermarkets, while it was €7.2 and 7.14 at traditional community fish markets and neighborhood fishmongers.

During the period from 2004 to 2008, hypermarkets sold 18.6% of the total sales of both species, and supermarkets sold another 47.5%. In both cases the market share for sea bream in the self-service retail sector is slightly larger than that for total seafood. The traditional retail formats account for the rest of the final consumer's market share. Community fish markets sold 11.9% and fishmongers, 22%.

Sea bass in Spain

In both cases these quotas are lower than their total seafood market share. In the same period supermarkets raised their participation in total seafood sales in Spain to 12.9%. This increase in the retail market share was favoured by the proximity of their facilities to the urban and suburban areas, and the progressive inclusion of fresh food sections. Hypermarkets and traditional fish markets remain stable both in their sales of total seafood and sea bream, while traditional fishmongers showed a decreasing trend since the late 90's. A similar trend, with almost the same market shares across store formats, can also be observed in the evolution of seafood retailing in Italy.

Main industry bottlenecks

Fragmentation of the industry across and within producing countries has been highlighted as one of the key factors explaining the gaps between total supply and demand. This is the main cause of the volatility in the prices resulting in frequent negative financial returns. Despite the efforts of the biggest companies, in particular Greek firms, for industrial concentration, attempts have not reached the required levels and there still remains a large number of small and medium companies. This not only affects the ability of a market oriented output control, but also limits the negotiating power of producers in front of the large wholesalers and retailers. Due to fragmentation, the power of the industry for setting market prices is limited and, in most cases, producers have to accept the prices fixed by wholesalers and retailers.

Until now, the companies have focused on increasing production and cost efficiency, but soft final prices have resulted in returns lower than expected. In many cases, the investments in new and improved capacity have not seen returns but has increased the level of industry's debt. Lack of real market orientation adds additional risk in periods of high supply.

Differentiation and value added products have been pointed as potential solutions. However, from a retailer's point of view, all perishable goods substitute each other in attracting consumers. Undifferentiated generic species can be easily replaced with a multiplicity of providers making consumer oriented differentiation efforts from producers less interesting. Failures in differentiating strategies such as branding or processing makes price the only competitive tool for the majority of the European bass and bream producers.

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Support to help China's aquaculture challenges

China, the world's largest aquaculture producer with close to 70% of the global aqua industry, is however facing numerous challenges, from effective disease management to low production efficiency to the need to shift from using homemade aqua feed to a formulated diet.

Such challenges, opportunities and solutions were raised and debated at the Alltech China 20-Year Celebratory Summit held in Beijing. Alltech, a global animal health and nutritional leader, has invested in successful research partnerships with academic institutions all over the world. China, is understandably, an Alltech top priority. In fact, it has dubbed its Chinese investment strategy as 'China Now'.

The latest aquaculture research alliance is between Alltech and the Ocean University of China in Qingdao, which was announced at this summit. China is one of the largest aquaculture exporters of the world and the country's compound aqua feed production of 23 million tonnes is the largest in the world. However, Chinese fish farmers still use homemade aqua feed with feed conversion ratios (FCR) as low as 6 to 1. Furthermore, using fish meal in making the feed is also common in China.

Jorge Arias

"Fish meal is not sustainable," said Jorge Arias, global director of Alltech. "Technologies such as algae based DHA or vegetable protein sources are already available in the Chinese market and can completely replace fish meal. The use of DHA can also be used to differentiate a functional food product, adding value to aquaculture products."

From left: Dr Li Defa, director of Ministry of Agriculture Feed Industry Centre and dean of College of Animal Science and Technology, China Agricultural University; Dr Pearse Lyons, founder and president of Alltech; Dr Mai Kangsen, served as the dean of Fisheries College and vice-president of the Ocean University of China from 1998 to 2013 during the closing session of the Alltech China 20-Year Celebratory Summit.

Dr Mark Lyons, vice-president corporate affairs at Alltech, announced as part of its China Now strategy, "Alltech committed to investing USD 2.5 million by 2016 in research alliance programs with top Chinese universities and research institutes. Back in 2012, we had launched the Alltech-Chinese University/Institute Research Alliance, a long-term partnership with five leading Chinese universities. Such investment and partnerships auger well for China's aquaculture prospects in scientific research." (More information: www.alltech.com)

What to look forward to in AQUA Culture Asia Pacific in 2014

Volume 10 2014			
Number	4 – **July/August**	5 – **September/October**	6 – **November/December**
Issue focus *Recent developments and challenges for the next step*	Industrialisation	Sustainable & Responsible Aquaculture	Culture technology
Industry Review *Trends and outlook, demand & supply*	Catfish	Marine shrimp	Freshwater Fish/Prawn
Feeds & Processing Technology *Technical contributions influencing the final value of aqua feeds*	Feed enzymes Product quality	Feed probiotics Good manufacturing practices	Nutrition & Formulation
Production Technology Technical information and ideas	Hygiene & Food Safety	Certification and Regulations	Health Management
Aqua business Feature articles	Experiences from industry, including role models, benchmarking and opinion articles in shrimp/fish culture		
Markets	Market trends, product development and promotions at local and regional trade shows		
Deadlines for articles in 2014	**June 2**	**August 1**	**October 1**
Show Issue & Distribution at these events as well as local and regional meetings	**The Aquaculture RoundTable Series (TARS 2014) - Shrimp Aquaculture** August 20-21 Phuket, Thailand **Vietfish 2014** August 6-8 Ho Chi Minh City, Vietnam	**19th China Seafood & Fisheries Exposition 2014** 5-7 November, Qingdao, China	
Deadlines Advert bookings in 2014	**June 9**	**August 7**	**October 8**

