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AQUA CULTURE
Asia Pacific

Early Mortality Syndrome in Malaysia

Black Tiger Shrimp in India and Vietnam

Debut of the Vegetarian Pangasius

Imaging of Fish Pellets

The Mycotoxin Survey

MICA (P) 006/10/2011 PPS1699/08/2013(022974)

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MALAYSIA *(JOHOR)*- Gold Coin Specialities Sdn Bhd/Gold Coin Biotechnologies Sdn Bhd, Tel: +607 237 0695 Fax: +607 236 1143 email: sp.koh@goldcoin-my.com

INDONESIA *(NORTH SUMATRA)* - P.T. Gold Coin Specialities Medan, Tel: +62 61 685 5127 Fax: +62 61 685 3452, email: p.zulkarnain@goldcoin-id.com

INDONESIA *(WEST JAVA)* - P.T. Gold Coin Indonesia, Specialities Division, Tel: +62 21 885 3668 Fax: 62 21 884 1947 email: p.zulkarnain@goldcoin-id.com

THAILAND *(SONGKHLA)* - Gold Coin Specialities (Thailand) Co Ltd, Tel: +66 74 483 600/5 Fax: +66 74 483 493 email: w.pradipat@goldcoin-th.com

INDIA *(CHENNAI)* - India- Gold Coin Biotechnologies Sdn. Bhd. India Liaison Office, No.1, B.V.R. Nagar, Alwar Thiru Nagar, Chennai 600087, India. Tel: +91 44 2486 8433 Fax: +91 44 2486 2091 email: v.ravi@goldcoin-id.com

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Aqua Culture Asia Pacific Online
View E-magazine
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Editor/Publisher
Zuridah Merican, PhD
Tel: +603 2096 2275 Fax: +603 2096 2276
Email: zuridah@aquaasiapac.com

Editorial Coordination
Corporate Media Services P L
Tel: +65 6327 8825/6327 8824
Fax: +65 6223 7314
Email: irene@corpmediapl.com
Web: www.corpmediapl.com

Design and Layout
Words Worth Media Management Pte Ltd
Email: sales@wordsworth.com.sg
Web: www.wordsworth.com.sg

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China Square Central, Singapore 048660
Web: www.aquaasiapac.com
Tel: +65 9151 2420 Fax: +65 6223 7314

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Overseas Supplies Pte Ltd
6 Jalan Lembah Kallang, Singapore 339562

Editorial and advertising enquiries
Email: zuridah@aquaasiapac.com
Tel: +603 2096 2275 Fax: +603 2096 2276

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- We strive to be the forum for the development of self-regulation in the Industry.

From the editor

Food Safety – Too big to take risks

Back in the 1980s, when we were more production than market driven, the issue of food safety was far from our minds. Now attention to food safety, not just by the farmers at their ponds, but all along the supply chain, from hatcheries to feed and other inputs and processing, has to be uppermost in our minds. However, in recent times as farms face disease and cost of inputs and raw materials are on the rise, do farmers and others gamble with food safety?

This editorial does not allege that farmers are doing this, but merely serves as a reminder on the perpetual concerns of food safety. A long term view on food safety is always an essential part of any sustainable business dealing in food production.

An important point to note is that health authorities in importing countries have the mandate to safeguard the health of the people. Food safety should not be complicated by notions of non-tariff barriers by importing countries etc. NGOs have taken up the gauntlet to put pressure on supermarket chains in the US to buy from certified producers as this would separate the credible producers from the rest. The US FDA, limited by resources, checks a small portion of the products coming into the country but has gone to the field to get producers to adhere to food safety norms through arrangements such as “training the trainer”.

In the past decade, the EU has improved on this and led with the benchmark of ‘farm to fork’ which improves on the traceability of the product through the supply chain. Not only does this place the responsibility of ensuring food safety from the importer to the producing country, it also serves as a preventive measure to ensure that an unsafe product does not leave the shores of the producing country without checks from the relevant authorities. Checks are still being conducted at the arrival ports and by the rapid alert system, to prevent the exporter from using another port of entry to slip in their product. This has been the evolution of the food safety system for aquaculture products. China has also asked for a country wide registration before imports can enter the country.

But what has changed recently? Demand is increasing with the purchasing power of middle class in emerging markets such as China and supply has been affected by disease problems especially in shrimp. Early mortality syndrome, white spot syndrome virus and IMNV has taken its toll in China, Vietnam, Malaysia, Indonesia and recently in Thailand. Unlike fish, where vaccines have been developed for specific diseases, the shrimp has a primitive immune system which does not produce specific antibodies. There are various remedies in the market and it is likely that in desperation, shrimp farmers will be tempted to take risks. This does seems like a recurring nightmare from the early 2000s when black tiger shrimp production was being decimated.

This food safety system that has evolved in the past decade will be put under tremendous pressure. The result will negate all the work the industry has put in place to safeguard the image that our aquaculture products are safe. There is a huge risk this could be portrayed negatively in the media which could lead to reduced consumption. A fall in demand would not do the industry any good. Can the industry work together as far as food safety is concerned? One could call for better enforcement by local authorities but this is only a short term measure. More education at the field level should be a proactive measure. Bearing in mind the fragmented nature of any sector of Asian aquaculture, from freshwater fish to the marine shrimp, self-regulation will be ideal as one bad apple affects the whole industry. Aside from producers, a more appropriate action would be for disease experts and animal health companies to work on products which improve the immune system of the shrimp.

Zuridah Merican

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Staging a comeback in shrimp production

New technologies and producer-processor alliances could bring back the glory days of shrimp production to the Philippines.

The fisheries industry in the Philippines often recount the mid-1990s with nostalgia as a time when they were leaders in marine shrimp *Penaeus monodon* production with almost 100,000 tonnes annually and the technology for production of *P. monodon* having its initial roots in the Philippines. Monodon shrimp still dominate production in Negros Occidental whereas most of the vannamei shrimp production is in Luzon with a total of 11,000 to 15,000 tonnes in 2011. In the south, General Santos produces 4,200 tonnes from large farms of 200 ha or more and in the Visayas, 1,000 tonnes are produced.

Collectively, the industry knows that it needs to catch up with other shrimp producing nations. At the 8th Philippines Shrimp Congress, held in Bacolod City from 9-11 May 2012, participants explored the strategies and proven technologies that industry needs to adopt in order to stage this comeback. Presentations on marketing asked producers to look beyond local markets and understand the changing landscape of the monodon shrimp market, including evolving demands of traditional markets such as Japan, changing nature of financing programs, concerns over food safety, and new technologies from government and companies on culture and disease management

The 550 participants of this biennial meeting of the Philippines Shrimp Industry Inc - PHILSHRIMP were drawn from throughout the country, including members, regional officers of the Bureau of Fisheries and Aquatic Resources (BFAR) and other stakeholders. This year, the unusually large participation of small producers from Luzon and other islands, indicated interest in vannamei shrimp farming which was officially approved in January 2007, as pointed out by Philshrimp president **Roberto Gatuslao**, who is also credited for development in monodon farming in Negros Occidental in the Western Visayas in the 1990s. He now farms vannamei and monodon shrimp and milkfish.

"We used to produce about 80% of the country's production and now we only contribute 5%," said **Edgardo Sarrosa**, who farms vannamei and monodon shrimp in Sagay City, Negros. "To expand and export, industry needs to come together and integrate facilities."

Philshrimp was formed to promote and maintain the growth and improvement of the shrimp industry in the country. It also serves as the voice for the industry to convey its concerns, needs, problems and other issues to the government. It has representatives from major shrimp producing areas. The largest group, the Negros Prawn Growers Cooperative based in Bacolod City and headed by Gatuslao, organised this biennial gathering.

President Roberto Gatuslao (centre) with from left: Luzon Director German Herman Cruz, Congress Chairman Philip Cruz, Joseph Edgar, Edgardo G Sarrosa, Luzon Vice President and Treasurer, Jake Vergara and Visayas Director, Tomas Hautea.

From left; Chingling Tanco (second right) with Mary Galenzoga-Basal, Mida Trade and from left, Rodriquez Salvacion and Dawn Jamandre, Jamandre Hatcheries, Inc.

Status quo or expand vannamei shrimp production

Immediately after the removal of the ban on vannamei shrimp production, conversion to its farming was adopted rapidly. However, as local prices started at higher than international levels, at that time, the question for industry is whether vannamei production should be limited to maintain these high local prices.

Markets in Metro Manila and large cities such as Cebu demand small size shrimp from 10g. The large volume passing through Metro Manila is mainly from farms in Luzon. Producers in outlying islands incur PHP40/kg in costs to airfreight shrimp to Metro Manila or other large cities. In May, ex-farm prices of chilled 10g and 15g shrimp was PHP190/kg (USD 4.36/kg) and PHP 225/kg (USD 5.17/kg) respectively. The local market for live and chilled shrimp is small and reportedly is already saturated.

According to National Director Asis G Perez of the Bureau of Fisheries and Aquatic Resources (BFAR), there is potential for expanding the local market. "The Philippines has a large population, many of whom are yet to see the benefits of eating shrimp. What is required is access to these new markets and the role of BFAR will be to provide infrastructure such as cold storage facilities."

Producers in the Philippines share many of the common challenges encountered by other shrimp farmers in the region. White spot syndrome virus continues to be a major problem in monodon shrimp farming, resulting in survival rates of 20-50% only. There could be a respite with post larvae from SPF monodon shrimp brood stock currently available in the country. Producers say that they have the highest costs of production in the region. Vannamei post larvae (PL)

prices are based on length of PL. PL10 (9-10mm) are sold at 20-22 centavos each (USD 5.06/1000PL) and monodon PL16 are sold at 33-37 centavos each (USD7.6-8.5/1000) with PCR testing. Both electricity and fuel rates vary with location and the average electricity rate is the highest in Asia at USD 0.23/kWh and is rising.

Vannamei shrimp is farmed throughout the country in diverse culture systems; intensive, such as in General Santos at 80-150 PL/m^2 and in Zambales by Taiwanese investors at 100-150 PL/m^2; extensive at 50 PL/m^2; or polyculture with 0.2 fry/m^2 of milkfish and 3-5 PL/m^2 in Pangasinan and 3-4 fry/m^2 of tilapia and 5 PL/m^2 in Pampanga. In polyculture, shrimp reaches 15-20g after 120 days (Tinambunan, 2011, Newsfeed).

Creating markets

However, Chingling Tanco, managing director of Mida Food as well as chair, Fisheries and Aquaculture Board said that producers still need to look at the vannamei shrimp for the local and international frozen shrimp market. Domestic shrimp prices can still be competitive and reach an affordable level to increase domestic consumption.

"Vannamei shrimp producers are now used to partially harvesting their ponds to access the relatively small volume local market for fresh and live shrimp. With this, they face a high feed conversion ratio (FCR) from 1.5 to 2.5 and a high cost of production. Processors on the other hand are used to low processing volumes arising from the reduced supply of monodon shrimp. This is around 1,000 tonnes per year or an average of only about 60-80 tonnes per month. With this gap in raw material, processors are reluctant to invest to modernise their plants. They put a high cost of processing of about 70 pesos (USD 1.62/kg) just for head-on. Processors give low offer prices to producers thus perpetuating the fear by the latter that there is no market for their shrimp in any volume.

"Our processing facilities need to be upgraded but, for any investment to be feasible, the processor requires the support of the producer with a consistent supply of raw material. In addition, third party certification is a new reality and this is added costs to the processor. The shrimp industry is not just about producers, it needs good post-harvest technology, processors and distributors."

The good news is that some producers are now seeing the lower cost of vannamei shrimp production. Survival rate of vannamei shrimp production is 85-90% and yields are higher than that for monodon shrimp production. The harvest is 1-3 times a year, as opposed to only one crop per year for monodon shrimp; and vannamei shrimp require lower protein and cheaper feeds costing USD 1 (PHP42/kg) while showing a feed conversion ratio of 1.2-1.4. Production costs are PHP130/kg for 17g shrimp in semi-intensive systems and PHP 80/kg for 10-15g shrimp in polyculture systems.

Tanco showed that the possible raw material prices that the processor could offer using a processing cost of PHP 50 may range from

Asis G Perez (centre) and office bearers of Philshrimp

PHP150.7/kg for 14-15 g shrimp to PHP 202/kg for 21-22 g shrimp. "However," notes Tanco, "the question is, can the processor manage with only PHP 50 of processing cost including freight? Yes if he sees an increased volume of turnover in his plant! Let's bridge the gap!"

"Will there be room for shrimp from the Philippines or is it too late? Yes, there is still room as demand is also increasing. Our local market is accepting frozen seafood and a lower price for shrimp will significantly increase local demand and access to what was otherwise perceived to be a luxury food. In 2010-2011, international shrimp demand was high but exports have been down in the main producing countries due to lower production volumes because of disease and adverse weather conditions so prices have been up by as much as 30%," said Tanco.

Changes in markets in Japan

"The import quantity of Japan for shrimp in frozen block form has been declining through the years while value added imports have been steadily increasing. From its peak of 302,975 tonnes in 1994, the volume of shrimp in frozen blocks has dropped to 205,216 tonnes in 2011, said **Pio Raymundo** of Maruha Nichiro in his presentation on the Japanese and Korean shrimp markets.

"Monodon head-on shrimp imported to Japan in 2011 was 6,300 tonnes which is almost the same volume in 2010. Although the Philippines is still the top exporter of monodon head-on with a volume of about 3,000 tonnes in 2011, the volume was down from 3,800 tonnes in 2010.

Raymundo added, "What is more significant is the steady growth of value added shrimp products imported into Japan. Breaded shrimp imported into Japan in 2003 totalled 33,318 tonnes and in 2011, this increased to about 49,184 tonnes. Cooked shrimp in 2003 was about 12,672 tonnes; this increased to 23,592 tonnes in 2011. Vannamei imports (frozen blocks and value added) into Japan has increased from 6,339 tonnes in 1997 to 69,709 in 2011. During the same period, monodon imports (frozen block and value added) into Japan declined from 104,989 tonnes in 1997 down to 39,430 tonnes in 2011."

Tanco said, "Japan may have been the pride and joy of producers in the Philippines for the large size monodon shrimp but this is no longer the case as prices of 25-40/kg size monodon shrimp have been dragged down by 30-40/kg vannamei shrimp. Vannamei shrimp can grow to large sizes and the niche market for the monodon shrimp now becomes the larger 50g. The base price for size 30/kg is PHP 280/kg now because of imports of the Argentinian red shrimp into the Japan market at USD 2-3 cheaper than monodon shrimp!"

News in Brief

Higher tariffs under new GSP for Thailand

Thailand's shrimp exports will be affected by the European Union's new generalised system of preferences (GSP), said Somsak Paneetatyasai, president of the Thai Shrimp Association in mcot.com. Under the new GSP, the tariff is 12% for raw shrimp, from the current 4.2% and 20% will apply for value added shrimp, up from the current 7%. The volume of Thai shrimp to the EU market could drop to less than 5%, from the current 20-25% of total exports. The association has asked the government to help, whether by negotiations on GSP or a free-trade agreement with the EU. Thailand's major competitors; Vietnam, Indonesia, China, and India have better tariffs than Thailand and Malaysia has a free trade agreement with the EU.

Charoen Pokphand Foods Plc, Thailand's largest shrimp producer may move processing to Malaysia and Vietnam if privileges are withdrawn. In the Bangkok Post, Adirek Sripratak said CPF exports THB 1 billion of processed shrimp to the EU. Pinyo Kiatpinyo, president of the Federation of Shrimp Farmers Cooperatives said that Thailand will likely produce 600,000 tonnes of shrimp in 2012 and asked the government to encourage domestic consumption, now at 100,000 tonnes. Thai shrimp will be 2% more expensive but the effect will be a year later if the new rates are implemented in January 2014, according to Kasikorn Research Centre.

Expansion to be largest shrimp farm

Saudi Arabia's National Prawn Company has obtained an Islamic financing worth USD 122 million for its expansion plans at Al-Laith. This will include the second phase development of its Red Sea shrimp and fish cultivation projects. Founded over two decades ago, NPC currently produces over 18,000 tonnes a year of white shrimp for markets in Saudi Arabia, Britain, Spain, Japan, Korea, America, China and Australia. On completion of the expansion, the company's production capacity will be 32,000 tonnes/year. In www.arabianbusiness.com, its managing director, Ahmed Al-Balla'a said, "This funding will provide us with the resources to add five shrimp farms, each consisting of 28 to 30 ponds. The expansion will ensure that NPC can retain its position as one of the largest fully integrated shrimp farms in the world."

Pangga in the Philippines

The government wants to reduce imports of the pangasius fillet (locally known as pangga) by 2016 with local farming of the fish. Trade undersecretary Merly Cruz said the growing interest in the local pangasius industry is now seen as a strategic area for development in terms of food security and job creation. Imported pangasius fillet products are sold in grocery stores and supplied to restaurants and popular fast food chains such as McDonalds, Chowking and Kenny Rogers. Imports have been rising, from 2,751 tonnes in 2008 to 4,652 tonnes in 2009 and 6,689 tonnes in 2010. In 2011, imports were down to 4,836 tonnes because of local production. By 2016, Cruz wants to substitute the country's imports of pangasius. This will require 270 ha of ponds and create jobs for 2,700 workers and generate PHP 945 million in sales. According to the Bureau of Fisheries and Aquatic Resources, total local production of pangasius grew by an average of 186% from 2008 to 2010.

Fall in black tiger shrimp prices

Bangladesh shrimp exporters are in dire straits because of the fall in prices for the black tiger shrimp in the international market, especially in the EU. In July, the Financial Express said that prices for the black tiger shrimp dropped to USD 4.60/lb (USD 10.12/kg) whilst it was up to USD6/lb (USD 13.2/kg) a month ago. Lockpur Group's senior executive director Khan Habibur Rahman said that some 10 to 12 foreign buyers have asked to renegotiate consignments. More than 80% of total shrimp exports go to the EU. According to Bangladesh Frozen Food Exporters Association vice-president Maksudur Rahman, black tiger shrimp of 16-20pcs/lb is not in high demand in the EU. There is more interest in vannamei shrimp and buyers want to reduce the price of black tiger to that of vannamei shrimp. Rahman said that this is not possible as the production cost of black tiger is much higher than vannamei shrimp. He asked that the government allow vannamei shrimp culture.

Stable production in China

The Fisheries Bureau of the Ministry of Agriculture reported that China's fishery production maintained stable growth in the first five months of 2012 (www.cs.com.cn). Aquaculture output increased 6.61% year-on-year to 13.54 million tonnes with ex-farm prices for marine and freshwater aquaculture products increasing by 213.26% and 84.75%, respectively. A comparison of transaction prices at 80 wholesale aquatic products markets within the same 5-month period in 2011, showed that the average wholesale price rose 9.23% to RMB 19.44/kg, with the average price of marine products increasing 9.84% to RMB 35.86/kg and for freshwater products, 8.46% to RMB13.25/kg. Exports of aquatic products in the first 4 months of 2012 dropped 4.54% to 1.18 million tonnes despite a 12.12% increase in export value to USD5.62 billion. The export volume of shrimp, shellfish, eel, and tilapia large yellow croakers dropped. Exports to Japan, the United States and ASEAN maintained growth, while exports to the EU and South Korea fell slightly

Golden grouper and exports

A fish farm in Pingtung county in southern Taiwan has produced a rare golden grouper which may be the one and only golden mutation of the species in the world. Ho Yuan-hsing, a marine biology researcher with the Fisheries Research Institute said the 10-month-old 30cm grouper is not an albino but a rare mutation resulting from the cross-breeding of two different species of grouper. The mutation caused its colour to turn yellow, very unusual for the fish, which is usually dark grey.

The Council of Agriculture reported that in Q1 2012, exports of groupers have increased by 40% in comparison to the same quarter last year with a sales value of USD15 million. Taiwan's grouper breeding techniques and suitable breeding grounds have driven the rapid growth of the domestic grouper industry in recent years. This is combined with the start of direct flights across the Taiwan Strait, the development of live-fish transportation fleets and the signing of early harvest programs under the Economic Cooperation Framework Agreement (ECFA) with China. The total export volume of domestic groupers has exceeded USD52.94 million at the end of March 2012.

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Symptoms, causes and remedies for EMS

By Erin Tan Chung Wei

An exchange on the EMS among experts and industry at the roadshow in Malaysia.

In Malaysia, Syndel Asia Sdn Bhd and Bayer Animal Health co-organise the annual 'shrimp protection' road shows where invited experts and company technicians, interact with marine shrimp farmers on current challenges. The road shows also aim to disseminate the latest information to improve culture practices.