Expansion of the aqua R&D centre

Regional customers and staff of Behn Meyer Aquaculture in front of the Aqua R&D centre in Vietnam

Behn Meyer Animal Nutrition has developed a strong presence in the aquaculture industry, marketing a complete range of products for fish and shrimp species in freshwater and marine waters, in all aquaculture sectors from hatcheries to grow-out farms and feed mills. The portfolio includes natural products designed to improve health and growth performance of aquatic animals, namely probiotics, prebiotics, enzymes, botanicals, organic acids, trace minerals and hatchery products. Behn Meyer Animal Nutrition operates in all ASEAN countries and specialises in tailoring solutions to local industry needs.

As proof of Behn Meyer Aquaculture's commitment to the aquaculture industry in Vietnam and in Southeast Asia, in 2011 the company set up an aquaculture R&D centre at the Vietnam Singapore Industrial Park (VSIP) in Binh Duong province. The aim is to address important questions on nutrition and growth of all farmed species. This facility has now been expanded with increased analytical capability and additional rearing systems. At the extension's inauguration in December 2013, Behn Meyer Aquaculture emphasised the value of conducting research together with customers. "We need to provide a scientific approach to the industry's many challenges in order to arrive at practical solutions," said Minh Huong, Behn Meyer's Aquaculture manager in Vietnam.

The centre is headed by its Regional technical manager Dr Wee Kok Leong, and a staff of 5 full time technicians. "It is amazing how the team in Vietnam has grown to over 20 people by now – all with their minds set on supporting our customers' business," said Wee. "This R&D centre is making a huge difference. Our research ties in strongly with the products that Behn Meyer Aquaculture is marketing which all have properties to improve health status, and/or improve digestive capacity."

There are 2 sets of research tanks measuring 24 x 200 litres round fibreglass tanks and 12 x 500 litres round fibreglass tanks. Both these sets of tanks are housed within individual recirculating aquaculture systems (RAS), with used water passing over mechanical and bio-filter systems before reuse. Trials with marine species are carried out in 36 glass aquaria (70 litres), housed within its own RAS. Due to the smaller size of the research tanks, it is suitable for shrimps and for marine fish species at young stages.

Wee (centre) with wet lab staff between shrimp aquaria and digestibility tanks of the newly added systems

In addition, the centre has also installed a dedicated faecal collection tank system for the study of nutrient digestibility in feeds. This system consists of 16 x 200 litres round fibreglass tanks with sloping bottom to assist in the collection of faecal matter.

"Having RAS of various sized tanks allows the study of aqua feeds and feed additives at different phases of the aquatic species' life cycle", said Wee on this investment. "We are also excited about the added analytical capability, giving us the opportunity to measure nutrient digestibility and immune response parameters such as total hemocyte count, total protein and phenoloxidase activity."

All research projects carried out at this Aqua R&D Centre are now assessed by growth performance, feed efficiencies, nutrient retention, nutrient digestibility in test feeds and basic immune response. "Our customers see a lot of value in the simultaneous evaluation of nutritional, performance and immune parameters. This gives them a much better understanding about their feed raw materials, complete diets and additives used," said Minh Huong.

Currently the R&D centre works on practical non-fishmeal diets for the tilapia and pangasius, building on Behn Meyer's strong presence in enzymes for aquafeeds with their Finase (phytase based) and Hemicell

Behn Meyer Vietnam's Animal Nutrition and Aquaculture team. Minh Huong is fourth from right, back row.

Behn Meyer staff feeding fish for a scientific study

(mannanase based) brands. The centre in Vietnam will play an important role in further improving the efficacy and cost effectiveness of enzymes and other additives through optimising dose rates and nutrient digestibility values.

"Data on nutrient digestibility determined *in vivo* for commonly used ingredients and commonly farmed species in Southeast Asia are scarce and feed millers desperately seek detailed and accurate information on nutrient availability when formulating their feeds. This is where the Aqua R&D centre provides its value: Behn Meyer has a programme to determine the nutrient digestibility coefficients for commonly used ingredients for a variety of aquatic species in Asia. The resulting database will be made available to interested feed millers and research institutes across Southeast Asia," said Wee.

More information: www.behnmeyer.com

Agreement on vaccines development in Vietnam

In March, PHARMAQ and Vietnam's Ministry of Agriculture and Rural Development of Vietnam (MARD) signed an agreement, which allows Pharmaq to develop vaccines for several different farmed fish species in close co-operation with Vietnamese authorities and their organisations.

"This agreement gives Pharmaq a strong basis for further development of vaccines for pangasius and other farmed species in Vietnam," said Morton K Nordstad, CEO of Pharmaq. "This strengthens the company's possibilities to develop high technology products based on knowledge from Norway in close co-operation with Norwegian and Vietnamese research teams. We are taking an important step further in a common goal of a forward-looking, sustainable Vietnamese fish farming industry."

Pharmaq first engaged in the development of fish vaccines for Vietnam in 2006. Since 2008, the company has established its presence in the country through its subsidiary, Pharmaq Vietnam, with 18 employees today. In April 2013, the company received the marketing authorisation for the first vaccine in Vietnam, a first in Vietnam to register a vaccine for fish. This vaccine, targeting the most important farmed pangasius was tested and documented in 2009-2010 through field trials conducted in Vietnam.

Pharmaq is the world's leading pharmaceutical company supplying to the aquaculture industry, with a state of the art production facility in Overhalla and Oslo, Norway. Administration and research and development activities are based in Oslo and Bergen. It has subsidiaries in several countries and its products are marketed in Europe, North and South America and Asia. (More information: www.pharmaq.com)

Appointments

Mathieu Castex

Stéphane Ralite

Caroline Desmaizières

Dr Mathieu Castex will be the new global Research & Development director for Lallemand Animal Nutrition in Blagnac, France, when Dr Henri Durand retires later this year. Durand has been heading Lallemand's Animal Nutrition R&D activities since the late 1990s. Castex spent the past 5 years as the Aquaculture and Yeast Derivatives product manager, contributing widely to the development and the success of these ranges.

Stéphane Ralite is appointed product manager Aquaculture and will take over Castex's acquaculture responsibilities. Ralite has a solid knowledge and experience of acquaculture in different regions of the world. He has held several positions within the Evialis/InVivo group in France, playing a key role in setting up its acqua division Ocialis, and was the aquaculture market manager of the Aquativ Division within Diana Group, before setting up his own consulting company.

He will be in charge of the global development of Lallemand Animal Nutrition aquaculture range, whose flagship product, Bactocell®, is the first probiotic to have been authorised for aquaculture (all farmed fish and shrimp) by EFSA.

The Yeast Derivatives portfolio will be managed by **Caroline Desmaizières**. She graduated from the Toulouse vet school and has held several marketing management positions within Merial in Spain and France. After running her own marketing and strategy consultancy agency, Desmaizières was recently marketing and communication manager with an equine health equipment organisation. She will be in charge of the expansion of the companies multi-species yeast derivatives line of products, in particular organic selenium Alkosel® and premium yeast cell walls Agrimos®.

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To produce qualified seafood products, comes with a cost that is sometimes unbearable. the list does not stop on a savvy tech processing cost; it goes way up and finally a question is asked: do you really need to add the list with certification? This session will switch your perspective of "cost" into "Investment".

Trick & Serve: Food Science & Savety

Apart from the competitive price and how it presents buttery delicate taste, escolars consist of wax esters that can cause gastrointestinal symptoms. It has been known that the fish are safe to eat if they are consumed in portions smaller than six ounces, but are there any other methods to produce safe-consumed escolar? Fine out more on how you could turn this tricky fish into a safe promising business.

Get Into The Marketing Chain

The initiation to seafood business and entering the market is a session for Micro and SME to provide comprehensive understanding operations best practice of Micro/ SME, especially facing the globalization and Free trade. The session expects to encourage the micro/ SMEs effectively and efficiently operate in seeking productivity and margins.

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SECURE YOUR PARTICIPATION NOW!

Sustainability first before competition

Four organisations joined forces for the first time on March 18, 2014 at the Seafood Expo North America in Boston, to demonstrate how the global farmed salmon industry can lead the way in changing current aquaculture business practices to ensure a sustainable future for the industry.

The four are the Global Salmon Initiative (GSI), World Wildlife Fund (WWF), the Food and Agricultural Organisation (FAO) of the United Nations (UN) and Rabobank.

The *Pathways to Sustainability Seminar* set an example of how co-operation among seafood industry members can lead to sustainable development and can be replicated across other industries. Many business leaders believe a significant change in current business practices is the only way for the industry to realise its market potential and satisfy future global salmon demand. The GSI executives and the other leaders at the Boston meeting hence proclaimed their commitment to put sustainability before competition. This is to pursue a unique model of environmental co-operation as a driver for the industry's success.

"It is extremely rare to see CEOs, who are usually competing fiercely for market share, joining together to address challenges around sustainability," said Jason Clay, senior vice president of market transformation for WWF. "This type of bold, collective action in the farmed salmon sector is what's needed across all food commodities if we ever hope to feed nine billion people while preserving biodiversity."

The GSI, formed by global farmed salmon producers which are focussed on industry sustainability, has initiated an environmental co-operation model to drive the industry's success. At the March 18 seminar, leaders from GSI and the expert panel reviewed the initial results of the GSI co-operation model, and discussed how industry collaboration could translate into industry improvements. This in turn, would provide a sustainable solution, both economically and environmentally, to the world's growing demand for high protein foods.

The GSI chose three priority areas in its model where significant industry improvements could be made.

- Having all member companies certified by the Aquaculture Stewardship Council (ASC) Salmon Standard by 2020. To date, GSI members have had their first three farms certified, a testament to the model's success.
- Focusing on biosecurity – primarily sea lice and disease management – where member companies are using knowledge transfer as a means of generating improved management practices.
- Working with industry partners to secure sustainable sources of feed to meet growing demand.

"As individual companies we can work as hard as we want at improving our operations to support sustainable growth, but due to the nature of our business we are inherently affected by the actions of neighbours and fellow companies," said Jon Hindar, Co-chair of GSI and CEO of Cermaq, member of GSI." By focusing instead on co-operation and collaboration, we are seeing that progress can be made on a much wider scale, and at a much quicker rate."