In 2012, these were held in three locations in Peninsula Malaysia from 23-26 April in Butterworth in the north, Lumut in the centre and Johor Bahru in the south. Naturally, the overwhelming problems with Early Mortality Syndrome or EMS, affecting shrimp in Malaysian farms since late 2010 dominated the meetings. Organisers also asked participants to fill out a short questionnaire regarding their culture practices during the first 30 days of culture (DOC). The total number of farmers attending the roadshow was 140 and this covered 74 farms in Malaysia.

Predominance of pathogenic bacteria

Each roadshow started with a short video on the EMS. This is a regional problem that has affected China, Vietnam, Malaysia and Thailand. Dr Chalor Limsuwan, Faculty of Fisheries, Kasetsart University, presented the latest results from research at the Aquaculture Business Research Center, Kasetsart University, Thailand.

The team in Butterworth: Chalor Limsuwan (middle right), Pornlerd Chanratchakool (third right) and Liew Chiow Yen country representative Bayer Animal Health Malaysia (fourth left), with the Syndel Asia Sdn Bhd team, from left, Fakhri Hanif, technical sales representative, Erin Tan, Karu @ Kevin, consultant- technical support,Sugania Vijayan, general manager and Khaw Seek Chuan, technical sales representative.

EMS, also known as Acute Hepatopancreatic Necrotic Syndrome (AHNS) was first reported in China and has since been observed in Vietnam, Malaysia and lately, in Thailand. EMS is characterised by high mortalities, usually 40-60% and in severe cases up to 80-100%. Mortalities also occur before 35 days of culture. Other common symptoms are that the hepatopancreas in affected shrimp has less lipid droplets or that shrimp shows an initially swollen hepatopancreas and histological slides show cells with enlarged nuclei.

Dr Chalor added that when EMS was first discovered in Thailand in September 2011, farmers thought that it was a form of vibriosis. They then proceeded to observe stricter biosecurity measures and implemented a higher level of disinfection practices. However, the problem persisted and continued to spread; by 2012, the infection was more severe and up to 500 ponds were infected. In collaboration with Dr Timothy Flegel from the Center of Excellence for Shrimp Molecular Biology and Biotechnology-Centex Shrimp, it was discovered that the hepatopancreas of affected shrimp harboured a predominance of pathogenic bacteria namely;

- Order Burkholdiales: *Ralstonia spp*
- Order Sphingononadales: *Delftia spp/Pseudomonas spp*
- Order Actinomycetales: *Leifsonia spp, Rhodococus spp*

According to Dr Chalor, these bacteria are not commonly found naturally in the pond environment and should not be present in the shrimp hepatopancreas. Yet, numerous specimens showed numbers that are too high to be a chance occurrence in the shrimp. A common trait amongst these bacteria is the ability to survive and grow well at low pH.

"I suspect that these bacteria were selected for these particular traits so that the hatchery tanks can be maintained at low pH levels to reduce *Vibrio* infections. These hatcheries apply these bacteria as part of their probiotic program and unknowingly, have infected all the post larvae from these hatcheries with the pathogenic bacteria. Subsequently infected shrimp then start to succumb from necrosis of the hepatopancreas when transported from the hatcheries to grow-out ponds, due to stress.

"If the hatcheries stop using the probiotics containing these pathogenic bacteria, there should be a reduction in EMS outbreaks by the end of June. However, since the environment is already

Dead vannamei shrimp stocked in March 2012, floating on the water surface at DOC30.

Black tiger shrimp dying within 28-31 days from a May 2012 stocking of 7 ponds. Dr Chalor said that when the shrimp consumes more feed and grows faster, and moults when pH levels are low, they become weaker and more susceptible to EMS.

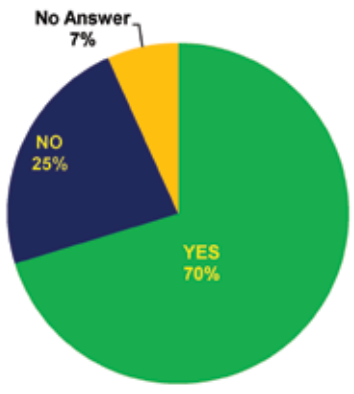
contaminated, there still will be outbreaks. Thus, a better bacterial disinfection program for the pond water and environment prior to stocking is a must. Meanwhile any immunostimulants or supplements that can help to improve the health of the shrimp should also be considered. However, shrimp dying after 35 days of culture is due to other diseases and not EMS," said Dr Chalor.

Key practices

Syndel Asia also conducted a survey to identify key practices that could be factors to EMS, either in lessening or aggravating the problem. We believe that the information will be beneficial to farmers as many are not aware of any potential problems with their practices and will be happy to learn of different strategies. Dr Pornlerd Chanratchakool, technical manager (Asia-Pacific), Novozymes Biologicals discussed with farmers their responses in this survey. In general, about 25% of farmers in Malaysia agreed with both experts that post larvae could be a source of the problem. However, another 20% of farmers also think that water quality is a contributing factor to EMS. Some 47% were unsure of the cause.

What could be the trigger for EMS? Some 93% of respondents reported pond water salinity ranging from 10-25 ppt. About 55% did not observe plankton die off before shrimp started dying, but 37% did. Bad weather or rainy and/or cloudy days were not contributing factors according to 53% of respondents. Some 81% said that accumulated excess feed was between 150 kg-250 kg during DOC30 whilst 29% recorded 200 kg. Thus we can summarise that salinity, plankton (under or over bloom), bad weather and overfeeding were not related to EMS.

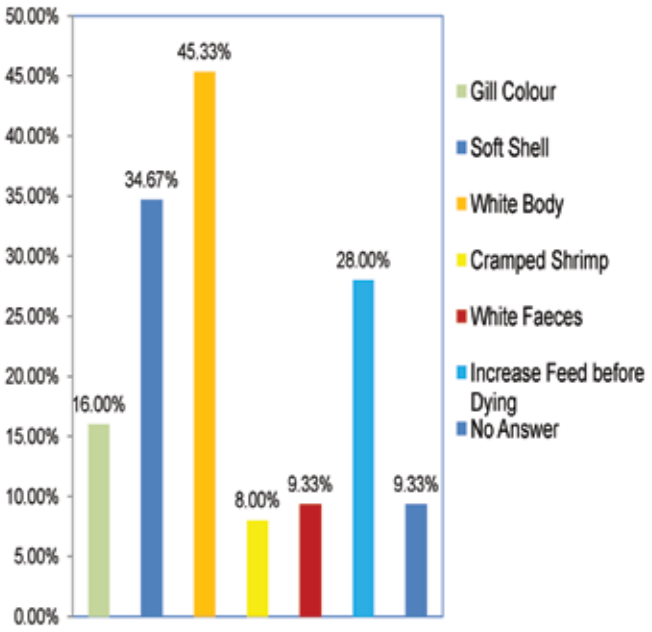
Figure 1. 'Do shrimp die during and after moulting?'



Indicators of EMS

What are the symptoms of EMS outbreaks? An overwhelming 70% of responses from participating farmers said that they noticed that shrimp are more likely to die during or after moulting (Figure 1). Other noticeable symptoms were soft shell (35%) and white body (45%, Figure 2). Some 54% indicated that fast growing shrimp seemed to be more susceptible to EMS.

Figure 2. What are the symptoms of EMS?
(Note: Multiple answers and percentages may add up to >100%).



What methods of disinfection of pond water and environment are used during pond preparation and during culture? About 49% said that they use virus carrier killers, 21% used synthetic pyrethroids and 8% used other chemicals. Some 27% used chlorine as a general disinfectant before culture (Figure 3). During culture, the most popular disinfectants used were potassium monopersulphate (29%), chlorine (24%), various other chemicals (with percentages ranging from 5-12%) such as iodine, hydrogen peroxide and benzylklonium chloride (BKC), while 33% of respondents did not give any answer (Figure 4).

Figure 3. Disinfectants used during pond preparation?
(Note: Multiple answers and percentages may add up to >100%).

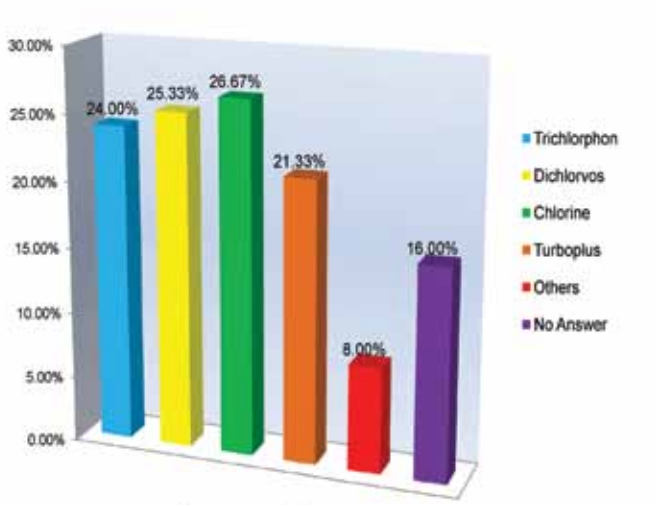


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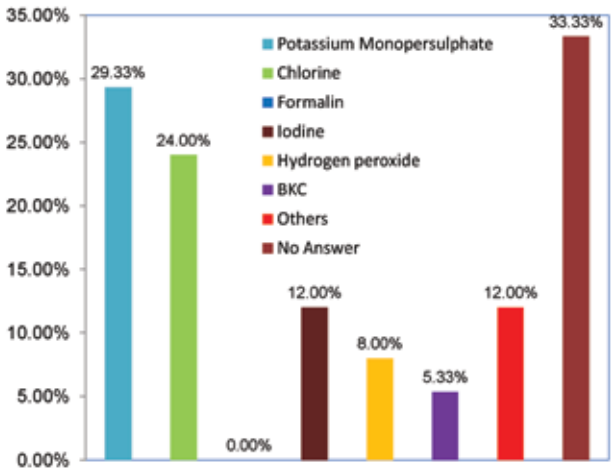
Figure 4. Disinfectants used during culture?
(Note: Multiple answers and percentages may add up to >100%).



Measures to alleviate the syndrome

Several key practices are needed to help reduce incidences of EMS. Firstly, the pond environment needs to be well prepared: the sludge should be removed or the pond bottom be completely dried, the water either in the reservoir or in the pond needs to be thoroughly disinfected, not only with a virus carrier killer but also with chemicals to remove the pathogenic bacteria. Secondly, healthy post larvae (preferably PL10 and above) from reliable hatcheries should be used. It is important to check the condition of the hepatopancreas to ensure that shrimp is healthy.

The stocking density of shrimp should be reduced or be based on the pond carrying capacity. In vannamei shrimp culture, the maximum should be between 13 to 15 tonnes of shrimp per hectare. In the case of the black tiger shrimp, the maximum carrying capacity of a pond is between 6 tonnes to 8 tonnes per hectare. These numbers assume that there is no partial harvesting.

Feed should be well controlled at about 12 kg per 100,000 pcs/day of shrimp at DOC30 with average body weight at 2.0-2.5 g. The accumulated feed at DOC30 should not be more than 250 kg. The amount of feed should be reduced when water temperatures fall below 26 °C and maximum daily feed increment should only be 500g/100,000 pcs shrimp. The dissolved oxygen levels should be >3.0 ppm near the edge of sludge. Approximately 1 horse power of aeration should be provided for every 400 kg of shrimp. When adequate oxygen is provided,

Pornlerd Chanratchakool

then problems with toxic hydrogen sulphide, ammonia and nitrite can be avoided.

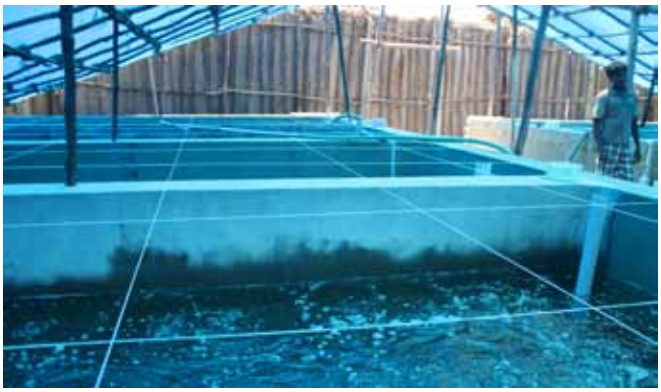
In addition, when the pond carrying capacity is being reached, the shrimp should be partially harvested or a total harvest should be conducted to avoid potential problems. The signs that a pond is reaching its carrying capacity are when feeding begins to level off or decrease, when there is slow growth of shrimp and when dissolved oxygen levels start to decrease.

In conclusion, if we assume that the affected hatcheries make changes in their application of the pathogenic bacteria, then we can expect a reduction in the number of outbreaks of EMS from the end of June. However, outbreaks will still continue until most of the pathogenic bacteria have been purged from the environment. Meanwhile, a better disinfection protocol coupled with immune boosters and supplements to improve the health of the shrimp may help to reduce further outbreaks.

Erin Tan Chung Wei Tan is technical manager at Syndel Asia Sdn Bhd since 2005 and provides technical support for products for fish hatchery and shrimp grow-out industry. She is also responsible for staff training and in sourcing for new products for better solutions for the aquaculture industry. Erin has a BSc from Universiti Malaya in 2001 and MSc University of Guelph, Canada. Email: erin@syndelasia.com

A position with the black tiger shrimp

Against the flow, this hatchery has experienced a steady increase of clients. By Zuridah Merican



India is the latest country to introduce *Penaeus vannamei* shrimp farming and the switch to its farming has been rapid. It is inevitable that many black tiger shrimp *P. monodon* hatcheries will also switch to the production of the vannamei, where demand is more than supply. However, there is still a demand for good quality black tiger post larvae and S.K. Selvaraj decided to use his 22 years of experience in hatchery operations of the black tiger rather than change species.

Together with a partner, Senthil Kumar, he now operates the Aquastar Hatchery, located in Mudaliarkuppam, facing the sea front along the main road from Chennai to Pondicherry. This is a renovated hatchery, and in its third year of operations, has managed to produce 70 million post larvae, almost double the planned capacity of 30-40 million per year.

Using gravids

Selvaraj is very specific in his management of the hatchery to achieve not only production targets but more demandingly, quality post larvae. First he uses wild gravid black tiger brood stock and in this way, does not face the risk of failures in the induced maturation process. In addition, the spawning section is located away from that of the main section for nauplii, larval and post larval rearing and live feeds production. There is a separate drainage facility. After spawning, the brood stocks are PCR tested for White Spot Syndrome Virus (WSSV) and Monodon Baculovirus (MBV).

"After spawning, on the evening of the second day, the brood stock is in a stress condition and the likelihood of a positive reading is

S.K. Selvaraj (second right) and P.K. Senthil Kumar (right) with customers; Ramanathan (in white, middle) and his friends from Balaji Enterprises in Chidambaram, Tamil Nadu. They are black tiger and vannamei shrimp farmers with 10 ha of ponds.

higher. If either WSSV or MBV is detected, the whole batch of nauplii is destroyed and tanks bleached. If all is good, we will transfer the batch of nauplii to the main section," said Selvaraj. "Actually, I am the only person using a ratio of one male to one female spawner without any inducement. A 150 g spawner can give me about a million eggs. The record that I have is 2.4 million eggs from a 240 g spawner."

Similarly to other parts of Asia, hatcheries in India depend on wild brood stocks but unfortunately surveys have revealed that most brood stocks have varying levels of infections of WSSV and MBV. However, the advantage is that industry in India has identified the locations of gravid spawners and has also documented the frequency of WSSV/MBV infections in these wild stocks according to locations and seasons. According to Selvaraj, in general there is higher frequency (40%) in the incidences of WSSV and/or MBV in winter as compared to the summer months.

"In March, the location for the least infected brood stock stretched from Chennai to Pazhayar, and after July we will depend on Kanyakumari in the south of Tamil Nadu and Andaman islands. Daily some 10-20 pieces are available and we do not need to worry on the availability of these wild shrimp. Fishermen are now very experienced with handling them and deliver these direct to hatcheries. The price range is from USD 120 to USD 250 each. This is so different from several years ago, such as in 1996-1998, when demand was high from several countries and prices reached USD 2,000 each."

His protocols at the hatchery simulate the seawater conditions. No antibiotics are used. Heaters are not used for the colder months even when temperatures drop to below the optimal of 28.5 °C. The hatchery shuts down from December to the middle of January. The survival rate from nauplii to post larvae is 60-80% and marine algae and Artemia are the main feed ingredients. Seawater is drawn from a 20 foot (6 m) deep natural seabed at low tide. Water treatment comprises chlorination at 20ppm for 24 hours, followed by rapid sand filtration. The water used for algae production is chlorinated as well as UV treated.

Tried and tested

Aquastar is the only hatchery with continuous production and it has earned the confidence of industry as a producer of quality post larvae. Black tiger shrimp farmers testify this with good results in farms when using their post larvae.

"We regularly test each and every brood stock as well as nauplii for diseases like WSSV and MBV. Interested buyers will send post larvae samples to PCR laboratories. After they are satisfied with the quality, we will do the packing. Some stocks show size variations at the hatchery and we believe that happens when the nauplii from more than one spawner is stocked together. We also believe that the size variation continues in the ponds."

Sales are to farms in Tamil Nadu, Andhra Pradesh, West Bengal and Gujarat. According to Senthil, they have records that shrimp reach 20 g sizes in 80-90 days. In comparison, post larvae from other hatcheries reach the same size in 110 days. The fastest growth was 50 g in 160 days and the maximum would be 180 days. In farms, WSSV infections have been attributed to neighbouring farms and loose shell syndrome is now reported less frequently.

Rising demand and cost

The demand is quickly exceeding supply and as long as there is demand, Aquastar can continue to have its 5-6 cycles per year.

"The target in 2012 will be 100 million post larvae (PL 10) but it all depends on demand. The cost of production has increased drastically, just as most input costs are rising. The GSL Artemia prices have increased from INR 1,250 to INR 3,600 (USD 22 to USD 64) and labour costs both in Tamil Nadu and Andhra Pradesh have doubled during the last two years. My lease has been increased by 60% and the electricity charges have also tripled. We will need to hire another generator to ensure a constant supply of power for aeration and other hatchery operations. Costs are rising too fast"

Black tiger shrimp in Vietnam

It has been difficult to meet export targets, reports Le Thi Ngoc Diep.

Large size frozen black tiger produced by Camimex in Ca Mau at Vietfish 2012 held from June 26-28, Ho Chi Minh City.

Since early 2011, the farming of both the black tiger and vannamei shrimp has been affected by the nationwide outbreak of early mortality in shrimp. Outbreaks have occurred in almost all farms, whether they are large integrated operations or small scale farms but the damage is particularly high with the black tiger shrimp. However, industry reported that black tiger shrimp production is relatively unaffected in Ca Mau in the south where the farming is largely extensive. It has recovered significantly in Bac Lieu but other key production areas such as Soc Trang and Tra Vinh continue to suffer from large scale damage.

According to the Fisheries Directorate, Ministry of Agriculture and Rural Development (MARD), at the end of October 2011, disease affected 81,000ha of black tiger shrimp farming areas. This was much higher than the 4,000ha used for vannamei shrimp farming.

The losses early after stocking has aggravated the shortage of black tiger post larvae (PL) in the country. Poor quality PL are also blamed for the outbreaks. Local authorities have directed that affected ponds should not be restocked. To solve the shortage, the Fisheries Directorate is encouraging local research institutions, universities and the private sector to import advanced technologies and cooperate with foreign partners to produce high quality PL. Local enterprises have been asked to increase PL production to meet demand.

In June, the ex-farm price of black tiger shrimp was VND 170,000/kg for 40/kg size in Ben Tre (June 29). Prices differ among provinces. It was highest in Khanh Hoa province as compared to Ca Mau and Danang; up to VND180,000/kg versus VND135,000/kg and VND110,000/kg for size 40/kg (vasep.com; 27 June 2012; VND20,875.00 to one USD). In Ca Mau, ex farm prices for 20/kg size shrimp was VND200,000 to 205,000/kg. Higher prices are attributed to the increased demand by shrimp processors.

Stricter standards set by the most important markets, notably Japan, are causing difficulties for Vietnamese shrimp exporters and processors. Currently, local processors are searching solutions to help Vietnam's shrimp access the Japan market after a recent decision of the authorities in Japan to check 30% of all shrimp shipments. Any sample containing more than 10ppb ethoxyquin will result in a decision to inspect 50-70% of all imported shipments or even a total ban of shrimp imports from Vietnam.