The Global Salmon Initiative (GSI), established in 2013 is committed to fully realising a shared goal of providing a highly sustainable source of healthy food to feed a growing global population, whilst minimising environmental footprint and continuing to improve social contribution.

More information: GSI secretariat: GSI@axon-com.com; www.globalsalmoninitiative.org.

June 19-21
Kuala Lumpur, Malaysia

The aim of the Malaysia International Seafood Exposition, held once in two years, is to promote the seafood industry in Malaysia. MISE2014 is the third in the series and is organised by the Fisheries Development Authority of Malaysia in collaboration with INFOFISH. Themed 'Showcasing World's Best Seafood', the 3-day event will be held at the Putra World Trade Centre, Kuala Lumpur from 19 to 21 June 2014. There will be a total of 220 booths with exhibitors comprising local and international seafood producers, exporters/ importers, processors, equipment suppliers as well as manufacturers, food service and from the hospitality industry.

There will also be a 2-day aquaculture and trade conference 'Ensuring the future through sustainability' from 19 to 20 June. At press time the conference program is as follows:

Thursday 19 JUNE 2014

Plenary Session- Keynote Address on Overview of Global Fisheries: Production and Trade, FAO

Aquaculture and Sustainability- Network of Aquaculture Centres in Asia Pacific (NACA)

Finfish aquaculture: challenges and opportunities- Marine finfish

- Introduction to global and Norway marine finfish aquaculture production and trade by Dr Erik Hempel, Nor-Fishing Foundation, Norway.
- Country reports on status of marine finfish aquaculture
  - Thailand by Dr Varin Tanasomwang, DOF Thailand
  - Malaysia by Dr Mazuki Hashim, DOF, Malaysia
  - Indonesia by Tatie SP, MMAF Indonesia
- Status and challenges in marine finfish aquaculture in the Philippines by Dr Jobert Toledo, Feedmix Specialists Inc, Philippines
- Challenges in marine finfish aquaculture in Malaysia by Mohammed Razali, Aquagrow, Malaysia
- Fish Cage Culture Technology by Neils Svennevig, Capacity Building in Marine Fish Farming of Vietnam

Finfish aquaculture: challenges and opportunities - Freshwater Finfish

- Global Overview of freshwater finfish aquaculture by Maria Shirlene Anthonysamy, INFOFISH
- Country reports on status of freshwater finfish aquaculture
  - Vietnam by Dr Nguyen Huu Dzung, VASEP
  - Bangladesh by SK. Mustafizur Rahman, DOF, Bangladesh
  - Philippines by Nerio G Casil, BFAR-XIII, Philippines
- Farmed Whitefish Market in Europe by Ragnar Nystoel, Kontali Analyse AS, Norway

Friday 20 JUNE 2014

Crustacean

- Shrimp Production and Trade by Fatima Ferdouse, INFOFISH
- EMS – handling the threat to shrimp industry by Dr Daniel Gruenberg, Acquestra (Thailand) Co. Ltd.
- Crab Farming Technology- Mudcrab by Dr Emilia Quinitio, SEAFDEC-AQD

Aquaculture Certification and Trade

- International Trade Law: How a good contract can make a difference by Neil Baylis, K & L Gates
- New EU legislations and the impacts for import (TBA)
- What's new on FDA seafood importation by Coley Anderson, Registrar Corp, USA
- Certification challenges and issues-The AIP (Aquaculture Improvement Programme) Approach by Dr Geoffrey Mouldoon, WWF Coral Triangle Programme
- The need for certification beyond the cost issues by Roy Palmer, Oceania Market, GAA/BAP, Australia

Food Safety and Market Access

- Risk analysis on aquaculture products by Samuel Chan, BSI Malaysia
- Intervention strategies to control foodborne viruses during processing and handling of aquaculture products by C. B. Alvin Lee, Center for Processing Innovation, USA
- Branding for premium pricing by John Lee, Sino-Singapore Jilin Food Zone Development & Management Co. Ltd, NE China
- Debate on aquaculture: Will aquaculture be the opportunity for increasing the availability of seafood and reducing the risks? By Chris Leftwich, Chief Inspector, Fishmongers' Company, UK and Evelyne Nusalim, Hibaru Jaya, Mandiri, The Netherlands

Feed, Fish Health and Nutrition

- Exploring the potentials of field-based diagnostics for pathogenic diseases of fish and shrimp as tools towards sustainable aquaculture by Christopher Marlowe A. Caipang, Temasek Polytechnic, Singapore
- Potential use of duckweeds for alternative raw feed materials in aquaculture – a solution for eutrophication and waste water by Prof. Mark D. Powell, Norwegian Institute for Water Research, Norway

Technological innovation

- Country experiences in product development in the Philippines, Indonesia and Malaysia

More information: Trade show: email: info@infofish.org (Azizul Yahaya); conference: info@infofish.org
Web: www.mise2014.com

Grouper, Snapper & Barramundi 2014 Seminar

Date: 21st June 2014 (Saturday)
Time: 8:00 am – 1:00 pm
Venue: Putra World Trade Centre, Kuala Lumpur Malaysia
Fee: TBA online at www.mffam.org

Seminar Highlights:

- To inform members of MFFAM and the industry on the latest development in sustainable aquaculture practices of grouper, snapper and barramundi.
- Discuss current issues affecting the marine fish aquaculture of these species.