Another challenge for the shrimp production industry is climate change. At a seminar organised by the Aquaculture Research Institute (RIA 2) on March 2012 in Ca Mau, Dr Nguyen Van Hao predicted that local shrimp output will be severely affected by diurnal temperature variations, heavy rains, flooding and environmental pollution. These combined with the current spread of infections in shrimp cause difficulties for most shrimp producers. Consequently, with these adversities, it will be hard for local shrimp processors and exporters to increase export turnover. (Sources: Report on Vietnam Seafood, Q3 2011, Viet Nam Association of Seafood Exporters and Producers, Ministry of Agriculture and Rural Development, General Statistic Department).

Le Thi Ngoc Diep is based in Hanoi. Email: ngoc.diep@hotmail.com

Changing to vannamei shrimp

The 10-year old Mercury aqua farm continues to adapt for its second crop of vannamei shrimp. By Zuridah Merican.

Durai (right) with P.K Senthil Kumar, Poseidon Biotech

The quick shift to vannamei shrimp farming began in 2010, but only after the registration with the Coastal Aquaculture Authority (CAA) and meeting the prerequisites for its farming. Irrespective of size, the CAA has legislated that the farm must have at least one reservoir pond and an effluent treatment system (ETS). In a location with existing ponds, this was a challenge. The farm only has 6 ponds of 0.6 to 0.8 ha in size in an area of 3.8 ha.

Luckily, in this farm in Kokkilamedu, Tamil Nadu, farm technician, Durai could use the land around the farm. As the pond area is saddled between a canal and mangrove swamps, he could easily add a reservoir pond alongside the canal. On the other side of the pond area, the mangroves act as his ETS. Water from the ETS then flows downstream to some salt pans.

"All this is new to us as we never needed this for our low density culture of the black tiger shrimp. We are also lucky that the canal separates us from the local village and helps with security."

However, although CAA also recommends fencing the farm, installing crab prevention nets and bird scaring overhead netting or lines, these devices are absent in this farm and are rarely found in shrimp farms in India.

For the first crop, Durai was very cautious and started with a low stocking density of 900,000 post larvae (PL) for all six ponds (23 PL/m^2). Survival was 95% and this crop produced 14 tonnes of 40/kg shrimp after a culture period of 90 days. There was only a one-time harvest and shrimp was sold at INR 220 to 250/kg.

Upgrading for the second crop

In preparation for the second crop, more needs to be done to the ponds. He has deepened ponds to a depth of 1.5 m and applied lime. Some of the ready- to-stock ponds now have 6 paddlewheels, with 2 units of 2 HP and 4 units of 1 HP paddlewheels , all imported from Taiwan. For this second crop, Durai has filled the ponds direct from the canal and later he will fill up the reservoir for top up water only. Salinity is 15 ppt but later during the dry season, it will be impossible to pump water into the ponds and salinity will also rise to 22 ppt. There is almost zero exchange of water at this farm.

"Now our plan is to stock all these ponds at 50 PL/m^2. This is still below the maximum permitted stocking density of 60 PL/m^2 as specified by CAA. We will use PL16 which is supplied through the feed company. During the first crop, the survival rate was very high but stocking was low. At that time we used Grobest feed which cost around INR 60/kg. In this new crop, I am changing the feed to an Avanti brand which will cost INR 50 and they will also supply the post larvae. We pay 45 paise for each post larvae."

Management protocols

Durai said that his target cost of production is INR 140/kg, but he is now unsure of what will be his final tally after the harvest, as many parameters such as stocking density has changed. He is also changing the feed. Previously, the feed conversion ratio was 1.3. This will change with the higher stocking density. The size at harvest has not been decided too. In addition, he expects to pay more for diesel to run the recently bought generator as they can no longer depend on the national grid because of frequent brown outs.

"Around 20% of my costs are for various chemical treatments which I started to use when farming the black tiger shrimp. I will continue to use these chemicals with the vannamei shrimp. Some of these include a moulting agent, a sanitizer, a garlic based shrimp health promoting agent and a digestive enhancer. As for the control of *Vibrio* bacteria, I will send water samples weekly to the nearby labs. Looking at the profile of the bacteria, I will then change to the appropriate probiotics to be added in the water."

The recently installed generator set

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Performance testing on SPF shrimp lines

By Jim Wyban, Brenda Noble and Donald V. Lightner

Growth rates and virus challenges for the next generation of shrimp.

Shrimp farmers want fast-growing shrimp with good resistance to common diseases. To breed for these traits, High Health Aquaculture Inc in Hawaii uses performance testing of its shrimp lines to determine which families to perpetuate each generation. The combined selection strategy is based on shrimp survival in replicated laboratory virus challenges together with shrimp growth performance under simulated commercial conditions. Since 1996, we have used this combined selection approach to develop a fast-growing, Taura Syndrome (TSV) resistant stock called GxTVR.

TSV and infectious myonecrosis virus (IMNV) cause significant economic diseases in farmed shrimp. Knowledge of the relative susceptibility of different lines of shrimp to these two viruses is lacking. Herein we describe a recent performance trial comparing growth rates and virus challenge results for a diverse collection of SPF shrimp. Four lines of shrimp, three *Penaeus vannamei* and one *P. stylirostris*, were compared. Each line was represented by multiple distinct same-age families. All families were tested in two virus challenges (TSV and IMNV) at the Shrimp Pathology Group in Tucson Arizona. Equivalent tagged samples of the families were tested in a growth trial at HHA in Kona Hawaii.

Shrimp families

A collection of 12 same-age (i.e. spawned the same day) Specific Pathogen Free (SPF) shrimp families were produced in the Shrimp Breeding Center in Kona Hawaii. The twelve families were derived from four distinct genetic lines as listed in Table 1.

Table 1. Composition of four shrimp groups in virus challenges and growth trial.

Species	Line	Families
P. vannamei	GxTVR	4
P. vannamei	Hybrid	4
P. vannamei	Kona Stock	2
P. stylirostris	SPF Blue Shrimp	2

GxTVR is HHA's commercial stock that has been selected for fast growth and TSV resistance for 14 generations. Families from this stock routinely achieve >90% survival in TSV lab challenges. Kona Stock is the original SPF shrimp stock developed in 1990. It is routinely used as the positive control stock in TSV challenges because of its well documented susceptibility to TSV. The company has maintained this SPF stock for this purpose since 1994. The Hybrid Line was produced by mating GxTVR and Kona Stock parents. It also breeds SPF Blue Shrimp (*P. stylirostris*) since 1994. Blue Shrimp are naturally resistant to TSV and we wanted to determine their relative resistance to IMNV.

The twelve families were produced at the shrimp breeding center in Kona Hawaii and colour-code tagged with elastomer by injection. Samples of the tagged families were shipped to the Shrimp Pathology Group (SPG) in Tucson Arizona for virus challenge testing. SPG conducts the virus challenges using purified strains of both viruses. SPG recently developed a lab challenge bioassay with purified IMNV and we wanted to test it with our shrimp.

Performance trial

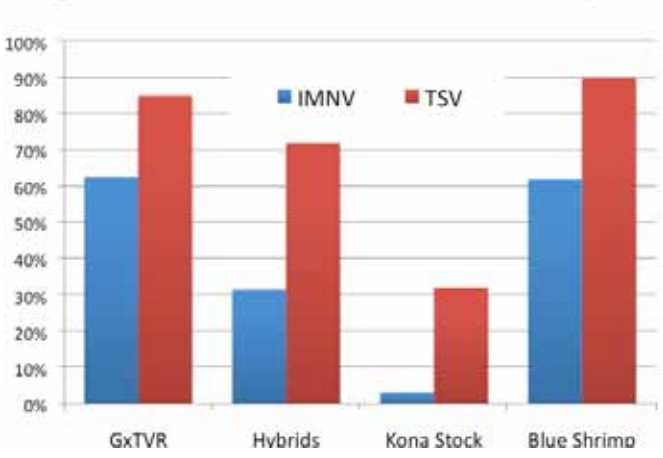
At SPG, the lines were challenge-tested with two different virus isolates, IMNV and TSV. Both positive and negative control treatments were included in the experimental design. IMNV challenge was administered by injection of a viral preparation in the 3rd abdominal segment of each test shrimp. TSV challenge was achieved by feeding (*per os*) TSV-contaminated shrimp tissue to the challenged animals. Mortalities in both challenges were recorded daily and representative samples of moribund shrimp were examined to determine cause of death.

A growth trial was conducted at HHA in Hawaii using a parallel set of tagged individuals from the same families and lines as the virus challenges. The growth trial shrimp were tagged using the same colour scheme as the viral challenges. The shrimp were stocked into a single tank at 125 shrimp/m^2. Shrimp were reared under a low water exchange, high aeration system using commercial diet. Shrimp were sampled monthly with 50 pcs per family individually scored to family and weighed.

Stock survival

In all results reported here, mean family values are presented. In the viral challenges, survival in the negative controls was essentially 100%. Positive controls (viral challenges with susceptible shrimp) are used to determine that the administered virus isolates were infectious. Survival in the IMNV positive control was only 10% while the positive control in the TSV challenge was 20%. Survival results by shrimp line are shown in Figure 1. In the IMNV challenge, GxTVR line had the highest survival among the *P. vannamei* lines. Kona Stock shrimp had the lowest survival while the hybrids were intermediate. Blue Shrimp survival in the IMNV challenge was not different from GxTVR stock. In the TSV challenge, GxTVR line had the highest survival among the *P. vannamei* lines. Kona Stock shrimp had the lowest survival while the hybrids were intermediate. Blue Shrimp survival in the TSV challenge was not different from GxTVR stock.

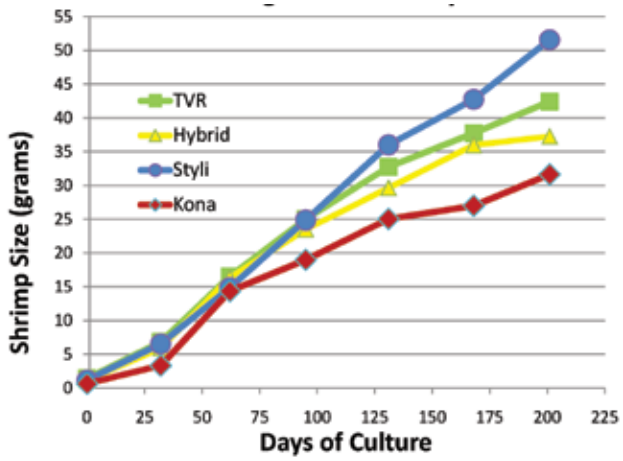
Figure 1. Stock survivals in IMNV and TSV challenges



Growth performance

There were significant differences in growth among the four lines (Figure 2). Up to 60 days, mean size (15.5g) by line were not different. After 60 days, the four lines growth started to separate. At 95 days, GxTVR and Blue Shrimp were not different at 25g while Hybrid line lagged at 23g and Kona Stock were only 18g. By 130 days there were statistical differences between the four lines with the Blue Shrimp largest at 36g, GxTVR at 33g, Hybrids at 29g and Kona Stock at 25g. These differences persisted through to the end of the trial at 200 days with Blue Shrimp reaching 52g, GxTVR at 42g, Hybrids at 36g and Kona Stock at 31g.

Figure 2. Growth by lines in 2011



Toward desirable traits

Shrimp farmers want fast-growing, disease-resistant seed. To produce these, shrimp breeding companies can use performance testing to determine best stocks for breeding for desirable traits. This experiment illustrates our approach to such a challenge. Multiple shrimp families from distinct strains were compared for their resistances to two important viruses and their growth rates.

Taura Syndrome (TS) is a widespread viral disease in both hemispheres. Results in the challenge study with the Thai strain of TSV were similar to our previous studies. GxTVR families were more resistant to TSV than Kona Stock or Kona Stock X GxTVR hybrids. These results clearly demonstrate that selective breeding for TS-resistance has been highly successful.

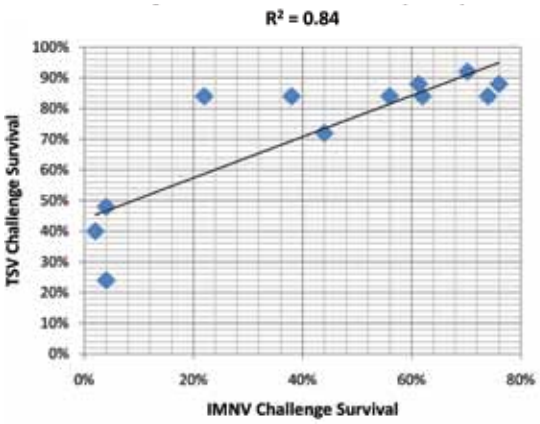
Blue Shrimp were also TSV resistant. There were no benefits in Hybrids for TSV resistance. An understanding of why the hybrid families were intermediate to the resistant and susceptible stocks is intriguing. Perhaps the genetics of TSV resistance is a simple Mendelian gene. Or perhaps it is polygenic. Molecular studies to understand this variation are needed. Farmers operating where TSV is established should use shrimp stocks that carry documented TSV resistance.

IMNV is a significant viral disease in white shrimp (*P. vannamei*) farming in both Brazil and Indonesia. It is a threat to shrimp farming in both regions. It was surprising to see a very similar pattern of susceptibility to IMNV as in TSV across all four strains (Figure 1). Again, GxTVR families were most resistant, Kona Stock were most susceptible and the hybrids were intermediate. As in the case of TSV, Blue Shrimp were also resistant to IMNV and similar to GxTVR. Are TSV and IMNV susceptibility and resistance a genetically related trait?

A common genetic factor

A scatter plot of family survival in TSV versus IMNV is shown in Figure 3. The two traits were highly correlated with an $r^2 = 0.84$. This high correlation among the 12 families suggests there maybe some common genetic factor for both viruses which requires further study.

Figure 3. IMNV vs TSV survival by family



In the growth trial, the four strains were very similar up to 15g and then separated in growth to adult size with Blue Shrimp growing to largest size followed closely by GxTVR then hybrids and finally Kona Stock. These results are consistent with previous experience at HHA and the breeding history of these stocks. We consistently see Blue Shrimp grow to larger sizes than *P. vannamei*. There are reports in the shrimp literature that shrimp progeny from matings between genetically distinct groups (hybrid crossing) exhibit faster growth (i.e heterosis) than either of the parent stocks. Since our GxTVR line and Kona Stock line are distinct genetic lines, we wanted to determine if hybrids between them would outperform the parent stocks. In both virus challenges and the growth trial, the hybrids were intermediate to the two pure stocks. For better growth performance, farmers should seek shrimp suppliers with documented growth rate breeding programs.

World shrimp production using *P. vannamei* is now more than 80% of total world production. In this last decade, *P. vannamei* production expanded from only 10% of total world production to this dominant position. This transformation is driven by *P. vannamei*'s lower production costs which derive from advancing domestication coupled with *P. vannamei*'s natural growth traits. With this shift to *P. vannamei,* Taura Syndrome and IMNV remain an important threat because they can cause huge production losses in *P. vannamei* farming. The *P. vannamei* component of the industry needs a stable supply of domesticated broodstock shrimp that are resistant to both TS and IMNV with reliable commercial performance in pond culture. As the industry matures, an ever increasing share of production will be based on use of certified stocks that are SPF and TSV-resistant.

Similar to other animals production industries, sustainable shrimp farming will depend on domesticated, certified pathogen-free, fast growing, pathogen-resistant stocks. Our results clearly demonstrate that selective breeding for virus resistance and fast growth is achievable and will contribute to the industry's long-term drive to reduce production costs and increase production reliability.

Jim Wyban

Donald V. Lightner

Brenda Noble

Jim Wyban is founder and president of High Health Aquaculture Inc. Kona, Hawaii, USA. Email: jim.wyban@gmail.com

Donald V. Lightner and **Brenda Noble** are at the Department of Veterinary Science and Microbiology, University of Arizona, USA.

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Two more fish feed mills in India

These are part of the recent developments in the Indian extruded fish feed industry, led by the ASA-IM program.

There are three new extrusion fish feed mills in Andhra Pradesh on the list of the American Soybean Association-International Marketing (ASA-IM) for capacity building in 2012. In the first quarter of the year, two have started operations. By the end of 2011, a total of eight fish feed mills have been established in India with the guidance and initial market research carried out by ASA-IM. These two new mills are the ninth and tenth respectively in the country.

Nexgen Feeds in Bhimavaram and Deepak Nexgen Feeds in Bommuluru, Krishna District, both in Andhra Pradesh, were inaugurated on February 5 and March 14, 2012, respectively. Deepak Nexgen Feeds has a capacity to produce 60,000 tonnes per year while that for Nexgen Feeds is 75,000 tonnes per year. In addition, Nexgen Feeds can also produce 45,000 tonnes per year of shrimp feed as part of the diversification of its aquaculture feed business. Previously, both companies were trading fish feeds and involved in fish farming. Fish feed production is an upstream activity for them and they will leverage on their existing business networks for the feed sales.

Building demand for fish feeds

With a total installed capacity of 1.37 million tonnes per year of extruded fish feeds in India, ASA-IM is presently not recommending the set-up of new fish feed mills; that is until feed demand catches up. It is of the opinion that current feed demand has not increased in tandem with feed production capacity nationwide. Therefore, the present strategy is to help existing feed mills utilise more of their current capacity. A larger feed market can be created by expansion of feed based fish farming, opening up cage culture ventures which will require extruded feeds and by increasing consumption of fish. New market opportunities for extruded fish feeds are also required. These strategies will help sustain the businesses of the existing feed mills by addressing the bottlenecks in the entire value chain of the industry.

Vijay was honoured in the traditional way with a golden shawl by Kamenineni Srinivas, M. Maganti Ventateshwar Rao, T. Srinivas, A.V. Sheshadri, A.K. Krishna Srinivas, C. Prabhakar, J. Ventataramana, V. Ramachandra Raju, D, Balavardhanarao, M. Subas Chandrabose and B. Mohan Krishna.

Win-win strategies

During the inauguration ceremony for Deepak Nexgen Feeds, ASA-IM and Dr. P. E. Vijay Anand, technical director, India Aquaculture and Animal Feed Program were honoured by Deepak Nexgen Feeds and industry leaders for creating and establishing the new fish feed industry for the country.

The management of Deepak Nexgen Feeds in Vijayawada, in consultation with a few industry leaders 'recognised and placed on record' the excellent vision that Vijay had foreseen in 2004. The citation added that the team guided Indian aquaculture to adopt modern practices so as to render a better business perspective to the fish farming industry.' The citation also stated that turning this potential into reality was driven by Vijay and his team with various stakeholders of the industry.

"His innovative and tireless efforts at all phases of the industry have resulted in moving the fish feed sector from a non-existent position to a significant status where 0.6 milliion tonnes of fish feed per year is used by the industry to date. This initiative has brought various processes, systems, as well as people together and is developing into an organised, mega industry. We are sure to receive the good will, guidance and support of the U.S. Soybean farmers through ASA-IM for future developments of this hitherto new industry and look forward to many more creative ideas from which all of us will definitely benefit."

The inauguration of the feed mill of Deepak Nexgen Feeds was attended by 3,500 guests and included a display and promotion of the Kingfish brand feed bags.

Notice inviting quotations
RAJIV GANDHI CENTRE FOR AQUACULTURE
(MPEDA, Ministry of Commerce & Industry, Govt of India)
3/197, Poompuhar Road, Karaimedu Village, Sattanathapuram,
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Rajiv Gandhi Centre for Aquaculture (RGCA), an aquaculture R & D arm of the Marine Products Export Development Authority, Ministry of Commerce & Industry, Govt of India, hereby request quotations from dealers/manufacturers for re-circulating aquaculture system components for its SPF *L. vannamei* Multiplication Centre in India. The following components are required:

1.	Combined Beadfilter & Bio-filter units:	5 numbers
2.	UV Sterilizers:	5 numbers
3.	Saltwater Pumps:	10 numbers
4.	Various air & pipe fittings:	As per the requirement.

Please log on to the website www.mpeda.com for specification and details. Manufacturers/Suppliers of the above aquaculture materials/equipment may send their quotation along with terms and conditions to the Project Director, Rajiv Gandhi Centre for Aquaculture, at the above address within 15 days from the date of this publication.

PROJECT DIRECTOR

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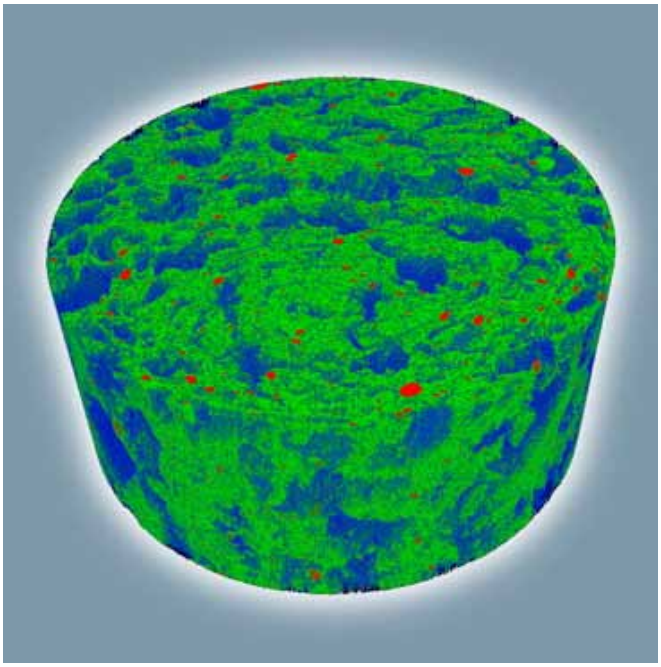
Fish feed gets 'hospital treatment'

High science imaging reveals feed pellets' secrets.

Imaging with X-rays and nuclear magnetic resonance imaging (NMR/MRI) are technologies normally associated with hi-tech materials science or medical examinations. Now the global feed company, Skretting is using them to examine the humble fish feed pellet. Together with specialist software, these techniques are revealing the inner secrets of pore size and pellet structure and the ways in which minor ingredients can affect them.

Jan Jonkers, Feed Production manager at Skretting Aquaculture Research Centre (ARC) in Stavanger, Norway gave an insight into the complicated world of fish feed pellets. "Feed pellets for fish are far more complex to make than the compound feed pellets used in animal feeds. Reliable production of pellets with consistent nutritional and physical properties requires a thorough understanding of how the combination of ingredients will react at critical stages such as extrusion and coating.

"In addition, vaporising the moisture content of the pellet at the moment of extrusion creates the initial porous structure but the pellet shrinks on drying. Getting the resulting porosity exactly right is a vital part of ensuring the final pellet will have the correct content of fats following the vacuum coating step. It influences the nutritional value of the pellet and its final density, which affects its floating or sinking behaviour. That is where the skill and knowledge of the process engineers are so important. In Skretting we hold monthly video



Fish feed pellet X-ray (Skretting photo)

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Phosphorus · care · life

MCP

Monocalcium Phosphate

【 MOLECULAR FORMULA】 $Ca(H_2PO_4)_2 \cdot H_2O$

【 STANDARD 】 GB/T 22548-2008

Item	Standard
Total P Content:	22.0%min
Water-Soluble P Content:	90.0%min
Ca Content:	13.0%min

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Jan Jonkers in the pilot feed plant of the Skretting Aquaculture Research Centre

meetings as a way of sharing the latest knowledge from ARC and the experience of our engineers around the world."

Complexity in fish feed

These aspects are becoming more complex as fish feed companies identify and use a wider range of feed raw materials in their quest to control costs and to become more sustainable. "While a Skretting feed will have consistent nutritional properties, the raw materials may vary from batch to batch, which affects the way the feed behaves in the production plant," said Jonkers.

Other recent trends also have an impact. "Increasingly Skretting is delivering feed from silo to silo, rather than in big bags. Transferring feed from the silo on the boat to a silo at the farms involves blowing it along pipes or using elevators and conveyors. Either way brings additional physical impacts on the pellets and we need to make them tougher. That is a challenge with feeds such as salmon grower feeds. The high contents of fats and proteins leave little space for the binding ingredients that hold the pellets together."

3-D images of pellets

ARC is using the X-ray microtomography and NMR technology to investigate how different feed ingredients and variations in production parameters such as grinding influence the behaviour and structure of pellets in production and in use. "Examining pellets before and after coating, we see the internal structure, the size of the pores and variation in size. This is important as it affects physical properties and how the pellet behaves in vacuum coating. Using specially developed software we are creating 3-D images of pellets, with colour to distinguish between oil and the matrix. You can actually achieve an effect of travelling through the pellet from end to end."

Shrimp feed

Skretting's growing activities in shrimp feed brought another task for Jonkers, "In our feed pilot plant we are installing the equipment needed to manufacture shrimp feed, which has quite different physical requirements. For example it must sink quickly, to avoid floating away, and be very water stable with virtually no nutrient leakage as shrimp are slow eaters. When the equipment is in place we will explore different production techniques and raw materials, of course with X-rays and NMR providing those extra insights."

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—Peter F. Drucker

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Mycotoxins: a rising threat for aquaculture

By Shu Guan, Pedro Encarnação and Karin Nährer

Mycotoxins are a large group of fungal secondary metabolites and are commonly found worldwide in cereal grains and animal feed.

On the basis of negative effects on animal production and contamination severity, aflatoxins (Afla), zearalenone (ZON), deoxynivalenol (DON), fumonisins (FUM) and ochratoxin A (OTA) are considered to be the most important mycotoxins (Miller, 1995). They produce acute and chronic toxicity in animals and pose severe threat to humans consuming contaminated cereal products (Eaton and Groopman, 1994; Diaz, 2005; Morgavi and Riley, 2007; He et al., 2010).

Recently, with rising public concern on food and feed safety, the monitoring of mycotoxins in the food and feed chains has become an important issue. Mycotoxin contamination of feed materials is widespread, especially in countries with humid tropical climates as these provide favourable conditions for mold growth. These mycotoxins pose a potential threat to aquaculture since many of the plant feedstuffs now commonly used in fish and shrimp diets may be contaminated with these deleterious substances.

Nowadays, with increasing costs of feedstuffs, feed manufacturers seek lower cost raw materials to avoid increasing feed prices. However, the use of more affordable raw materials, often of lower quality, might increase the risk of mycotoxin contamination in feeds produced. For example, DDGS is an economical source of energy and protein that can be used in animal feeds, but data show that it is highly contaminated with multiple mycotoxins (Naehrer, 2012; Rodrigues and Chin, 2012). Additionally, increasing global trade and incorporation of imported raw materials in aqua feeds expose feed manufacturers and their clients to the risk of combinations of mycotoxins both from multiple mycotoxins in individual raw materials and in different ingredients in the formulation (Fegan & Spring, 2008).

The occurrence of mycotoxins in food grains, feed ingredients and compound feed samples from some regions has been investigated during the past years (Pietri et al., 2004; Ayalew et al., 2006; Binder et al., 2007; Monbaliu et al., 2010). However, information on the incidence and levels of mycotoxins for each feed ingredient in different regions is still very limited. There is an urgent need to further extend the database on the profile and level of mycotoxin contaminations on a global scale.

The mycotoxin survey program

Starting from 2005, BIOMIN has carried out extensive research on the occurrence of mycotoxins in different regions. From January to December 2011, a total number of 4,327 samples were collected and analysed for the most important mycotoxins for the feed industry and in animal production. These are Afla, ZON, DON, FUM and OTA.

These samples were classified according to their region of origin, mainly Asia-Pacific (37%), Europe (35%), the Americas (27%), and by commodity types. Samples tested were diverse, ranging from cereals such as corn, wheat and rice to by-products, namely soybean meal, corn gluten meal, dried distillers grains with solubles (DDGS) and other fodder such as straw, silage and finished feed.

Figure 1 show that the positive percentage of all tested samples for Afla, ZON, DON, FUM and OTA was 27%, 40%, 59%, 51% and 27% respectively. In general, the occurrence of each mycotoxin is very much similar with that in the previous year. Table 1 gives an overview on the survey results with actual contamination levels. Figure 2 provides an overview on the distribution of mycotoxins throughout different regions across the globe.

Figure 1. Global mycotoxin occurrence in 2011 in the analysed samples.

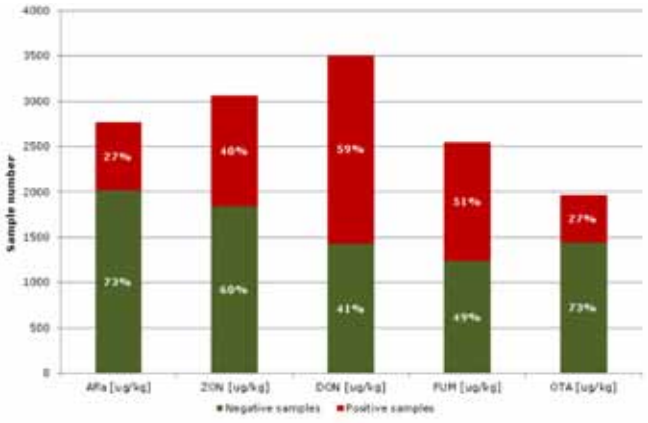
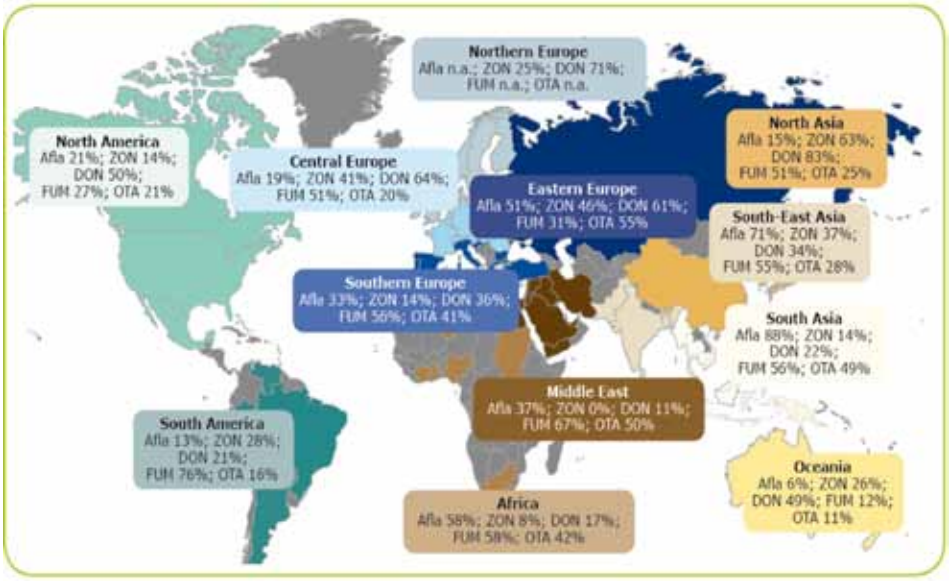


Figure 2. Prevalence of mycotoxins in different geographic regions in 2011.



Results by geographic region

Due to the various origins of the different samples, data were categorised into regions. In this paper, detailed data on mycotoxin prevalence in different Asian regions was highlighted in Table 2 (2a to 2d).

Similarly with that for the previous years, the most prevalent mycotoxins were DON, ZON and FUM in North Asia. DON, ZON and FUM were present in 83%, 63% and 51% of tested samples with an average level of 782µg/kg, 164µg/kg and 1,068µg/kg. It is worth mentioning that the prevalence of all five major mycotoxins had increased compared with that presented in the survey of 2010.

Table 1. Overview of the survey results in 2011.

Global Results	Afla	ZON	DON	FUM	OTA
Number of tests	2,770	3,061	3,509	2,548	1,966
Percent Positive (%)	27	40	59	51	27
Average (µg/kg)	16	96	625	887	3
Maximum (µg/kg)	2,230	23,278	49,307	77,502	400
Commodity found	maize	wheat	wheat	finished feed	maize
Country of origin	Pakistan	Australia	Australia	China	India

Table 2. Survey results by geographical region in Asia.

Table 2a. North Asia (includes China, Taiwan, Korea and Japan).

North Asia	Afla	ZON	DON	FUM	OTA
Number of tests	879	894	918	811	774
Percent positive (%)	15	63	83	51	25
Average (µg/kg)	4	164	782	1,068	1
Maximum (µg/kg)	340	7,446	15,073	77,502	53

Table 2. Survey results by geographical region in Asia. (continued)

Table 2b. South East Asia (includes Malaysia, Philippines, Thailand, Vietnam and Indonesia).

North Asia	Afla	ZON	DON	FUM	OTA
Number of tests	357	349	349	353	348
Percent positive (%)	71	37	34	55	28
Average (µg/kg)	42	72	199	784	1
Maximum (µg/kg)	933	11,276	41,439	30,255	80

Table 2c. South Asia (includes India, Pakistan and Bangladesh).

North Asia	Afla	ZON	DON	FUM	OTA
Number of tests	101	97	97	97	97
Percent positive (%)	88	14	22	56	49
Average (µg/kg)	181	8	43	389	11
Maximum (µg/kg)	2,230	168	885	5,387	400

Table 2d. Oceania (includes Australia).

North Asia	Afla	ZON	DON	FUM	OTA
Number of tests	191	213	207	179	191
Percent positive (%)	6	26	49	12	11
Average (µg/kg)	2	270	1,354	118	0
Maximum (µg/kg)	179	23,278	49,307	4,756	11

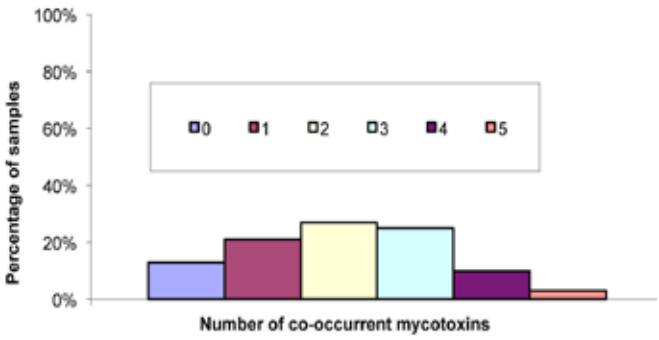
In South-East Asia, there was a clear trend of an increasing prevalence of ZON and FUM, with a positive percentage of 37% and 55%. As usual, Afla was a big issue in this region, with an average contamination level of 42µg/kg; almost twice the level reported in 2010.

Afla, FUM and OTA were the most prevalent mycotoxins in South Asia where 88%, 56% and 49% of analysed samples were positive for these mycotoxins respectively. An extremely high level of Afla with an average of 181µg/kg was found in this region.

The Oceania region showed a different mycotoxin profile, with a relatively lower mycotoxin prevalence compared to the other regions in Asia. However, the importance of *Fusarium* mycotoxins in this region should not be disregarded. The average DON and ZON concentrations in all tested samples were as high as 1,354µg/kg and 270µg/kg, respectively. These increased drastically from 2010. Also, maximum mycotoxin levels for ZON and DON were also registered in Australia wheat this year.

In addition, the co-occurrence of mycotoxins is very common in Asia. Out of 1,592 samples, 1,040 (65%) were contaminated with more than one mycotoxin (Figure 3). Most of the samples contained multiple mycotoxins from 1 to 3 classes (74%).

Figure 3. Co-occurrence of mycotoxins in Asia samples in 2011.



Results by commodity

Results by commodity are detailed in Table 3.

Corn

Continuing the trend of past years, corn was the most extensively and highly contaminated commodity from the survey. FUM, DON and ZON were the most prevalent mycotoxins in corn with percentage contamination of 71%, 64% and 39%. The average levels for FUM, DON and ZON were 1,379µg/kg, 665µg/kg and 106µg/kg, respectively.

Table 3. Global prevalence of mycotoxins in different commodities in 2011.

Corn	Afla	ZON	DON	FUM	OTA
Number of tests	1,076	750	850	1,026	515
Percent positive (%)	29	39	64	71	15
Average (µg/kg)	29	106	665	1,379	5
Maximum (µg/kg)	2,230	7,446	19,919	31,050	400
Wheat/bran	**Afla**	**ZON**	**DON**	**FUM**	**OTA**
Number of tests	171	295	350	161	150
Percent positive (%)	12	25	57	12	15
Average (µg/kg)	0	204	1,254	60	1
Maximum (µg/kg)	9	23,278	49,307	1,715	43
Barley	**Afla**	**ZON**	**DON**	**FUM**	**OTA**
Number of tests	19	213	299	17	20
Percent positive (%)	16	13	40	0	20
Average (µg/kg)	6	14	367	0	1
Maximum (µg/kg)	120	800	12,130	0	8
Soybean meal	**Afla**	**ZON**	**DON**	**FUM**	**OTA**
Number of tests	197	178	180	165	130
Percent positive (%)	15	18	18	5	17
Average (µg/kg)	1	13	81	39	2
Maximum (µg/kg)	74	191	5,500	5,088	46
Rice/bran	**Afla**	**ZON**	**DON**	**FUM**	**OTA**
Number of tests	38	38	38	38	35
Percent positive (%)	45	34	42	24	17
Average (µg/kg)	4	29	246	100	1
Maximum (µg/kg)	25	663	2,447	807	11
DDGS	Afla	ZON	DON	FUM	OTA
Number of tests	37	38	39	30	26
Percent positive (%)	24	74	90	47	42
Average (µg/kg)	17	204	2,586	862	1
Maximum (µg/kg)	340	1,016	13,747	9,782	14
Finished feed	**Afla**	**ZON**	**DON**	**FUM**	**OTA**
Number of tests	665	941	1,032	661	663
Percent positive (%)	42	58	64	64	40
Average (µg/kg)	15	91	476	855	2
Maximum (µg/kg)	431	5,791	25,759	77,502	71

Wheat/bran

In the case of wheat/bran, the most prevalent mycotoxin was still DON, which was present in 57% of tested samples with an average contamination of 1,254µg/kg. Attention is drawn to ZON in wheat/bran samples, which was present at an average level of 204µg/kg.

Soybean and soybean meal

Soybean and soybean meal was less contaminated with mycotoxins as compared with corn in general. However, there is an increase in both prevalence and concentration of mycotoxins in comparison with results in previous years. Some 15%, 18%, 18%, 5% and 17% of the samples tested positive for Afla, ZON, DON, FUM and OTA respectively.

Rice/bran

The most prevalent mycotoxins found in rice/bran were Afla, DON and ZON, with 45%, 42% and 34% of samples positive. Despite the relatively low average contamination levels in rice/bran, the co-occurrence and synergistic effects of mycotoxins should not be discarded when using this feedstuff in formulations.

DDGS

With regard to corn derivatives such as DDGS and corn gluten meal, all five major mycotoxins were highly prevalent. Some 90% of DDGS samples were positive for DON, 74% for ZON, 47% for FUM, 42% for OTA and 24% for Afla. Additionally, the actual contamination levels in corn derivatives for all mycotoxins were rather high.

Finished feed

One of the largest commodity groups in this survey was finished feed, with more than 1,000 samples analysed in 2011. Though there were limited number of Aqua feed samples in this survey, there was a trend that aqua feeds covered a complex mixture of all important mycotoxins. In general, more than 60% of all feed samples contained at least two types of mycotoxins. Among finished feed samples, 42%, 58%, 64%, 64% and 40% tested positive for contamination with Afla, ZON, DON, FUM and OTA, respectively.

Conclusion

The results of this survey program showed once again that the presence of mycotoxins is ubiquitous not only in terms of geographic regions, but also by commodity. In general, DON, FUM and ZON were the most widespread mycotoxins, followed by Afla and OTA.

In normal practice, animal producers are confronted with the facts that even a low level of mycotoxins show negative effects on animal performance and health status. These negative effects are always reflected through sub-clinical parameters together with performance losses in the field. Furthermore, due to the synergistic effects of co-occurrent mycotoxins in the feed, the economic losses for the farms can be exacerbated.

Several scientific publications have shown that no single strategy could control these multiple mycotoxins (He et al., 2010). Although some types of mineral clays are able to bind aflatoxins, no mycotoxin binder component could bind *Fusarium* mycotoxins very well, such as DON, T-2, ZON, et al. In mycotoxin risk management, Mycofix® manages to protect the animal against a wide range of adsorbable and non-adsorbable mycotoxins, by incorporating three strategies; biotransformation, adsorption and bioprotection.

References are available on request.


Shu Guan


Pedro Encarnação

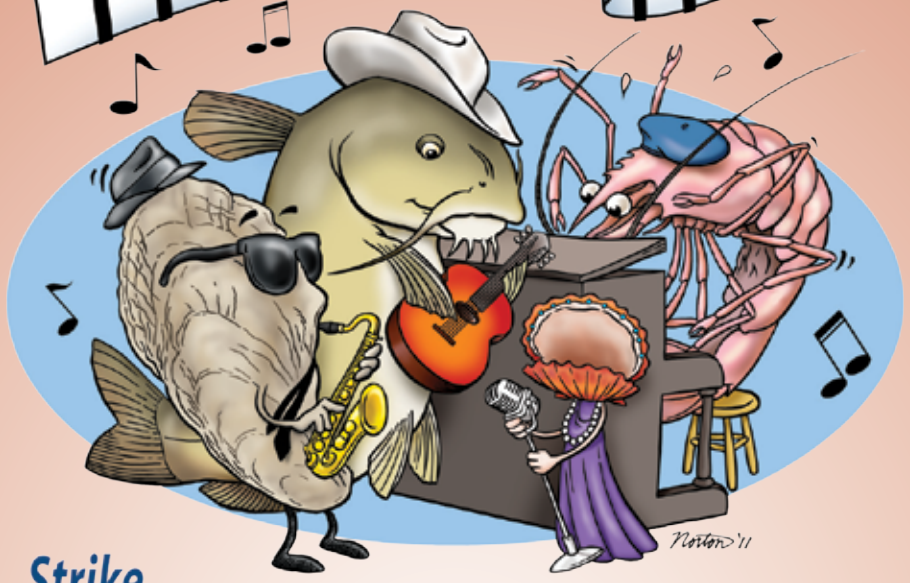

Karin Nährer

Dr Shu Guan is the technical manager for Mycotoxin Management in Asia with Biomin Singapore Pte Ltd since 2011. Shu gained his PhD at China Agricultural University, Beijing, majoring in animal nutrition from 2004-2009. He was a research associate at the Guelph Food Research Center, Agriculture and Agri-Food Canada during 2008-2010, where he specialised in the field of bio-detoxification of mycotoxins. Email: guan.shu@biomin.net

Dr Pedro Encarnação is director Business Development and aquaculture specialist at BIOMIN Singapore Pte Ltd.