Speakers:

- Representatives from INFOFISH, LKIM, DOF, MSD, WWF Coral Triangle Programme.

More information:

- www.mffam.org; email: admin@mffam.org

World Aquaculture 2014

June 7-11, Adelaide, South Australia

For the first time since 1999, Australia is proud to be hosting World Aquaculture Adelaide 2014 (WAA14) which combines the international annual conference and trade show of the World Aquaculture Society (WAS) with the highly successful biennial Australasian Aquaculture.

WAA14 will be an opportunity for the international aquaculture community to present their work, exchange ideas and develop a vision for the future of the aquaculture industry as we focus on the theme of 'Create, Nurture, Grow', said organisers, WAS, Asia-Pacific Chapter WAS and National Aquaculture Council. They added that by attending the conference and trade show, participants have the opportunity to enjoy a comprehensive program, including an impressive line-up of speakers from academia, research and industry and network at the largest gathering of aquaculture professionals in the Asia Pacific in 2014.

Innovations in commercial shrimp nutrition and fish health

Participants will hear from key note speaker Dr Alex Obach, managing director, Skretting Aquaculture Research Centre, on how fish and shrimp nutrition and health studies are playing a major role in improving the sustainability and productivity of aquaculture production around the world. Skretting Australia is the naming sponsor of WAA2014. Conference sponsors are the Fisheries Research and Development Cooperation (FRDC) and Australian Seafood CRC and WAS premier sponsors are Tyson and Alltech.

At the Shrimp Nutrition session, Obach will present on some of the major challenges faced by today's shrimp farming industry; how recent developments in nutrition can contribute to improved water quality, health status and optimised performance for shrimp farming operations. The Commercial Fish Health session will have presentations from world experts relating to best aquaculture practices, disease prevention and control measures and integrated management schemes for different species and culture systems.

The list of sessions and topics is available online at the conference website. There are some special sessions which may be of particular interest to readers; Early Mortality Syndrome (EMS) of Shrimp; Climate Change Ready – management strategies for the future; Technical Advances for Finfish Cage Culture; Improving Energy Efficiency in Aquaculture Operations; Branding & Marketing – What works for me? and Emerging Industries: New and Upcoming.

Aquaculture in South Australia

South Australia has a vibrant aquaculture industry. The major species produced include Pacific oysters, tuna, mussels, abalone, snapper, freshwater fish, barramundi, atlantic salmon, freshwater crayfish, rock lobster and inland saline species. Growth of aquaculture has been impressive and the opportunities for the industry are in the marine environment.

As part of WAA 2014, aquaculture in the Eyre Peninsula will be showcased. The post conference from 12 to 14 June will be to Port Lincoln to visit aquaculture operations at Port Lincoln, Boston Bay, Arno Bay, Kellidie Bay and Coffin Bay. These will cover the huge

diversity of world class aquaculture operations including tuna, mussels, kingfish, oysters and abalone within the same region.

More information: web: www.aquaculture.org.au/www.was.org

Trade show

At the trade show, participants can view a large and diverse selection of suppliers to the aquaculture and related industries. The list of exhibitors at press time is given below:

Booths numbers	Company	Products and services
49	AKVA Group, Denmark	Aqua systems design and consultancy
64	Alltech, USA	Nutrition and health products
128	AQ1 Systems, Australia	Feed control technology
35	Aqua Culture Asia Pacific, Singapore	Trade publication
70-72	Aqualine AS, Norway	Cages, nets and mooring systems
18-20	Aquasonic, Australia	Equipment and recirculation systems
54	AS Horne Consolidate Pty Ltd, Australia	Protective clothing
10	Austrade, Australia	Government, trade and investment
26	Ausyfish, Australia	Fry and fingerlings
65, 66	Biogill, Australia	Wastewater treatment and water recycling
106, 107	Biologix, Australia	Biotechnology in aqua health
29	Blue Aqua International, Thailand	Aquaculture solutions and equipment
68	BSI Group, Australia	Certification
69	BST/Woodshield, Australia	Aqua equipment
134	Cameron of Tasmania, Australia	Shellfish culture
79, 80	Catalysis, Spain	Aqua health
31	CSIRO, Australia	Research and consultancy
136	Dept. Environment & Primary Industries, Victoria, Australia	Government
87	DHI Group, Australia	Research and consultancy in Water resources
40	Empyreal, USA	Feed ingredients
34	Environmental Technologies, Australia	Environmental solutions
92	ETEC, Colombia	Pumping systems
112, 113, 132, 133	Faivre, France	Fish farming equipment
52, 53	Fishpac, Australia	Live fish transportation
108	Flow-Ice Pty Ltd, Australia	Refrigeration and ice slurry systems
117, 118, 126, 127	FRDC/Seafood CRC, Australia	R&D along seafood value chain
1, 2, 3, 4, 5	Fresh by Design Australia	Aquaculture systems designs and solutions
15	GAA, USA	Association, education and certification
76	HallPrint, Australia	Electronic fish tags and measuring equipment
88	Hatchery Int, Canada	Trade publication
50	IMAREST, Australia	Marine engineering
120, 124	Imbros P/L, Australia	Oceanographic, marine and scientific equipment
9	Insta Pro, USA	Feed processing equipment
103	Intermas, Spain	Plastic solutions in aquaculture
48	International Aquafeed,UK	Trade publication
91	Kruger Kaldness/ Veolia,Norway	Water solutions and technologies
22	Life Technologies, Australia	Biosystems for disease diagnostics
104	Marine Solutions, Australia	Marine accessories
14	Marisource, USA	Incubation systems
125	MItech, Australia	Marine lighting technologies
61	NMT, USA	Implant fish tags
15	Nor Seafood, Norway	Seafood business
74	Nutrakol - Dept Fish WAUS, Australia	Nutrition and health solutions
59-60	Oystek, Australia	Grading technology for oyster industry.
96	Pacific Consolidated Industries, USA	Waste water treatment
24	Panorama Acuicola, Mexico	Trade publication
93, 94, 101, 102	Pentair, USA	Aquaculture systems and designs
55	Peptide Technology Inc, Australia	Anti fouling solutions
115, 129	ProAqua, Australia	Farm products
63	Pump Engineers, Australia	Pumping equipment
136	Queensland, Australia	Government
33	Radaqua, Australia	Aquaculture systems and consultancy
16-17	Ridley, Australia	Aquafeeds
56-57, 82, 83	SA Govt./PIRSA, Australia	Government
47	Scielex, Australia	Electronic equipment
98, 99	SEAPA, Australia	Plastic equipment
119	Shellfish Culture Tasmania, Australia	Shellfish
37	Sirene Sea Pearls, Australia	Pearl production
84, 85, 110, 111	Skretting, Australia	Aquafeeds
23	Smith Root, Australia	Electrofishing
97	Steinsvik Aqua, Norway	Feeding and monitoring systems
21	Sunderland Marine Mutual Insurance, Australia	Aquaculture insurance
27	Sunlover Heating, Australia	Water heating technology
78	Tanaka Sanjiro, Japan	Equipment and monitoring systems
32	Technolab, Australia	Monitoring and control systems
41, 42, 43, 44, 45, 46	The PFG Group, Australia	Machinery
116	Wenger, USA	Feed processing equipment
30	Wiley Blackwell, Singapore	Publications
28	Worldfish Center, Malaysia	International, nonprofit research organisation
6	Xylem, Australia	Water solutions
11, 12	Yanmar, Singapore	Power equipment

THE
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TARS 2014
The Aquaculture Roundtable Series

SHRIMP AQUACULTURE INDUSTRY: RECOVERY • REVIVAL • RENAISSANCE

20-21 August 2014, JW Marriott Resort & Spa, Phuket, Thailand

In the last few years, the shrimp farming industry in China, Vietnam, Malaysia and more recently, Thailand is finding it difficult to maintain consistent harvests. Crop failures and poor survival rates are common resulting in low supply of shrimp in global markets and consequently the highest prices since year 2004.

The reason behind the poor performance since 2010 is due to early mortality syndrome (EMS) or AHPND outbreaks. In the history of shrimp farming, EMS has the largest impact on production. However, it is occurring alongside the white spot syndrome virus and other diseases, omnipresent in shrimp farming. While EMS has been shown to have a bacterial etiology, curative treatments are still far away and farmers continue to have doubts about the success of future stocking.

Opportunity for multi-stakeholders

Loss in production is not just the plight of shrimp farmers but has a multiplier effect on stakeholders across the entire supply chain, from broodstock to hatchery, to feed producers and processing plants. Feed ingredients and additives suppliers, pond equipment and health diagnostics are also affected, as are governments as they face up to the economic consequences of revenue generation and the social impact of job losses.

While various groups and producers are working on disease and production issues, they lack synergy and collaboration. The industry needs to collectively find solutions and determine a suitable course of action to ensure the sustainable development of Asia's shrimp aquaculture.

The fourth **Aquaculture Roundtable Series (TARS 2014), *Shrimp Aquaculture: Recovery • Revival • Renaissance*** aims to have an open dialogue, among key stakeholders, on the current state of the industry. Specifically, TARS 2014 will explore workable solutions towards the prevention and control of future disease outbreaks, with a focus on culture technology and management, nutrition and health, production efficiency, and environmental concerns, rising shrimp prices and tight supply.

Building on the successful format of this roundtable series, TARS 2014 promises a comprehensive agenda on shrimp aquaculture 'state-of-the-science' presentations by a host of international experts, and thought-provoking, interactive breakout sessions with industry participation that are hallmarks of this critical series.

Industry experts

At the plenary session, international experts from academia and industry from Asia, Europe and the Americas will share insights into the challenges with supply and production of shrimp amidst EMS and other diseases. How to overcome disease at the hatchery and grow-out stages will be presented based on current information. The breakout session provides all participants with the opportunity for real time discussions and deliberations on how to take this industry forward.

PROGRAM HIGHLIGHTS

State of Shrimp Aquaculture Industry in Asia

Daniel F Fegan

Aside from new and persistent disease problems, the industry faces many other issues ranging from rising ingredient, feed and production costs, and financial constraints to ensuring food safety and environmental sustainability…

Identification and Validation of Molecular Markers for Genetic Improvement of Shrimp

Chu-Fang Lo

Although traditional genetic selection is time-consuming (and progress may be limited for some traits), it is expected that molecular-marker assisted selective breeding, would greatly hasten genetic improvement…

Does Specific Acquired Immunity Exist in Shrimp? Moving Dscam Research from Benchtop to Pondside

Han-Ching Wang

Our goal is to mitigate threats of infectious disease. There is increasing evidence that shrimp and other arthropods exhibit immune specificity and immune memory…

Three Phase Culture: Benefits Beyond EMS/AHPND

Fernando Garcia Abad

With the presence of new diseases and adverse environmental conditions, the industry needs to change and use new tools. As different strains of Vibrio are stage specific pathogens, the use of raceways may be an alternative tool where farmers can focus on keeping the Vibrio excluded in a smaller space...