Karin Nährer is the product manager for Mycofix product line at BIOMIN Holding GmbH, Austria.

AQUACULTURE 2013



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Producing quality probiotics is an art and science

By Mathieu Castex and Jérôme Panes

Stringent quality controls throughout the production process assures an efficacious and pure product.

Today, aquaculture needs to be both sustainable and profitable, a necessity that fuels the search for acceptable solutions to optimize production in a natural and environmentally friendly way. Among these, probiotics have gained momentum, offering a natural alternative to antibiotics in fish and shrimp farming to enhance performance and protection against pathogens without the risks of antibiotic-resistance. However, even though research on the benefits of probiotics in aquaculture is mounting, it seems sometimes difficult to reproduce these benefits in practice. This is because producers are presented with a plethora of so-called probiotics or bioremediation products for aquaculture but are not clear on how to select the most effective product.

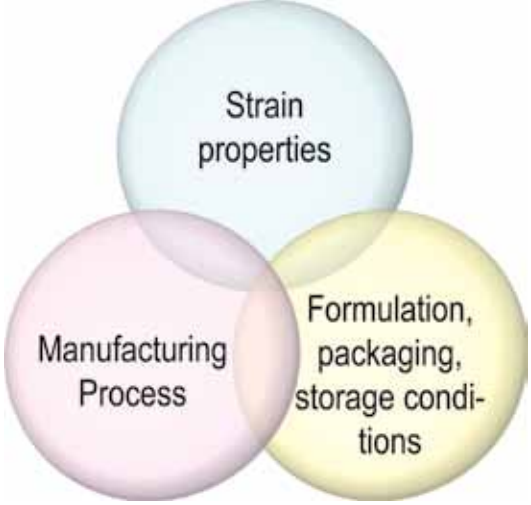
The first thing to note about probiotics is that, by definition, they are live microorganisms. This is where they differ from most feed ingredients. Their efficacy depends on the physiology and activity of these microorganisms and on their viability. Also, not all bacteria are equal in terms of benefits and modes of action; hence not all products are equal.

A recent study evaluated 12 different commercial probiotics marketed for marine shrimp production in Thailand. Among these, only two actually provided the necessary information on the label as to the actual number and name of live microorganisms in the product and recommended dosage. Nevertheless, in the end, none of the 12 products tested showed the composition and number stated on the label and sometimes, even, with huge discrepancies (Nimrat and Vuthiphandchai, 2011).

The viability of bacteria depends on the intrinsic properties of the strain. We often overlook the quality of the production process, formulation, and finally, storage conditions (Figure 1). The production of live bacteria requires expertise and stringent quality controls throughout the process. Only a few companies in the world possess the know-how and industrial capability to produce and process live bacteria in a way that ensures that what is on the label is inside the package: a pure, live, stable, and consistent bacteria preparation.

This article explains the process of probiotic bacteria production (e.g. *Pediococcus acidilactici* MA18/5M, known under the brand name BACTOCELL®) achieved in Lallemand bacteria plants and shows the various factors to ensure its viability and quality. *P. acidilactici* MA18/5M is one of the most scientifically documented probiotic strains applied for aquatic species. This strain is the first and unique patented strain to be authorised for use in aquaculture in Europe since 2009.

Figure 1. The factors affecting bacterial stability.



Pre-fermenter

Controlling each step

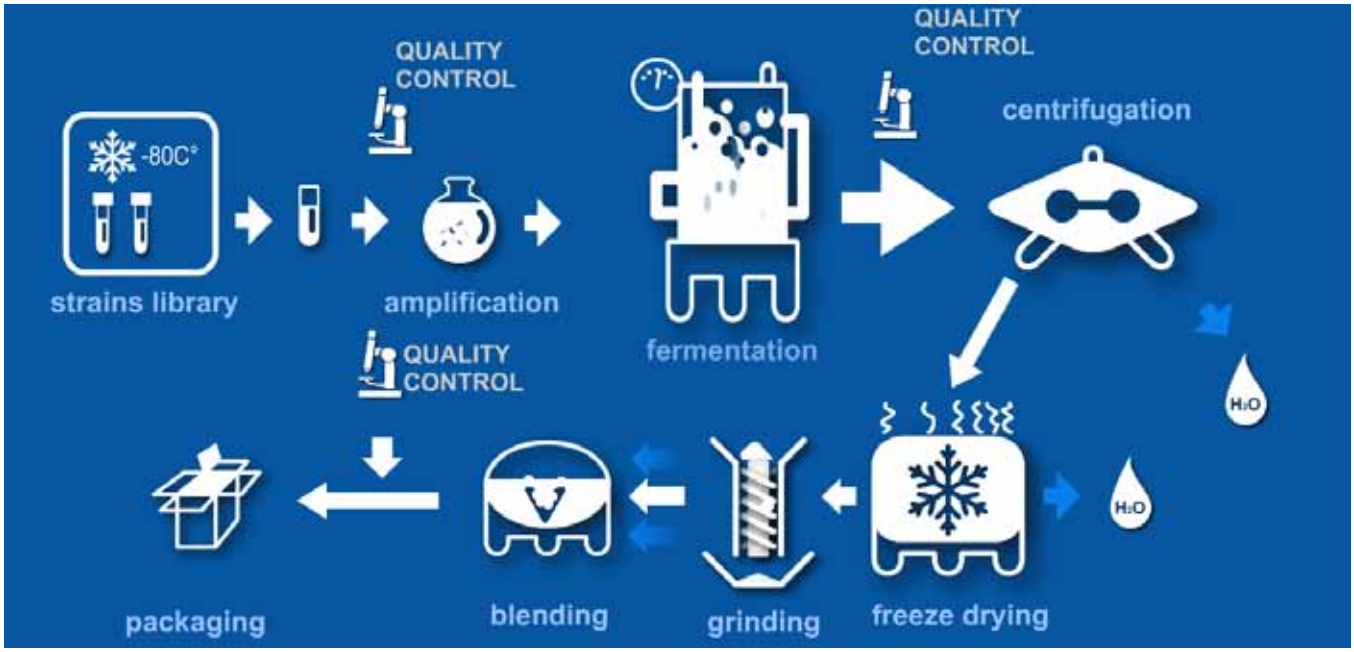
Several hundred tons of products containing hundred billion of live bacteria per gram are produced each year in a bacteria plant. However, it always starts with a few hundred microlitres of a cell bank vial of the particular strain to be produced, about the equivalent of a full eye dropper. This tiny amount of live bacteria undergoes sequential multiplications in strictly controlled and sterile conditions, first in a lab flask, all the way up to industrial fermenters, where the final volume is around 8 tons.

With this in mind, it is easy to understand the importance of stringent quality controls along the process. Any contaminant or changes in growth conditions that will affect bacteria behaviour or physiology could lead to undesired microorganisms and affect the end product purity, activity and efficacy.

The maintenance of a sterile environment along the process and stringent quality controls after each step of the process is essential to make sure there is no contamination and that the bacteria remain pure, alive and in their optimal condition. At each step in the production process, bacteria are examined according to strict standards including optimal cell condition and DNA testing. These checks ensure that the end product is efficacious and pure. The identity of the strain is tested four times for strain purity and consistency before the product reaches full-scale production. During production, it is tested three more times.

Another key element to ensure that the strain being grown is strictly identical to the one selected years ago, is to ensure purity and consistency of the stock culture from which all new batches are produced. The pure strains, when selected are deposited in recognised culture collections (e.g. NCIMB, Pasteur Institute) that maintain the pure inoculum from which working solutions can be produced at any time. For instance our commercial probiotic strain *P. acidilactici* MA18/5M, is deposited at the Pasteur Institute under the number MA18/5M. Genetic profiling is performed on each and every batch to check for purity of the culture and ensure genetic identity against the deposited culture.

Figure 2. Scheme of the *P. acidilactici* MA18/5M production process.



Bacteria production process

The whole bacteria production process is schematised on Figure 2.

Amplification

As stated earlier, it all starts from a few bacteria from the cell bank vial, which will be grown step-wise from a lab-flask to the industrial fermenter. The inoculum is introduced in a flask containing the adapted culture medium, under sterile conditions. The bacteria become activated and start to multiply. The culture is then transferred to a larger container.

Fermentation scale-up

Once the quality and purity of the inoculum is checked, it is transferred under sterile conditions to a pre-fermenter, where growth conditions are continuously monitored (pH, temperature, pressure etc). Each bacteria strain follows its own growth pattern and timeline, but typical microbial growth curve includes an exponential phase (multiplication) followed by a plateau and then a descending phase (death). The aim is to halt the fermentation when the bacteria are at their most active, which is not necessarily the maximum yield. Indeed, the maximal population is reached just before the population starts to decline, which is not the optimal metabolic activity step. Producers who use stationary phase bacteria maximise production yield at the expense of quality and activity. In order to monitor the bacteria growth, the culture medium's optical density is measured.

The culture is then transferred to industrial fermenters, with capacities ranging from 2 to 20 m^3, depending on market needs. Again, fermentation is stopped at the optimal stage in terms of biological activity rather than yield.

Harvesting

Live bacteria are then separated from the culture medium by centrifugation. Here, around 75% of water is removed at this stage, resulting in 50-100 times concentration of the live bacteria.

Freeze-drying

The best preservation method to ensure bacteria stability is freeze-drying. In freeze-drying, the product is first taken down to very low temperature and the remaining water is eliminated by sublimation under low pressure (sublimation is the passage from solid to gaseous phase without liquid intermediary).

Freeze drying was first used as a method of food preservation some 600 years ago by the Incas. However, in the case of live bacteria, this method was introduced in the 1940s by Institut Rosell in Canada (today part of the Lallemand Human Nutrition division) which developed freeze-drying for lactic acid bacteria, revolutionising bacteria preservation and industrial applications.

Freeze drying is a very delicate step for bacteria which are sensitive to extreme temperatures as it can affect their final viability. Prior to freeze-drying, the bacteria are mixed with an adapted cryprotective

Lallemand and bacteria production: a long story

Lallemand is a leading developer and producer of yeast and bacteria for the animal nutrition, baking, winemaking and pharmaceutical industries. With 75 years of expertise in the development and fermentation of bacteria, Lallemand operates four production facilities, in France, Canada and in the US. With a strong focus on R&D, the company also dedicates substantial resources to the continuous optimisation of bacteria production and preservation processes, through its Toulouse based R&D pilot plant.

From the petri dish to the packaged product, the company controls the whole process, ensuring the purity, traceability, viability and consistency of its finished products. With commitment to high quality standards, all Lallemand facilities are cGMP compliant and comply with the highest standards of the feed and food industry: FAMI-QS, HACCP, ISO9001, AIB, AFIA SF/SF, up to pharma GMP in the French plant which produces pharmaceutical ingredients (API). A virtual tour of a bacteria production plant is available at http://stsimon.lallemand.com/tour_canim.htm

The cell bank vials

formula. As these are live organisms, it is easy to understand that each bacteria strain will behave differently and have different sensitivity to freeze-drying. Hence, applying freeze-drying to bacteria is a difficult task. At Lallemand, for example, important R&D resources are dedicated to the optimisation of cryoprotectant formula and freeze-drying cycles for each bacteria strain produced.

Downstream processing

After freeze-drying, the bacteria forms a solid 'cake', containing 2-4% water. This is ground to obtain a fine, consistent powder. During grinding, blending and packaging, humidity and temperature are strictly controlled. The bacteria powder is then ready to be further blended, still under strict temperature and humidity control, in order to obtain the desired formulation. It is mixed with carriers and diluents to obtain the desired bacteria concentration. For example, in the case of dietary probiotic *P. acidilactici* MA18/5M, an 8-ton volume of harvested bacteria will yield approximately 1,500 500g sachets of commercial product.

Finally, packaging is another key step and is best performed on site, under tightly controlled conditions and using appropriate packaging material. Indeed, storage is another critical point in probiotic survival. Live bacteria are sensitive to moisture and atmospheric humidity should be avoided during storage. Stringent control of temperature and humidity during packaging ensures product stability and activity. Packaging material is also very important as plastics have varying levels of oxygen and moisture permeability (transmission rates). For example, Lallemand dietary probiotics are packaged in gas impermeable laminates. This is the same packaging used by the US military for long-term preservation of sensitive materials such as rations. This packaging keeps out air, gases and moisture. Each pouch is 'back filled' with nitrogen, an inert gas that displaces oxygen in the package to help keep the product strain(s) dormant.

Conclusion

Bacteria production involves unique and complex processes, which require substantial and continuous R&D to fine-tune the fermentation, downstream processing, as well as packaging conditions and materials and adapt them to each of the strains produced.

Strict quality control all along the process is crucial to ensure that the end product really contains the bacteria strain indicated on the label, and only this one, and that it is in its best condition 'alive and kicking' and ready for action. Thus, when selecting and developing a probiotic product for aquaculture, it is important to ensure that stringent QC is applied (plants accreditations are up to date, etc.) and to have full traceability of the product. Moreover, it is also important to make sure the producer has total control over the full process, up to the packaging. This is the best way to ensure total safety, purity, quality, traceability and most importantly, efficacy.

References are available on request.

Mathieu Castex

Jérôme Panes

Mathieu Castex, PhD is product manager for Aquaculture Applications within the Lallemand Animal Nutrition division. He has a strong expertise in the application of probiotics for many farmed species in Europe, South East Asia and Americas. Email: mcastex@lallemand.com

Jérôme Panes is vice president of the Specialties Division of Lallemand in charge of bacterial production services and is based in Lallemand Specialties Inc, Milwaukee, Wisconsin, USA.

An exciting future for cobia aquaculture in India

By Anilkumar P

Year round breeding, grow out for sashimi and exports of fingerlings, juveniles and yolk fry.

3 year old brood stock in RAS tanks

2 month old cobia fingerlings ready for stocking in cages.

Cobia *Rachycentron canadum*, also known as lemon fish or ling is a promising species for open ocean aquaculture production. The fish is known to grow exceedingly fast to approximately 6-8kg within a year. Cobia flesh has a desirable appearance; pearly white colour with a texture and flavour that appeal to all seafood lovers. It is very popular raw as sashimi. Cobia also has a host of health benefits and boasts of one of the highest levels of omega-3 fatty acids.

The Rajiv Gandhi Centre for Aquaculture (RGCA) is the Research and Development wing of the Marine Products Export Development Authority (MPEDA) under the Ministry of Commerce and Industry, Government of India. RGCA is involved in the development of new aquaculture technologies, in particular export oriented ones. It also supports existing technologies available in India to strengthen the aquaculture production base in the country.

In pursuit of the above, RGCA has established several species-specific projects in different locations across the country. One such project is the marine finfish project with its hatchery located at Pozhiyoor near Thiruvananthapuram and an open sea cage farm at Muttom, Kanyakumari District in the south west coast of Tamil Nadu. The cobia is the primary candidate species for this project.

First harvest

RGCA developed the technology for breeding and mass production of cobia seed stock in 2011. Following this, it successfully developed and demonstrated the technology for farming of this species in open sea cages at the sea cage farm in Muttom. Open sea cage farming has become a promising area for aquaculture all over the world and is now predicted to become the most popular form of aquaculture contributing considerably to total world aquaculture production in years to come.

The technology developed by RGCA in sea cage farming of cobia was shown during a harvest function on 9 April 2012 to a gathering of over 1,200 comprising scientists, policy makers, technocrats, officials, fishermen and students in fisheries. This is a landmark event in Indian aquaculture. The farming of the cobia promises excellent opportunities for entrepreneurs and fisher folk, with the potential to provide the latter with a steady year round income without being totally dependent on the unpredictable catches from the sea.

Year round breeding of cobia

The RGCA has also developed a technique for multiple spawning throughout the year. The captive brood stock is kept for 24 months in recirculated aquaculture tanks with Photo-Thermal Control (PTC). This is a deviation from the conventional breeding of cobia in South Asia where broodstock are kept in cages and spawning is confined to specific seasons of a few months. This breeding technology using recirculating aquaculture systems (RAS) with thermal control mimics breeding conditions and is also aided by photoperiods of 14 hours light. In this way, we are able to spawn cobia year round at regular intervals.

We also quarantine the brood stock and monitor for OIE listed pathogens. Fish are continuously kept in the RAS and are fed with special brood stock formulated feeds. Trash fish feeding is avoided in order to protect brood stock from parasites and pathogens. As part of the disease surveillance program, brood stock, as well as fish at varying stages of development, are regularly monitored for OIE listed

Sashimi preparation by Ms Lin Li Che

Sashimi

Feeding in grow out cages

Cobia harvest function

pathogens, such as iridovirus (both strains of red sea bream RSIV and grouper GIV), VNN, and the bacteria *Photobacterium damsellae*. This is carried out at our Central Pathology Laboratory attached to the RGCA headquarters in Sirkali, Tamil Nadu.

Grow-out trials

The pilot trials on grow-out were conducted from May 2011 to April 2012. Fish reared exclusively on extruded pellets were rated to be excellent and of sashimi grade with good fat content by experts in sashimi. Sashimi grade fish was exported to Taiwan. This demonstrated that the climatic conditions in open waters in India are conducive for an excellent growth of 6-8kg in a year. The potential of cobia farming is tremendous. However, since it is a new development, it will take some time for infrastructure development in sea cage farming and capacity building. Nevertheless, the demonstrations by RGCA will definitely increase the confidence of prospective entrepreneurs and help to encourage open sea cage farming in the years to come.

Export of yolk fry

The hatchery production of cobia at regular intervals exceeded the current demand for grow-out operations within India. Some fingerlings and juveniles were used for the regular stock enhancement programs. Thus, it was decided to share the excess production with other countries. We have given 0.5 million yolk fry and some juveniles of 30g to AFTM, Tehran a company under the Iran Fisheries Organisation.

In many instances, the fertilised eggs are transported for short distances within India. However, logistic issues remain for longer distances and international transport. The packing for the transport of yolk fry immediately after hatching in 2-3 hours was attempted. Our objective is to transport the yolk fry before the 48-hour post hatch period, during which they depend on the yolk sac and before opening of mouth and they are ready for feeding in larval tanks. As in the case of the consignment to Iran, this was a challenge as shipping took 31 hours. In long distance transport, the temperature of the packing water was reduced to 25°C and ammonia adsorbents were added. In the case of juveniles, organic anaesthetics were used. Nevertheless, the shipment was successful and AFTM has ordered another 1.3 million yolk fry.

There are also trade enquiries from several countries to supply yolk fry as well as fingerlings of 10cm. These will be taken up on a priority basis. Our next activity is to fulfil a commitment in the last week of June for 10 cm fingerlings for M/S Fisherfarms Inc, a subsidiary of Feedmix, a major aquafeed company in the Philippines.

Anilkumar P is project manager, RGCA MPEDA and is in charge of the cobia hatchery project and sea cage unit. Email: anilmpeda@yahoo.com

Raising the bar in fry supply in Asia

Making a mark with a modern vertically integrated land-based hatchery and nursery on its own island in Singapore.

On the north eastern part of Singapore lying beneath the flight path of aircrafts taking-off and landing at Singapore Changi Airport is a small cluster of islands. Among them, situated just off the south western end of Pulau Ubin, is a small island barely 12 ha in size with no supply of water or electricity called Crab Island or Pulau Ketam (Ketam). On its rocky beach lies a rusting, abandoned construction crane serving as a reminder of the failed business attempts on Ketam some 2 decades ago, the last being a shrimp farm.

On the island, disused ponds now collect rainwater. Through erosion, the ponds nearer the coast have turned into mangrove swamps. While many farmers write off Ketam as a barren island with limited use, it takes the passion and entrepreneurial vision of 38 year-old Frank Tan to see the potential that Ketam can offer. Frank's vision is a modern vertically integrated land-based hatchery and nursery with grow-out net-cages strategically situated just south of Ketam.