Industry Perspective: Farming Vannamei the Black Tiger Way

Manoj Sharma

The vannamei shrimp does not seem as resilient by virtue of diseases especially EMS. At Mayank Aquaculture, we have seen lowering density and production of 40-50g shrimp as encouraging, most profitable and sustainable…

Improved Shrimp Hatchery Techniques, Post-Larval Quality and The Link with Grow-Out Performance

Roeland Wouters

Larviculture performance, PL quality and PL costs can significantly improve by applying state-of-the-art hatchery management, in particular, through nutrition and health protocols. Good PL, in turn, reduces mortality during stress, transport and stocking of post-larvae in nursery facilities or ponds…

PROGRAM (as at press time)

Day 1, August 20, 2014

Session 1: State of Industry & Marketing

- **State of the Shrimp Aquaculture Industry in Asia**
  Daniel F Fegan, *Cargill Animal Nutrition, Thailand*
- **Marketing Shrimp: Seller's Perspective**
- **Market Demand and Supply: Buyer's Perspective**
  Panisuan Jamnarnwej, *Thai Frozen Foods Association, Thailand*

Session 2: Learning and Surviving Diseases

Part 1: Challenging Times

- **Current Shrimp Disease Threats in Asia including a Review of EMS/AHPND**
  Siripong Thitamadee, *Centex Shrimp, Mahidol University, Thailand*
- **Identification and Validation of Molecular Markers for Genetic Improvement of Shrimp**
  Chu-Fang Lo, *Institute of Bioinformatics and Biosignal Transduction, National Cheng Kung University, Taiwan*
- **Does Specific Acquired Immunity Exist in Shrimp? Moving Dscam Research from Benchtop to Pondside**
  Han-Ching Wang, *Institute of Biotechnology, College of Bioscience and Biotechnology, National Cheng Kung University, Taiwan*

Part 2: Our Future

- **Developing a Robust Shrimp via Genetic Selection – The Theory and Practice**
  Thomas Gitterle, *SyAqua Group, Thailand*
- **Fighting Pathogens: Choosing from a Range of Molecular Mechanisms**
  Tim Goossens, *Nutriad International, Belgium*

Session 3: Culture Technology and Practices

- **Improved Shrimp Hatchery Techniques, Post-larval Quality and the Link with Grow-out Performance**
  Roeland Wouters, *Inve Technologies, Belgium*
- **Country Perspective: Proactive Management to Keep Diseases Away**
  Soraphat Panakorn, *Novozymes, Thailand*
- **Three Phase Culture: Benefits Beyond EMS/AHPND**
  Fernando Garcia Abad, *Epicore BioNetworks Inc., USA*
- **Revisiting Probiotics in Shrimp Culture: From 'Do They Work?' to 'How Do They Work?'**
  Pedro Encarnação, *Biomin, Singapore*
- **Industry Perspective: Farming Vannamei the Black Tiger Way**
  Manoj M Sharma, *Mayank Aquaculture, India*

Day 2, August 21, 2014

Session 4: Nutrition and Health Interaction

- **Developing the Ideal Feeds for Shrimp: Gap Analysis**
- **Nutrition and Disease Interactions: Learning from a Holistic Approach in Marine Fish Industry**
- **Enzymes in Shrimp Nutrition: Is the Future Here?**
  M A Kabir Chowdhury, *Jefo Nutrition Inc., Canada*

Breakout Sessions

The objective of the breakout session is to stimulate group discussions that will lead to the identification of key challenges and priority areas for improvement, and recommend workable strategies to take the industry forward. Guided by facilitators, multiple groups will brainstorm on the following suggested areas:

- **State-of-the-Industry and Marketing** (high prices reducing demand; downstream margins squeezed and is integration the way forward?)
- **Learning and Surviving Diseases** (genetics for disease resistance; biosecurity and regulation; vaccines in shrimp and health monitoring protocols)
- **Culture Technology and Practices** (high health shrimp starts at hatchery and nursery; bioflocs and probiotics as tools to prevent EMS and stable water parameters)
- **Nutrition and Health Interaction** (nutrition for genetically improved strains; boosting natural immunity and efficacy of functional feeds)

Review (Report) Session

Team leaders from each breakout group will report on key discussion points. This will be followed by an interactive session with participants who will provide further input and recommendations to take the shrimp aquaculture industry forward. A final report will be made available to all participants.