MLA's barramundi is cultured in large-scale net-cages

Raising the bar

It is well recognised that one of the key success factors in any commercial farming is the availability of quality seeds. For several years, Frank had recognised the lack of quality fry as the bottleneck limiting the success of large scale commercial farming of tropical marine fin-fish in Singapore and the region. In partnership with a few friends and Tan Kay Heok, a 30-year veteran marine aquaculturist, Marine Life Aquaculture Pte Ltd (MLA) was incorporated in Singapore in 2009. Another partner, Loh Tee Wee oversees the corporate governance and financial matters.

The first key corporate objective is simple. Produce healthy disease-free and disease-resistant fry so that downstream grow-out farmers can improve production yields. While this objective seems simple enough, locating a bio-secure land-based hatchery and nursery in land-scarce Singapore can be challenging. However, with the support of the relevant government agencies, MLA has managed to secure the lease on Ketam.

On the technical side, Kay Heok uses his vast experience accumulated in the past 30 years and set to work on the culture protocols. Specifications on water quality, fish nutrition and feed, and animal health were set and refined. Frank and Kay Heok worked tirelessly with international animal health veterinarians, fish feed nutritionists and aquaculture engineers as they fine-tuned their requirements.

On the development side, Frank began to transform Ketam from a disused former shrimp farm into a modern bio-secure hatchery and nursery with its supporting infrastructure needs. With modern water-

The MLA team, from left, Frank Tan, Loh Tee Wee, chairman and Tan Kay Heok

Netcages for barramundi grow-out

The bio-secure land based facility on Pulau Ketam

Vaccinating barramundi with IridoV and StrepSi

treatment technology available, the fresh water needs on the island can be met by treating the rainwater collected in the various ponds. The disused ponds nearer the coast now act as bio-filters to treat effluents from the hatchery and nursery ensuring sustainability. To minimise the impact of the development on the environment, simple single storey greenhouse structures are used. Perimeter natural vegetation is left untouched to provide a natural visual and environmental screen. Reforestation efforts are on-going.

Operating in Singapore

A common complaint among farmers in Singapore is the high labour and operating costs. While this is true to a certain extent, MLA is focussing on its advantages. An advantage which works in favour of MLA is Singapore's reputation for respecting intellectual property rights and institution. The "Made in Singapore" brand has given MLA much credibility in the export markets. The other key advantage for MLA is the fact that Singapore is a major logistics hub. Being in the flight path of aircrafts taking-off and landing at Singapore's Changi Airport is not such a bad thing after all for the hatchery, said Frank. "For fry exports by air, the lead time from packing to take-off is barely 5 hours. This reduces the stress that fry are subject to, resulting in higher survival rates. On the import side, lead time in feed and equipment imports is also short which gives us a more efficient inventory management. Given the good law enforcement environment in Singapore, farm security costs are low."

Work in progress

The journey to what MLA is today has been fraught with challenges and sleepless nights. In the last 3 years, the company has established itself as a major supplier of quality barramundi or Asian seabass *Lates calcarifer* vaccinated pathogen free (VPF) fry cultured under a stringent protocol of vertical contamination prevention management. Grow-out farmers can now choose to buy disease-free and disease-resistant fry that can give them a much better yield. Such fry also provide the farmers with more certainty in their production projections enabling them to commit themselves with a higher level of confidence to their customers.

MLA is still work-in-progress. The vertical integration model will fully exploit the economy of scope and will soon enjoy the economy of scale. Frank said that despite a generally higher labour cost environment, the total production cost is still competitive. Barely one-third of its rolling 5-year business plan has been executed.

"There is still much to be done. We are pressing ahead with the R&D program to produce large size fry which will shorten the culture cycle during grow-out. For Kay Heok and I, looking back to the day we stepped onto barren Ketam 4 years ago to survey the land for a feasibility study seems such a long time ago."

Together they continue to envision what MLA will be in 3 years. The personal satisfaction of seeing what MLA is today is priceless. It makes all the sacrifices and hard work in the last 3 years well worth it.

"As it is now, we are still a "fry" in the global aquaculture stage and like the disease-free and disease-resistant fry we produce, MLA hopes to grow quickly into a much better "fish" in the global aquaculture industry. The foundations are in place and we are extremely excited of what MLA can be in the next 3 years."

Workboat-5 transporting 12 tonnes of pellet feeds from the wharf to net-cages

Debut of the vegetarian fish

Creation of the brand 'Pangas 100% vegetal'; a safe, traceable, sustainable and responsibly farmed pangasius in Vietnam.

The team, from right, Stéphane Barbut, Alexandre Beljean, Vuong Quang Khanh, marketing manager, Caseamex, Christelle Vigot, Food business developer at Bayong Ltd, Christophe Guillaume, director general, Guyomarc'h Vietnam, Vo Dong Duc, chairman and general director, Caseamex, Marc Campet and Nguyen van Trung, commercial director, Guyomarc'h Vietnam.

In 2008, whilst its major markets were in an economic crisis, the pangasius underwent an image problem. In France, the popularity of the fish dropped from the ninth to fifth position in 2010. In Vietnam, feed producer Ocialis, part of the InVivo NSA group in France which has an integral role in the development of the pangasius in Vietnam, took a position that it needs to raise the bar for the fish and a different route to market.

At a press conference during the European Seafood Exposition (ESE) in April, InVivo NSA launched the 100% vegetarian pangasius, a collaborative effort between Ocialis Vietnam and project partners, Caseamex, Davigel and Nautilus. Alexandre Beljean, Global Aquaculture business unit manager said, "This is a global first in the production of 100% safe, natural, traceable and 100% vegetal fed pangasius. In 2009, we launched the R&D program at Nha Be station, outside Ho Chi Minh City to evaluate the possibility of developing a pangasius product fed entirely on plant ingredients. This is aided by InVivo Labs whose mission is to assure the quality and safety of raw materials, final feed and the end product. Both companies are part of the InVivo NSA group in France. We are doing this in response to consumers seeking a more responsible aquaculture of the pangasius which takes into consideration aspects of ecology and the environment."

Globally Ocialis produces 350,000 tonnes of feeds for several species of fish from factories in Vietnam, Brazil, Mexico, Indonesia and Belgium. In Vietnam, it produces grow-out feeds for the pangasius, barramundi and shrimp and starter feeds for freshwater and marine fish. According to Marc Campet, manager, Ocialis Vietnam, "we studied the different stages of the farming of the fish. However, feeding an omnivorous fish a 100% plant based feed cannot be at the expense of growth performance. Our first harvest was tested by fishmongers in France who gave the thumbs up on the superior quality of the flesh"

The fish is farmed in dedicated ponds within the farms of Caseamex, a pangasius producer and processor. The stocking density is controlled at below that of the average in ponds in Vietnam. The criteria must be responsible farming. Ocialis and its partner Davigel monitored each stage in the production chain. In 2010, Bureau Veritas (BV) certified the fish and BV in Vietnam now conducts a full chain audit out twice a year. To date almost 5,000 tonnes have been produced and the premium price is 25% over conventional pangasius products. In 2011, Davigel introduced the fish to its markets and Nautilus launched the new product in hypermarkets in France in 2012.

"In summary, what we have now is a pangasius product from a controlled production chain, farmed in dedicated ponds in a suitable density, without the use of any preventive antibiotics and fed on a specific formulated diet. It is totally traceable with the absence of any additives in the pond and feed. From the 20g stage, the fish is fed on a 100% plant based feed," said Campet.

The fifth fish

Davigel is part of the Nestle group and distributes to 'out of home' catering (restaurants, delicatessen stores, hotels, hospitals, schools,etc).

Laurent Froget (right) and guest Benoit Vidal-Giraud, Via Aqua at the launch

Display of the fish at the Nautilus booth

The company imports and distributes fresh and frozen seafood and has a presence in Belgium, Spain, Italy and Portugal. Davigel has always dealt with wild caught fish and marketing seafood from aquaculture is a relatively new activity, even if it was one of the first to import frozen tilapia for the French market. However, as demand is increasing and supply from capture fisheries dwindling, they needed to source from aquaculture but at the same time need to be assured of the quality of the aquaculture product. The pangasius is an ideal fish; a white fish with no pin bones and does not have a strong taste. It is also not expensive but there was a question of food safety? Laurent Froget, Sea Product manager, explained the marketing strategy for the company.

"We needed to look for a fifth species. We now have saithe, hoki, hake and Alaskan pollack, all of which are marine caught. Most of these species are already MSC certified and so there is no doubt on the quality and sustainability. These 4 species used to be the cheapest white fish fillets that we could sell to the institutional catering industry.

"Initially Davigel was sceptical in marketing the pangasius because of quality issues and the intensive nature of its culture system. However in 2007 and 2008, teams from the company went to Vietnam to see first-hand the farming of the fish. To start selling the fish, we need to be confident on the production methods and that there will be a source of a sustainable supply of the fish. In early, 2009, we started to work with Ocialis in farming the fish under our specific culture conditions at the Caseamex farm.

"In spite of this new fish in the market, we need to do considerable public relations work to convince our customers. This is because of the previous bad image of the fish. Now they are ready to pay more for the quality. Higher prices comes with security but if it is over quality, nobody wants to pay too much for this. We always need to find the balance.

"Thus what we have today is ideal; a 100% vegetal fish. When we had one with 97% vegetal, customers used to ask 'what is in the 3%'?"

Culmination of efforts

At the booth of the Group Nautilus Food, Stéphane Barbut, president director general, said that the Pangas 100% vegetal product is already on its shelf. Nautilus imports, exports and value add seafood products for supermarkets, food services and industries.

"We are now tracking the response from the final consumer. If buyers feel confident, they will promote the product. Now we see that the market is looking for better quality and safe fish. However, they also need to try out the product.

"In the last two years, sales of the pangasius have dropped as there was a loss of confidence in the fish. Retail outlets stopped promoting the fish. Then when prices for the cod and other white fish rose, the pangasius came back into the market. The benefit of aquaculture products versus caught fish is that supply can be controlled. The short life cycle of the pangasius is a plus point."

However, Barbut is confident that the market will build up as the vegetal pangasius is an entirely different product. At ESE, Nautilus is ready to market as it has stocks from the trials conducted in Vietnam. Modified Atmosphere Packaging (MAP) is used for the products which allows it be placed in supermarket shelves and in the traditional markets within big hypermarkets.

"On our part, developing this fish and then marketing it well has taken a lot of effort and we would like to see this success go a long way for us and others in the supply chain," said Barbut.

ASC's progress to market

In March, ASC's certification and accreditation requirements became operational and the tilapia standard was open for accreditation, followed by that for the pangasius standard in April. The consumer facing logo was also launched.

During the European Seafood Exhibition 2012 in Brussels in April, the Sustainable Trade Initiative (IDH), Aquaculture Stewardship Council, Vietnam Association for Seafood Exporters and Producers (VASEP) and World Wildlife Fund (WWF) jointly presented updates on the farmer support program. ASC is building momentum in 2012, said Chris Ninnes, CEO.

"The ASC (MSC) Chain of Custody accreditation opens in Feb 2012 with the first certification companies accredited and COC certificates awarded. In March, ASC launched the accreditation for tilapia, which is first standard into the market. In April, it launched its second standard into the market with the opening of its accreditation process for the pangasius."

"This is a clear signal that ASC is making tremendous progress towards its goal of becoming the world's leading certification and labelling program for responsibly farmed seafood. ASC helps bring farmed pangasius to the market from farms that have proved to limit their environmental and social impacts." He added, "we will next launch the shellfish standards and we will now turn our attention to delivering the remaining standards to market during 2012".

Ninnes also noted, "With the recent launch of our new ASC logo, consumers can now easily choose responsibly farmed seafood. The logo helps them make positive environmentally and socially responsible choices when shopping for fish. It allows consumers to enjoy seafood knowing where it has come from and how it was produced."

WWF addresses aquaculture within the entire supply chain; retailers, food service to producers, said Dr Jose Villalon, vice president WWF- Market transformation, Aquaculture. "We are in a novel position and mature relationship with retailers to help them make the right choice in responsible sourcing of farmed seafood. The independent ASC certification is one tool. We are assisting farmers with gap-analysis and production protocol adjustments to comply with ASC standards."

ASC Accelerator platform

To support producers in complying with ASC standards, IDH launched a mechanism that provides both technical and financial support to producers targeting ASC certification. Driven largely by pangasius traders who co-finance a minimum of 50% for the program, the ASC Accelerator is also open to independent producers willing to move towards ASC compliance. The ASC Accelerator is managed by the Netherlands Development Organization (SNV) and co-founded by international pangasius traders Binca, DKSH, Femeg, Mayonna, Nordic Seafood, Queens and Seafood Connection.

"This will help pangasius farmers to comply faster to ASC standards, by preparing business plans and sharing costs of technical assistance and capacity building. In Vietnam, the accelerator is supported by the Vietnamese government, VASEP, VINAFIS (Viet Nam Fisheries Society) and WWF. Both IDH and WWF are firmly committed to ensure that ASC has a global presence in certification. IDH has funding of €150,000 for the program and €1.4 million for producers. The target is at least 100,000 tonnes of ASC certified pangasius by 2013," said Dr Flavio Corsin, IDH.

Vietnam's pangasius & ASC

The production of the pangasius totalled 1.3 million tonnes in 2011 and 2015 targets are 1.5 – 2.0 million tonnes at an annual growth of 4.8%. The volume of exported pangasius has increased to 660,000 tonnes in 2011 with an export revenue of USD 1.86 million. In 2012, it is estimated that the top 5 producing provinces, An Giang, Dong Thap, Cantho, Ben Tre and Vinh Long will produce 1.09 million tonnes of fish in 2012.

Dr. Nguyen Huu Dzung, vice president, VASEP listed the merits of pangasius. Ecological sustainability is assured as it uses only 0.4kg of wild fish to produce 1kg of the fish as compared to 4kg for the salmon.

Nguyen Huu Dzung with ASC Supervisory Board members, from left: Knut Nesse, CEO Aquaculture, Nutreco, Hank Cauley, Innovative Environmental Technologies Inc and Peter Hajipieris, Chief Technical, Sustainability and External Affairs Officer, Birds Eye/Iglo

From left: Nguyen Huu Dzung, Chris Ninnes, Flavio Corsin and Jose Villalon

VASEP at ESE

Already some 65% of farms are integrated and for the first 3 months of 2012, 63.8% of the export volume was from integrated operations of the top 5 provinces. The consolidation of farming is on-going and in Ben Tre, 90% of farms are integrated, 61.9% in Dong Thap, 58% in An Giang, 46% in Vinh Long and 23% in Cantho.

Dzung said, "Pangasius producers face marketing issues. These include the absence of a guaranteed price difference between certified and non-certified products; weak cooperation between producers and importers and the US anti-dumping tariffs, now in its seventh year." He added that there are too many certification and rating systems with limited transparency on systems' performance. This has resulted in confusion and mismatch between producers and key markets and unnecessary costs for certification.

On the status of certification up to June 2011, Dzung said that 49 pangasius processing companies have been and are being certified by GlobalG.A.P and 103 pangasius farms with 2,805 ha have been or are being certified by different sustainable standards. This accounted for 40% of total pangasius farming area. The farms partnering with WWF and working towards ASC compliance represent 27,600 tonnes of fillet (4.6% of total export) in 2011. The target for 2012 is 10%. Now 10-15 other farms are moving towards ASC compliance. The first 5 pangasius farms owned by processing companies are now waiting for accreditation and certification by ASC. More information: www.asc-aqua.org

The European shrimp market

Asia's tropical frozen shrimp to Europe is led by India and Thailand.

The main type of shrimp imported by the European countries is the frozen tropical shrimp (Figure 1). With total imports of more than 498,523 tonnes of tropical frozen shrimp in 2011, the European market was resisting well to the economic crisis facing the world and the European Union countries in the recent year. The main importers are Spain and France at 169,727 tonnes and 82,389 tonnes (Figure 2). In 2011, the European Union countries imported 812,699 tonnes of four types of shrimp; frozen coldwater, frozen warm water, prepared or processed and raw or cooked chilled shrimp and an additional 610,300 tonnes of others.

Figure 1. European imports of shrimp in 2011.

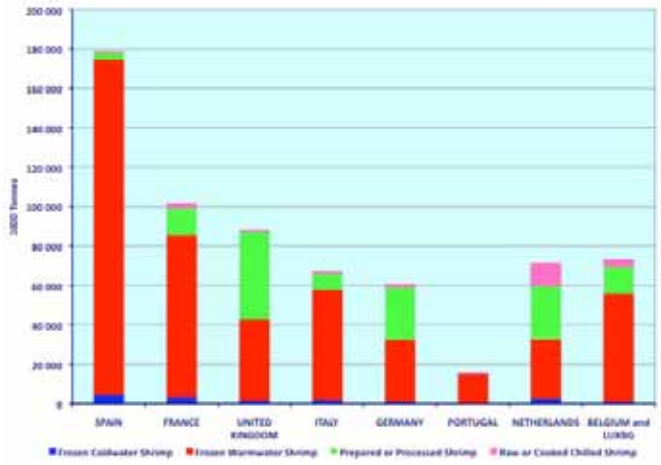
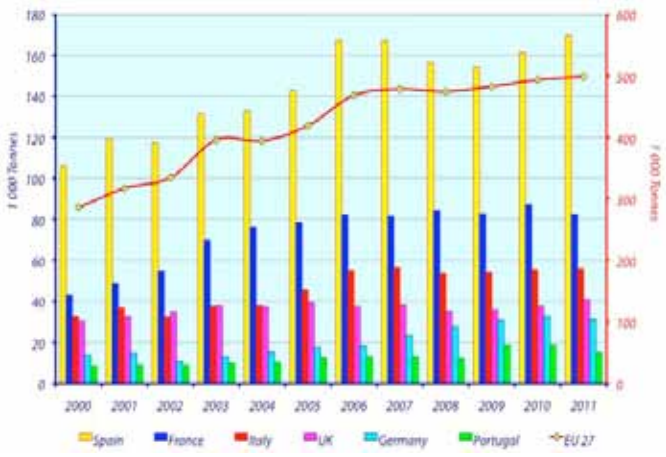


Figure 2. European imports of tropical frozen shrimp.



In 2011, Asia was the leading supplier of frozen warm water shrimp with 132,962 tonnes. The major importers of Asian shrimp are the United Kingdom and Germany. In the first case this is explained in particular by the membership in the Commonwealth of many Asian countries. Germany's requirements are different to southern Europe, often more demanding in terms of quality and price. In 2011, the strong demand from China has increased prices which have not helped most Asian countries to be competitive with Latin America (Figure 3).

Figure 3. European imports of tropical frozen shrimp from Asian countries.

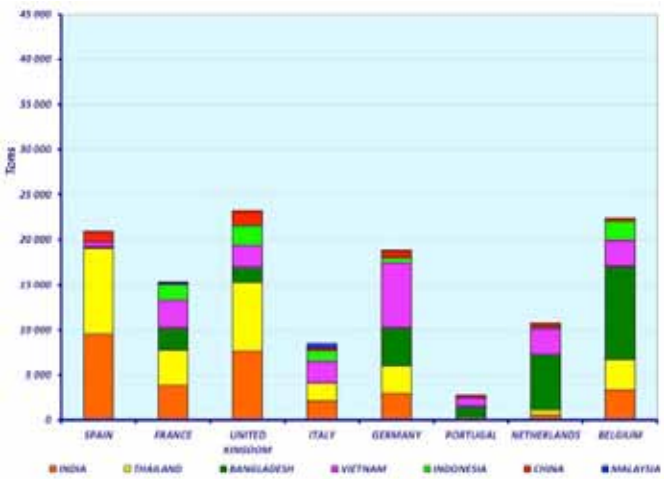
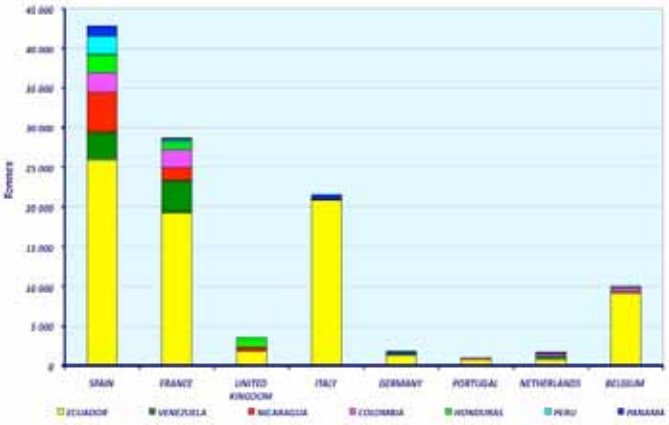


Figure 4. European imports of tropical frozen shrimp from Latin American countries.



Latin America is the leading supplier of frozen warm water shrimp to Europe's largest importers, Spain and France. This is explained by the long relationships that helped to produce and to guarantee a quality adapted to European demand. The main supplier is Ecuador with 14.7% of the total supply (Figure 4).

Traditionally, imports are low in January and February as demand is relatively low and importers are taking stock of the period of the previous year end. From March, imports rise gradually to meet higher demand during the summer holiday period. Its reaches its highest point from August as importers prepare stocks in order to meet the demand for Christmas and New Year. The period from Christmas to New Year is when demand is highest in major consuming countries of shrimp and seafood

During the first two months of 2012, there was a dramatic drop in imports of shrimp. This may be due to the crisis, in particular the case in Spain where the economic situation is very critical. But it also results from the remaining stock after Christmas 2011. For several years, European importers were working just in time and no longer held

Figure 5. Volumes of imports to Europe in 2010, 2011 and up to February 2012.

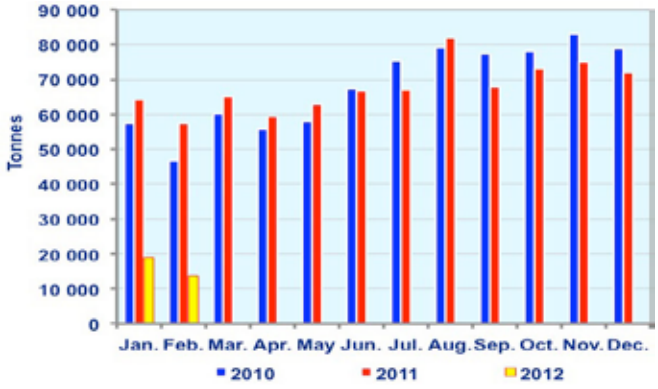
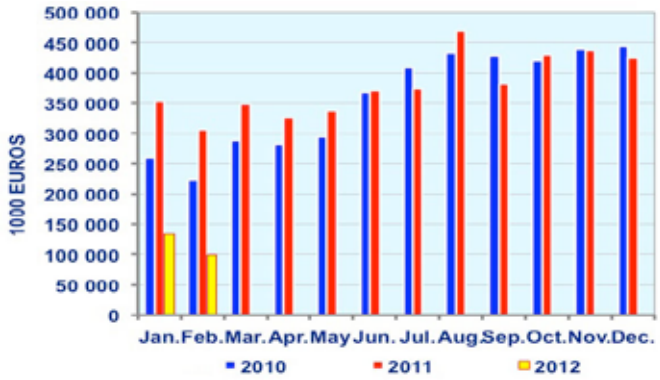


Figure 6. Value of imports to the Europe in 2010,2011 and up to February 2012.



stock. When sales slow down, they reduce imports to sell the remaining quantities. This seems to be the case of French importers who have sold the remaining stock in early 2012. In France, where the situation is less affected than in Spain, the market has been relatively quiet in January and February but seems to be recovering since March.

It is true that Europe is going through a crisis but this does not affect each member country in the Union in the same way. It is therefore important to monitor the import data published by Eurostat in order to identify cuts that could result from crisis situations or, less serious, arising from the management of stock (Figure 5 & 6).

We can note on these graphs that the value did not decrease as much as the volume of the imported shrimp. This is a result of the fall of the Euro against the dollar during the past few months. Shrimp consumption in European countries is directly affected by prices. When they rise, Europeans consume less. This is especially true in Southern Europe where the market has been impacted by higher Euro prices. (Source: Eurostat Database, 2012).

The article was contributed by **Hervé Lucien-Brun**, an independent consultant based in France. He has more than 30 years of experience in tropical marine shrimp and fin fish aquaculture in major producing countries in Latin America, North Africa, Europe and Asia, as well as in New Caledonia, Madagascar, Mozambique, Tanzania and Saudi Arabia. Email: hervelb@gmail.com

Farmed Shrimp Still Safe

Sensationalised news report overplays antibiotic use

Despite the impression left by a recent ABC News story on farmed shrimp, the use of antibiotics is neither a common nor accepted practice in shrimp farming. In fact, great progress has been made to eliminate antibiotics, and shrimp can now be obtained from certified sources that provide the food safety assurance that consumers demand.

Shrimp imports to the United States are subject to multiple controls. The US Food and Drug Administration routinely tests imported seafood. Further, exporting countries test and screen shrimp for banned antibiotics and chemicals before it leaves their borders, and countries like China and Thailand also monitor their shrimp farms directly.

For added assurance, seafood buyers typically require their suppliers to test for illegal substances, a requirement that is now mandatory for certification programs such as Best Aquaculture Practices (BAP), which the Global Aquaculture Alliance (GAA) developed specifically to address concerns such as antibiotics.

BAP-certified farms produce 174,500 tonnes of shrimp annually. Most of this volume is sent to the United States, where it represents over a quarter of the shrimp imported to the US.

"The shrimp-farming industry recognises the use of antibiotics in food production should be avoided due to concerns about food safety and the development of antibiotic-resistant bacteria," GAA president George Chamberlain said. "The technology for disease management in shrimp farming has made transformative advances."

Pathogens are increasingly managed through the use of specific pathogen-free broodstock and breeding for genetic resistance to disease. At farms, proper pond preparation, disinfection of incoming water and the application of beneficial bacteria to displace pathogens help limit diseases.

The use of banned substances has been reduced thanks to stiffer regulation and enforcement, and pressure from responsible buyers who refuse to buy suspect shrimp. Education also plays a role.

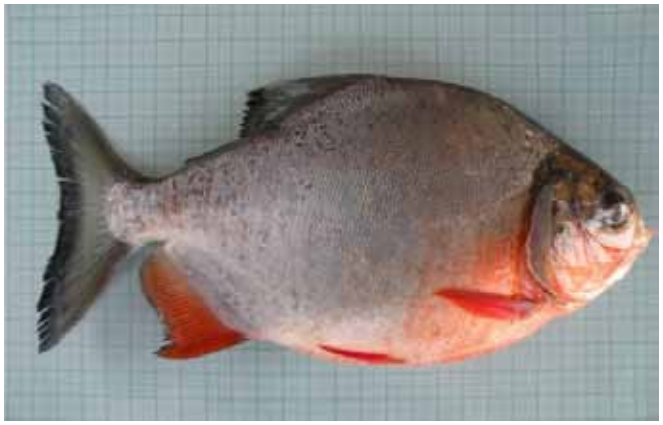
"GAA has an active educational program to assist farmers, regulators and policy makers in understanding the importance of health management through prevention," Chamberlain said. "We hope further training will help move all aquaculturists further away from the use of unapproved chemicals."

Best Aquaculture Practices (BAP) is an international certification program based on achievable, science-based and continuously improved global performance standards for the entire aquaculture supply chain: farms, hatcheries, processing plants and feed mills, that assure healthful foods produced through environmentally and socially responsible means. More information: Email: georgec@gaalliance.org (George Chamberlain), Web: www.gaalliance.org/bap/

Commercial farming of the red belly pacu

By A.K.Singh, Dinesh Kumar, Abubakar Ansari and Sharad C Srivastava

The fish is popular as a 'freshwater pomfret' and polyculture with the Indian major carps is preferred.



The red belly Pacu

A harvest from a grow-out pond

The pacu *Piaractus brachypomus* is a freshwater fish commonly known as pirapatinga or red belly pacu, a native fish of South America (Singh and Lakra, 2011). Intensive culture of pacu has been developed in Brazil. It was recently introduced to other countries including India. In the United States, this fish is an invasive species. Pacu was clandestinely introduced from Bangladesh to West Bengal possibly in 2004.

The red belly pacu is often confused with the other common pacu species; tambaqui *Colossoma macropomum* and *Piaractus mesopotamicus*. Pacu is a common name used to refer to several species of South American freshwater fish that are related to the piranha, but they are not the same fish. Pacu is a herbivorous fish whilst the piranha is omnivorous. However, while the pacu is a vegetarian in its natural distribution, reports from Papua New Guinea claimed that pacu can grow to a large size and is a man eater. Several reports back the claims that the pacu does attack humans with a very crushing and painful bite (Singh and Lakra, 2011).

The fish is harmless and can grow up to 85 cm but does not have the sharp teeth of the red belly piranhas which can reach only up to 33 cm (Howells et al., 1991; Ruiz-Carus and Davis, 2003). *Piaractus brachypomus* possesses a unique rare feature; the adipose fin is rayed in adults. The juveniles have a spotted (body) and the fins are dark edged in the young. They also have a distinctive large blotch on the operculum. Adults are uniformly dark or marbled. It has small scales and weighs between 3 to 7 kg at normal growth. It has been reported that an 18 kg fish has been harvested from the wild.

Pacu culture

Pacu is simple to grow and requires only a low-cost feed. It has been preferred over tilapia and catfish in informal taste tests. In recent years, the species is gaining popularity as an aquaculture species, both as an ornamental fish and as food fish. Its large size, eating habits and prolificacy make it adequate for the practice of fish culture (Chatterjee and Mazumdar, 2009; Das, 2011).

Leading hatchery owners in West Bengal state have started the culture of pacu in captivity to raise brood stock for commercial breeding and propagation (Chatterjee and Mazumdar, 2009). In India, the farming the pacu is relatively new. However, even though the pacu is omnivorous and feeds mainly on decaying plants, fruit and insects, it is a predator of other fish when the plant based feeds are scarce. Consequently, an impact assessment of this farming will be undertaken by the National Bureau of Fish Genetic Resources (NBFGR). Pacu has been found to attain maturity at 3 years or more with a stocking density of 2,000-2,500 fish/ha.

Breeding techniques

Pacu does not breed in captivity. Therefore they require induced breeding techniques (Chatterjee and Mazumdar, 2009). Induced breeding of *Piaractus brachypomus* with pituitary hormone gives better results as compared to inducing hormones such as Ovaprim and Ovatide. In the first stage of induced breeding, mature male and female brood stock are selected and kept separately. Then, the first dose at 2mg/kg body weight for females is typically given. The second resolving dose of 10-12 mg/kg body weight is administered four and a half to five hours later. At the time of the second female injection, the males are also given a single resolving dose of 2 mg/kg body weight. After injection the fish are kept in a hapa and they are stripped some five to six hours later. Injected fish may also be kept in cement cisterns, with induced fish producing a characteristic vibrating sound on the walls of the cistern.

The eggs are stripped out in trays and the milt and eggs mixed with a feather and the addition of water. The ratio of male:female for stripping is usually 1:1 or 1.5:1 depending on the maturity. Environmental factors play an important role with regards to both the dose of inducing hormone required and stripping. When temperature is higher i.e. 34-35°C, then both the dose requirement and stripping time is reduced. For better fertilisation a congenial environment is needed.

Fertilised eggs are transferred successfully into a hatchery hapa where hatching take place in 48 hours. As the yolk is absorbed the hatchlings increased in length. From the third day onwards these are ready for sale. For nursery management, the hatchlings are stocked in the prepared nursery pond, at the rate of 150,000 individuals/ha. Feeds are artificial feed comprising groundnut oil cake, rice polish, soybean dust and zooplankton. Generally 2kg of feed/ha is given daily at this stocking rate. Within 8-10 days, the hatchlings develop into fry, which are transferred to rearing ponds. A 3 ha pond is ideal for rearing and stocking density is usually around 100,000 fry/ha. The fry are fed

with artificial feed at the rate of 5kg/ha per day made from groundnut oil cake, sunflower oil cake, fish meal, boiled rice and Canadian peas.

Grow–out and marketing

Polyculture of the pacu is at a stocking ratio of 1 pacu: 3 Indian major carps (IMC). In Andhra Pradesh, the total pond areas under culture is over 809ha. The present production level of pacu in Andhra Pradesh itself has crossed 150,000 tonnes/annum. Some farmers in Uttar Pradesh have attempted the polyculture of pacu with IMC and reported that this fish may perform better in polyculture than in monoculture. During brood stock management the fish were fed at 5% of total biomass per day. Compared to other feed ingredients, fishmeal and groundnut oil cake offer better growth and maturation due to the high protein percentage. Adult fish require more energy than juveniles simply for maintenance and also require energy for the production of gametes.

Pacu was introduced into the farming sector in India after its seed production technique was perfected in West Bengal. At the fingerling stage, the fish possess an alluring shining colour with a tint of bright red around the ventro-anterior region of the trunk which attracts aquarium fish hobbyist to culture this fish. On maturity, the colour becomes more subdued with some round spots appearing throughout the body. The overall colour is dark in nature with a shape similar to that of a pomfret.

There is a demand for fingerlings of pacu from farms in Chennai in Tamil Nadu, Kerala and Andhra Pradesh, Rajasthan, Uttar Pradesh and Punjab. The hatcheries of Midnapore and 24 Parganas (south) districts of West Bengal regions also supply mature fish to Maharashtra, Bihar,

Transport of the fingerlings

Cultured black pacu

Seed grading of red-belly pacu

Uttar Pradesh and Rajasthan where people are buying this fish as a 'freshwater pomfret'. The characteristic pomfret-like shape is considered an attractive quality amongst consumers.

References are available on request

A. K. Singh, is principal scientist and Dinesh Kumar, Abubakar Ansari and Sharad C Srivastavais are senior research fellows at the National Bureau of Fish Genetic Resources, Lucknow, Uttar Pradesh India. Email: aksingh56@rediffmail.com

8th Shrimp Congress

Proven technologies and promising innovations.

In the Philippines, industry, research and government groups are unified in ensuring that its shrimp farming industry should be on par with other shrimp producing nations in Asia. However, as others improve their competitiveness, Philippines producers will need to leapfrog to keep abreast. At this year's Philshrimp Congress, held from 9-12 May 2012 in Bacolod City, the theme was 'proven technologies and promising innovations'. According to the Daily Star, Salvador S. Salacup, the Department of Agriculture's Assistant Secretary for Agribusiness, Marketing and Fisheries believes that the formulae for rapid growth and revitalisation of shrimp farming in the Philippines are new technologies, efficiency and modernisation in addition to market linkages and good practices,.

Although the government is pushing for aquaculture development, it should be in a sustainable manner and within ecological limits. National Director, Asis G Perez of the Bureau of Fisheries and Aquatic Resources (BFAR) reiterated the problems encountered in 2011. "We saw how if aquaculture is not well managed, it can be detrimental to business. Last year, the massive fish kill in Lake Taal not only incurred losses of almost half a million pesos but consumers moved away from eating fish, even though they were from unaffected areas. This showed the need to balance production with sustainability and that industry must give due regard to the environment."

On disease prevention and control, "it is important to have core personnel to manage disease as this goes together with good aquaculture and technical knowhow. At BFAR, we will increase capacity in providing services in disease prevention by hiring more veterinarians,"said Perez, a veterinarian by training.

Managing WSSV

Living with the threat of white spot syndrome virus (WSSV) in the farming of the black tiger shrimp is common in the Philippines. During the 2010 Congress, **Roselyn Usero**, Negros Prawn Producers Marketing Cooperative Inc, (NPPMCI) had presented some results on the monitoring of WSSV occurrences in the Aqua-Cards Victorias farm in Negros. The continuation of this project with SEAFDEC/AQD had achieved tremendous results. Dr **Leobert D. de la Peña** from SEAFDEC/AQD showed that the strategies applied had led to further improvements: from three cases of WSSV infections in September 2009 to two in 2010 and to zero in 2011.

The strategies were listed as biosecurity measures, PCR tests as well as regular physico-chemical and bacterial analyses of water and shrimp, twice a week. Key to the success was also the isolation of the infected area and ponds during an infection, application of corrective measures such as supplementation with probiotics and vitamin C in feeds, addition of probiotics in rearing water and addition of immune enhancers above the regular dosages.The success was not only due to the continuous refinements of farm management practices but also to the regular tests and calibration of equipment at the in-house diagnostic laboratory.

Two approaches to managing WSSV as well as other known viruses in shrimp were presented. **Ung Eng Huan**, GS Biotech S/B in Malaysia,

At the DOST consultation, deputy executive director for Aquatic and Natural Resources of PCAARRD, Cesario R. Pagdilao and executive director Dr Patricio S. Faylon and Valeriano L. Corre Jr.

At the booth of San Miguel Foods Inc., Amelyne Hky Farm (third from left) and the team (from left); Stephen John Danico (Western Visayas), Anju Barrieses (Visayas), Sublime Altavas (Western Visayas), Bobby Escudero (Mindanao) and Felicisimo Rosales Jr. (Central Visayas).

introduced Beta-Defense for 'defensive apoptosis' in WSSV infected shrimp. This basically means that nutritionally supplied Caspase-3 interacts with the WSSV 449 anti-apoptotic protein in a way as to promote viral accommodation where shrimp have much better chances of surviving WSSV.

"In several laboratory and field trials, we demonstrated the effectiveness of the product incorporated into feeds and fed to both black tiger and vannamei shrimp. This up-regulation did not affect feed conversion ratio (FCR) despite a 65-120 times increase in PPO (prophenol oxidase, the main non-specific immunity marker for crustaceans) in the haemolymph and indeed improved FCR dramatically under certain conditions as well as improving growth rate. Beta-Defense has been shown to 'buy' the farmer an extra 8 weeks of grow-out time following an incoming WSSV wave in over 90% of the time."

In another presentation, **Thamayanthi Nada Raja**, BioValence, Malaysia detailed results with RetroMAD1, an orally administered broad spectrum antiviral protein. Each peptide active site of the 3 in 1 antiviral cocktail as one recombinant protein has different functionalities. They act to interfere with viral fusion, entry, integration and translation. To date, trials have shown that the product shows promising results for black tiger and vannamei shrimp infected with hepatopancreatic parvovirus (HPV) Monodon Baculovirus (MBV) and WSSV. The limitations are possibly RNA viruses although trials have not yet begun on these. RetroMAD1 together with Beta-Defense showed a 78% survival in a 4-week trial in an as yet unidentified disease in Asian seabass fingerlings while the control had 100% mortality within 6 days. This broad spectrum drug is being developed for dengue fever and has shown promising results in 15 out of 18 viruses tested so far in shrimp, fish, cats, dogs, monkeys and human viruses grown on mammalian cell lines.

The oral administration of immunostimulants at a defined dose and frequency of feeding could be an effective disease management strategy, according to the research team comprising the Institute of Aquaculture, University of the Philippines, Visayas and SAEFDEC/AQD. They studied the effects of the oral administration of alginic acid in the growth performance, immune responses and disease resistance against WSSV. Alginic acid is one of the major components of brown seaweeds mostly in *Laminaria* and *Ascophylum*. The optimum dose and frequency of alginic acid administration was 1,000 mg alginic acid per kg diet fed once every 3 days for improved growth, enhanced immune responses and WSSV-resistance of *Penaeus monodon*.

Controlling IMNV, EMS and white faeces in vannamei shrimp

The major diseases faced by vannamei shrimp farmers in many parts of Asia are Infectious myonecrosis virus (IMNV), early mortality syndrome (EMS), white faeces and WSSV. According to Dr **Matt Briggs**, Vannamei 101, Thailand, these major diseases explain the stagnation in shrimp production for 2-3 years. In Indonesia, IMNV particularly

infects vannamei shrimp and the infection starts with > 6 g shrimp and 50-70% loss is recorded when the situation worsens with slow shrimp growth and high FCR.

"The strategies against IMNV include reducing stocking densities, from >130 to 70-80 PL/m^2 as shrimp at densities < 80 are less affected due to lower stress levels and can be harvested quicker, or progressively by partial harvesting. They also practise batch all in: all out stocking practices for farms and have lined reservoirs covering 20-30% of pond area. Other strategies include using closed biofloc systems and polyculture with tilapia/milkfish (at 0.5/m^2)"

The most recent reports on EMS in vannamei farming are from farms in Rayong and Chantaburi where 500-600 ponds are affected. It is bringing down production in Malaysia and Vietnam, where it also affects the black tiger shrimp. According to Dr **Pornlerd Chanratchakool**, Novozymes Biologicals, it occurs as early as 8-10 days after stocking in Malaysia. In Vietnam, mortality is at more than 35 days and shrimp stop feeding. Often about 60% of stock can be saved. White faeces disease affects shrimp after 30 days of culture and the mortality is from 5 to 35%. What triggers these infections?

In EMS, *Vibrio* and other bacteria have been found with severe damage to the hepatopancreas of infected shrimp (see page 8). In white faeces, poor water/soil quality, low dissolved oxygen, high hydrogen sulphide and *Vibrios* are common, apart from gregarine, microsporidian etc. If feeding is stopped, mortality can be arrested leading to 25-60% survival of stock.