Sponsors:

Supported By:

Organisers:

Country Perspective: Proactive Management to Keep Diseases Away

Soraphat Panakorn

The implementation of a proactive management system, adoption of knowledge-based farm practices, and improvement of worker skills are essential components to achieve success in shrimp farming…

Developing a Robust Shrimp via Genetic Selection – The Theory and Practice

Thomas Gitterle

Conditions in production ponds favour disease development. When elimination, eradication or control of culture conditions is difficult, selective breeding for host resistance to the pathogen may be an attractive option for disease control…

Fighting Pathogens: Choosing from a Range of Molecular Mechanisms

Tim Goossens

EMS outbreaks highlight the need for multifaceted sanitary programs, combining biosecurity protocols at the hatchery and farm to avoid the entry of pathogens, microbial control measures aimed at steering the microbial ecosystem in the pond, and shrimp gut for maximum growth and survival...

Revisiting Probiotics in Shrimp Culture: From 'Do They Work?' to 'How Do They Work?'

Pedro Encarnação

As we learn more about pond ecosystems we can better understand the modus operandi of probiotics and how they should be used as a tool in shrimp farming. A closer look at differences between strains of bacteria, will explain how they work and should be applied in pond environments, hatcheries and feed, and what the farmer should expect from probiotics…

Enzymes in Shrimp Nutrition: Is the Future Here?

M A Kabir Chowdhury

There is also an interest in the use of various alkaline proteases and lipase to improve protein and lipid digestibility. We need to maximize use of feed resources not only for better profit, but also for better animal health and to reduce environmental pollution…

Registration is limited to 200 and participants will be asked to select their preferred break-out group. Walk-ins are not encouraged.
Register online at www.tarsaquaculture.com
Email conference@tarsaquaculture.com

JAKARTA - AUGUST 2014

"Aquaculture Business and Food Security"

Following the success of Indonesian Aquaculture (INDOAQUA) 2012 in Makassar – South Sulawesi, we invite everyone to join and participate in INDOAQUA 2014 in Jakarta. INDOAQUA 2014 is biennial event that will be the place to expose and learn the latest technology in aquaculture. It also open the opportunity to invest in Indonesian aquaculture sector. INDOAQUA 2014 also provide technical conference program and session to address the current issues on aquaculture and contribute to global economic growth.

INDOAQUA 2014 is hosted by Directorate General of Aquaculture,
Ministry of Marine Affairs and Fisheries, Republic of Indonesia

For more information, please call :
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2014

Details on the events below are available online at http://www.aquaasiapac.com/news.php
To have your event included in this section, email details to zuridah@aquaasiapac.com

May 29-31
5th Aquatech: Aquaculture Expo & Convention Philippines 2014
Dagupan City, Pangasinan
Email: aquatech.ph@gmail.com/ mgv.equipinc@yahoo.com

June 5-7
Future Fish Eurasia 2014
Izmir, Turkey
Email: info@marevent.com
Web: www.Eurasiafairs.com

June 7- 11
World Aquaculture 2014
Adelaide, South Australia
Web:www.was.org/ www.aquaculture.org.au

June 13-14
Aquaculture Chennai – 2014
Chennai, India
Email: felixtnfu@gmail.com
Web: www.tnfu.org.in

June 19-21
Malaysia International Seafood Exposition
Kuala Lumpur, Malaysia
Email:mise2014@lkim.gov.my
Web:infofish.org

June 20-21
International Conference of Aquaculture Indonesia 2014 (ICAI 2014)
Bandung, Indonesia
Email:icai.aquaculture@gmail.com
Web: www.icai.aquaculture-mai.org

June 27-28
EMS Forum: Managing the shrimp epidemic
Bangkok, Thailand
Email: info@asianaquaculturenetwork.com
Web: www.asianaquaculturenetwork.com

July 2-4
9th National Shrimp Congress
Bacolod City, Philippines
Email: r.usero@yahoo.com.
Tel: +63-34 433-2131 (Secretariat)

July 31-August 1
PAES Recirculating Aquaculture Technology Workshop
Apopka, Florida, USA
Email: PAES.General@Pentair.com
Web: www.PentairAES.com

August 6-8
Vietfish 2014
Ho Chi Minh City, Vietnam
Email: tienloc@vasep.com.vn
(Nguyen Tien Loc)
Web: www.en.vietfish.com.vn

August 20-21
TARS 2014 Shrimp Aquaculture
Phuket, Thailand
Email: conference@ tarsaquaculture.com
Web: www.tarsaquaculture.com

August 22-24
10th International Conference on Recirculating Aquaculture
Roanoke, Virginia, USA
Web:www.recircaqua.com

TBA August
Indonesian Aquaculture 2014 (Indoaqua)
Jakarta
Tel:+6281315862409 (Shirley Ivone)
/+6281281096338 (Hani Wijianti)

September 2-4
Asian Seafood Expo
Hong Kong
Web: www.asianseafoodexpo.com

October 7-8
Aqua Fisheries Myanmar 2014
Yangon, Myanmar
www.veas.com.vn

October 14-17
Aquaculture Europe 2014
Donostia–San Sebastián, Spain
Web: www.easonline.org

October 29-31
Indonesia International Seafood and Processing Expo 2014 - IISP2014
Bali, Indonesia
Email: info@iisp2014.com
Web: www.iisp2014.com

November 6-8
Aquamar International Mazatlan
Sinalao, Mexico
Web:www.aquamarinternacional.com

November 24-28
9th Symposium on Diseases in Asian Aquaculture (DAA9)
Ho Chi Minh City, Vietnam
Web: www.fhs-afs.net

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Eric Barratt
Sanford Fisheries Ltd.

November 5-7, 2014

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For more information contact Jennie Fu
jennie8888@seafare.com

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