"Some common observations with affected ponds are an unstable phytoplankton during the first 20-30 days, stocking density is too high such as more than 120 PL/m^2 for vannamei shrimp and sudden rain after a period of hot and dry weather. There is over feeding or shrimp is eating more but growth is slow with lower average daily growth than expected. There is more organic waste accumulation, poor water quality with more toxic built up of hydrogen sulphide, ammonia and nitrite and low dissolved oxygen."

Chanratchakool listed several strategies for a stable production of vannamei shrimp. This included a recommendation by shrimp expert, Dr **Chalor Limsuwan**, Kasetsart University, Thailand to adjust feed amounts and feeding frequency with different water temperatures. At temperatures from 24-26 °C, the feed amount should be reduced by 40-60% and times between feeding extended to 6 hours. The effects of low dissolved oxygen on feeding were also explained.

New feeds and automatic feeders

Probiotics have a history of 20 years in aquaculture and reports showed that it is usually used in pond water. Uni-President Enterprises, Taiwan's **Jimmy Wang** introduced feeds with probiotics. These feeds are already commonly used in marine fish farming for the pompano, seabass and cobia. As a major aqua feed producer, Uni President has its own bacterial bank used for the production of probiotics, said Wang. There are more than 500 strains. Selected *Bacillus* spp and *Lactobacillus* have been chosen for inclusion in new feed formulations. *In vitro* efficacy experiments showed that the probiotic feeds possess two characteristics: antibacterial activity against *Vibrio parahaemolyticus* and marine *Vibrio* species and protease activity to break down proteins.

In another development, Wang presented some results on the advantage of automatic versus manual feeding. The feeding frequency is increased to 50-100 times/day, days of culture for 20 g shrimp is reduced by 20% and FCR is better at 1.35 to 1.4 from 1.6 previously. A comparison was also made with blower autofeeders from Taiwan which are commonly used in milkfish farms in Taiwan. There is a dispersion of 16 m and as feed is blown by air, feed breakages are reduced. With new automatic feeding, the changes in feed specifications are imperative, "we used to worry about the water stability but with automatic feeders dispersing feeds at more regular interval, we now need only 20 minutes of water stability. The new feeds are based on formulae which can allow for quick water absorption and use of hydrolysed raw materials for better digestion".

Knowing the shrimp and the pond environment

According to Dr **Robins McIntosh**, Charoen Pokphand Food (CPF), increased yields in Thailand are the result of changes in growth rate with genetic improvements during 2008 to 2010. Cycles are increased to 3.15 times/year and at stocking density of 110 PL/m^2 and survival of 91%, the production is as high as 52.2 tonnes/ha/year. Growth increased to 1.29 g/week and the improvement in FCR to 1.32 from 1.72 lowered production costs to USD 2.45/kg. McIntosh explained CPF's process of domestication and selective breeding in Thailand and said that this has been the driver for production increases. The improved genetic strain in 2011 resulted in higher ADG (average daily growth) of 0.31 g and with increase fed intake, growth to 14 g is achieved in 70 days (at a stocking density of 130 PL/m^2). However, he emphasised that what is critical is the control of the pond environment. Faster growth requires a better and stable environment.

Dr **Prakan Chiarahkhongman**, CPF followed-up with a presentation on the optimal water quality in the pond environment- alkalinity; calcium, magnesium, potassium and the relationship with pH and salinity; transparency; control of plankton biomass and C:N ratios. He said that a large daily range of pH (eg 9.2 to 5.2) has been ascribed to WSSV infections and that transparency should be maintained and should not be less than 30-40 cm. His message was "do not let pond dynamics control you, you have to control the pond dynamics."

Research for the industry

The Department of Science and Technology (DOST) of the University of the Philippines Visayas (UPV) has a multi-million peso research program to uplift the shrimp industry. During this congress, DOST took advantage of the presence of major stakeholders to seek their opinions on the program. Research teams presented the progress to date. The two programs were on integrated and sustainable development for the shrimp industry and biotechnology for shrimp: utilising molecular technologies to elucidate shrimp immunity and develop disease diagnostics.

From left, Dr.Leobert D. de la Peña, Diomede Bucog, Jr (Santeh Feeds Corp), Roselyn Usero and Audie Lim, Phishrimp Director, Mindanao.

Jimmy Wang (right) and Wen, Wei Uni President Enterprises, Taiwan

"The Next Ten Years"

How will the aquaculture industry be in ten years time? And how would we want it to look? These and many more questions were considered by over 1,000 delegates at the Skretting Australasian Aquaculture Conference 2012 (AA12) which was held from 1 to 3 May, 2012 at the Melbourne Convention and Exhibition Centre.

"The aquaculture industry faces many challenges but the industry has shown tremendous resilience and it is fantastic that so many people are willing to come together every two years to consider the sort of future they want for this increasingly important industry," Conference chair Pheroze Jungalwalla said, in a media release before the conference.

"And at this year's conference we will look ahead 10 years – this is really important because we all have a chance to help shape the sort of industry we want well into the future."

Aquaculture in the Next Ten Years

Biggest food producing industry and algae

Author of The Coming Famine, **Julian Cribb** said, "By 2060 we will need around 600 quadrillion calories every single day to feed the human race." The answer to this major food security problem could be aquaculture, which may become one of the boom industries of the 21st century. By the second half of this century, it will grow steadily to become the biggest food producing industry in the world.

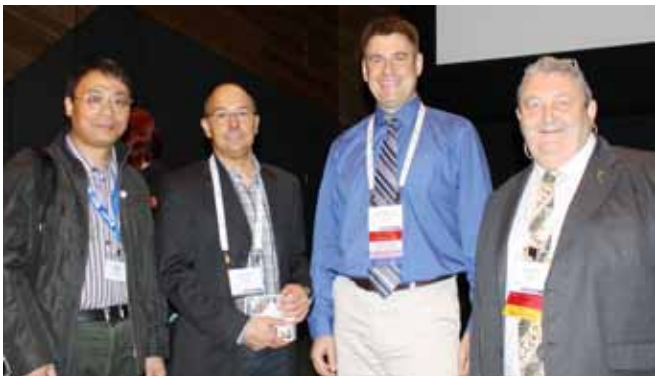
"A CSIRO spatial analysis carried out a couple of years ago estimated that more than 1.5 million hectares of coastal land in northern Australia alone is suitable for farmed fish production. Northern fish farms currently yield 5 to 10 tonnes of prawns or barramundi to the hectare, so you can see the potential for a very large aquaculture sector producing millions of tonnes of food in the north alone."

However Cribb said the grains industry alone will be unable to feed these millions of fish and sea creatures. "In future I envision huge algae farms – on land, at sea and in salt lakes – producing food for people, feed for animals, biofuels for transport, pharmaceuticals, plastics and fine chemicals."

China invests

Aquaculture is very important for Guangdong Province in China, said **Chen Yen**, director, Fisheries Department, Guangdong Provincial Oceanic and Fisheries Administration. In 2011, the total aquaculture production was 5.97 million tonnes comprising 3.32 million tonnes from freshwater and 2.66 million from the marine sector. Exports totaled 850,000 tonnes valued at USD3.5 billion which is a third of the export value from agriculture.

The strategies to meet the growing demand for seafood include efficient and eco-friendly aquaculture systems. In 2015, the production will be 6.87 million tonnes from 587,000ha and by 2020, because of limited land resources; the same area will produce 7.06 million tonnes. Strategies include genetic improvement where the local government already invests USD 3.2 million annually. Most of marine aquaculture will be moved offshore to avoid pollution and competition in near-shore areas. An annual allocation of USD 4 million is for offshore cage culture development. By 2015, 22 offshore cage industrial enterprises and 2,400 offshore cages with an annual production of over 30,000 tonnes will be developed. Investments will be to reinforce inspection and supervision of food safety, traceability and disease control.



Roy Palmer, director at Seafood Experience Australia; (right) with plenary speakers (from left), Chen Wen, Alex Obach and Lukas Manomaitis

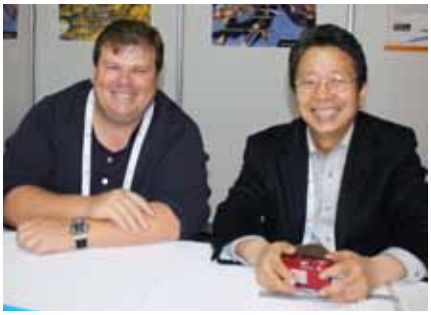
Independence from fish meal and fish oils

Lukas Manomaitis, American Soybean Association International Marketing, South East Asia technical director said that the Program has been working with farmers worldwide to promote sustainable, feed-based approaches to aquaculture. Its approach for the future is to develop and encourage the use of marine fish grow-out diets with the lowest inclusion of fishmeal. Currently at 11%, the target is 0% with the same nutritional quality.

Replacement of fish meal and fish oil has been the main focus of Skretting's research during the last two decades where the objective is independence from fish meal and fish oils. Globally, the feed company has replaced 50% of fish oils with alternative oils said Dr **Alex Obach**, managing director, Skretting Aquaculture Research Centre, Stavanger, Norway. The partial replacement of fish meal with other animal protein or plant proteins can be achieved combined with the use of active micro ingredients (MicroBalance™). The focus is to seek new sources of new sources of omega 3 fatty acid sources such as microalgae and plant oils and optimisation of DHA and EPA. Improvements of feed

At the Seafarms booth, from left, Marco Montagnoli, Maccaferri, Malaysia, Jeroen Gallens, Bekaert, Belgium and Gopakumar Menon, Garware Ropes, India.

At the DHI booth, Dr Guillaume Drillet (left) is Aquaculture and Plankton Research Group leader, DHI-NTU Research Center and Education Hub, Singapore.



Mark Oliver, Australian Aquaculture Support Services Pty Ltd (left) and Dr Charles Bai, Korea

conversion ratios will also continue as this has been reduced from 1.3 in the 1980s to 1.14 in the 1990s to 1.10 in the 2000s for the salmon. The future will also require more investigations to match different feeds to genetic stocks, feeds adapted to farming technology, different culture systems and more use of functional feeds.

Australasian Aquaculture Awards

The inaugural Australasian Aquaculture Awards, sponsored by the Global Aquaculture Alliance Best Aquaculture Practices (GAA-BAP) recognised individuals and businesses that apply innovative and sustainable practices that will have lasting impacts on Australasian aquaculture over the next 10 years.

Tassal Operations Pty. Ltd. won the Aquaculture Production Award. The largest vertically integrated Atlantic Salmon producer in Australia, Tassal provides fish predominantly for the regional market. With sustainability at the core of all operations, it consulted varied stakeholders in preparing its first annual sustainability report – the first released by an Australian aquaculture company. Tassal's Environment and Sustainability team is focused on addressing environmental and social issues, and "what we learn we share," by being, amongst other things, active in the Tasmania Salmon Growers Association.

The Fish Oil Replacement in Australian Aquafeed project won the Aquaculture Science Research Award. Project work by Prof Chris Carter (University of Tasmania), Dr David Francis (Australian Institute of Marine Science), Dr Peter Nichols (CSIRO Food Futures Flagship) and Dr Giovanni Turchini (Deakin University) is helping Australian aquaculturists plan for a more economically and environmentally secure future by reducing dependence on imported fish oil as an ingredient in aquafeed. Australia's aquafeed industry quickly took up project findings and developed new, cost effective and more sustainable diets for the Australasian market. Current feeds have minimal fish oil content and utilize nationally produced alternative oils, but still deliver excellent fish performance and products with optimal nutritional and sensory qualities.

Sealite Pty. Ltd. won the Aquaculture Service Provider Award. Sealite, which designs and manufactures marine navigation aids in Somerville, Victoria, Australia, offers the widest range of solar-powered LED lanterns in the marketplace. Fish farmers typically install flashing lights to identify the boundaries of their farms. Sealite's low-cost synchronized light systems clearly illuminate their assets against confusing background lighting and other navigation aids for greater visibility to mariners.

Since their inception, the biennial Australasian Aquaculture conferences have been organised on a joint venture basis between the Australian National Aquaculture Council and the World Aquaculture Society-Asia Pacific Chapter. The strong relationship recently secured the World Aquaculture Conference and Trade Show which will be held in Adelaide from 7 to 11 June 2014. (Information here was contributed by Media Liaison, Australasian Aquaculture Conference 2012. Email: jppaparo@gmail.com).

The team from Trans Instruments, Singapore

At the trade show

The exhibitions ranged from those providing services such as DHI to cage and farm equipment at the Seafarm booth. Also present were the two major feed producers, Skretting and Ridley Aqua –Feed, various government departments and industry groups. These included the Australian Centre for International Agricultural Research (ACIAR), Australian Seafood CRC and Fisheries Research and Development Corporation, Department of Primary Industries Victoria and Future Fisheries Veterinary services.

DHI is an independent international consulting and research organisation. It provides advance technological development and competence in water, environment and health. In aquaculture, DHI cover sustainable solutions to optimised production and minimise environmental impact. Solutions include designing zero-discharge fish farms to feed regime optimisation, improvement of plankton production systems to optimise larval rearing to biological treatment methods for waste from fish farms.

Seafarm is major supplier of sea cages, mooring systems, nets etc. At the booth, there was the Maccaferri KikkoNet which is made of stabilised PET monofilaments woven into a double hexagon mesh. These are predator proof nets. The KikkoNet does not absorb water and the weight remains constant throughout its service life. Also at the booth, were nets from India's Garware-Wall Ropes Ltd.

New exhibitors were Singapore's Trans Instruments and Friend of the Sea (FOS). Trans Instruments is a specialist manufacturer of scientific instruments. The range of products include professional and basic, potable and bench top pH, conductivity meters and dissolved oxygen meters, refractometers and electodes for various applications. FOS provides international certification for seafood from sustainable fisheries and aquaculture. FOS follows FAO guidelines and is the main certification scheme globally.

Market paradox with seafood in Australia

In a study on the role of imported seafood in Australia, Nick Ruello, Ruello and Associates Pty Ltd showed several discoveries. One of them is that Australian consumers prefer fresh fish over frozen options but supermarket retailers prefer frozen over fresh because it is easier for their logistics and centralised buying. Ruello describes this as a paradox because the retailers are usually driven to meet consumers demand.

The FRDC (Fisheries Research Development Corporation) funded study on 'the composition, value and utilisation of imported seafood in Australia was to find out details in the business of imported seafood. Ruello said that although 20,000 tonnes of prawns are imported, details on the composition and the type of competition faced by local prawn producers are not known.

Data from the Australian Bureau of Statistics showed that in 2008-2009, imports totalled 193,000 tonnes costing AUD 1.3 billion and a final sales value of AUD 4.5 billion. Imports accounted for 72% of seafood consumed in Australia because imports match local products for quality and through smart marketing and efficient supply chain management. Ruello said, "Imported seafood is totally different to the historic image of cheap and inferior products. The overall quality, packing, size, grading and branding of imports is good, so much so that the prices of many imports are as high as or surpassing those of equivalent Australia products. (Source: Treadgold, T, 2012 in Fish, Volume 19 No 4, pages 8-9)

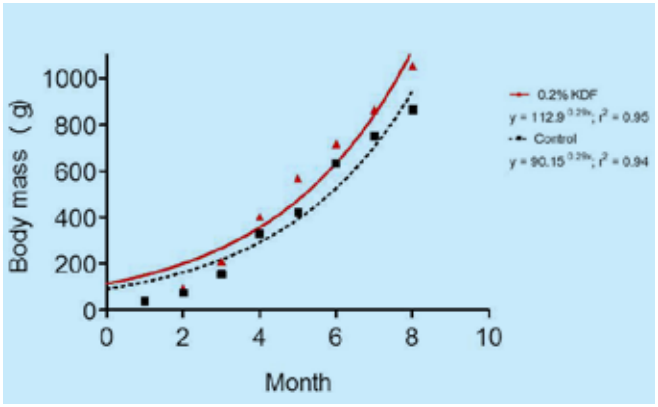
Aqua-nutrition seminar in the Mekong Delta

On June 6, 2012, ADDCON and its Vietnamese distributer AuViet organised an aqua-nutrition seminar for decision makers from the Mekong Delta. It was held in Can Tho City. Vietnam is currently the third largest aquaculture producer in the world, after China and India. The Mekong Delta is the centre of aquaculture accounting for 72% of production.

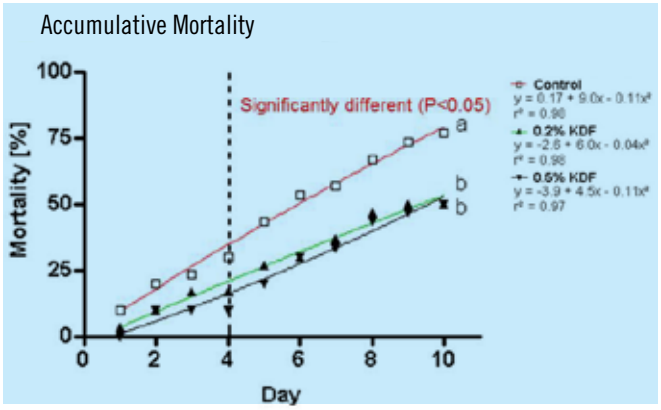
Nguyen Duc Nghia, CEO of AuViet, opened the seminar attended by more than 80 participants. Dr Van Tho Minh, technical manager of Addcon, Vietnam followed with a review on production trends in the Vietnamese aquaculture industry. Prof Hung Le Thanh, Dean of Aquaculture Department at Nong Lam University gave a lecture on pangasius catfish nutrition and Dr Kai-J. Kühlmann, technical manager of Addcon discussed the use of AQUAFORM - the most widely used acidifier in aquaculture; in the shrimp and Pangasius. Kühlmann clarified the high efficiency of the potassium-diformate based product in getting rid of pathogenic bacteria and improving digestibility parameters and thus performance. He presented data from trials with pangasius and white leg shrimp (*Litopenaeus vannamei*) obtained from research and commercial trials conducted in Thailand, Vietnam and the Philippines.

The seminar was a milestone for the aquaculture industry in the Mekong Delta. The audience showed strong interest, especially for the fast growing shrimp aquaculture. The Germany based Addcon Group of companies specialises in green chemistry. Their diformate based product range was the first and only antibiotic free growth promoter registered in the EU. More information; Email: info@addcon.com

Kai-J. Kühlmann (left)



Pangasius fed with 0.2% Aquaform inclusion has a ~ 22% higher body mass compared to control fish



Starting day 5, Aquaform treated shrimps showed 40% less mortality compared to control group during *Vibrio* challenge

Acquisition of German feed additive company energizes phytogenics business

Animal nutrition company BIOMIN finalised the acquisition and integration of the German based phytogenic feed additive and feed flavourings company MICRO-PLUS. This acquisition adds to Biomin's proven expertise in phytogenics and its passion for providing innovative and trend- setting solutions to its customers.

Building on the existing strengths of the two companies, Biomin is setting the pace once again, this time in the field of phytogenics. The company's strong R&D capabilities are now combined with extensive know-how in functional plant ingredients and essential oils. In addition, its global network will strengthen access to markets while allowing for an extended technical support to customers worldwide.

"Micro-Plus is an excellent acquisition, which will add to Biomin's extensive competence in phytogenics an additional 27 years of know-how, along with an experienced team of professionals working to provide the best possible solutions for our customers," says Dr Tobias Steiner, director Competence Centre Phytogenics within Biomin. Digestarom®, the new product range completes its phytogenics portfolio and has a proven and well-documented efficacy, with numerous scientific and field studies.

"It is the strong scientific background, the expertise and the global sales network which makes me believe that Biomin is the best company to take these products to the next level," said Randolf Nott, founder and former CEO of Micro-Plus. In addition to its new optimised product portfolio in phytogenics, Biomin also provides a complete range of aromas and sweeteners.

More information: www.biomin.net

Appointments

President and CEO

US based Aeration Industries International, the global manufacturer of advanced aeration equipment and wastewater treatment systems has appointed **Brian J. Cohen** as President and CEO. Cohen succeeds Daniel Durda, who will remain with Aeration Industries in his ongoing roles as chairman of the Board and Past Chair of WWEMA (Water & Wastewater Equipment Manufacturers Association). Cohen joined Aeration in early 1999 in the international sales area and quickly rose through the ranks to sales manager and then, vice president of International Sales, setting all-time company sales records and opening major markets, notably in China and India, and was later named COO.

Prior to joining the company, Cohen worked at GE Water, formerly Osmonics, as an applications engineer supporting Asia and Latin America. Cohen is the grandson of the co-founder, Joseph Durda, and nephew of Daniel Durda. "As a third-generation leader, it is an honour to be appointed President and CEO," said Cohen. "I look forward to following in the footsteps of my grandfather and uncle."

Cohen has a bachelor's degree in East Asian Studies from Harvard University and is proficient in Mandarin Chinese and Spanish. Cohen is a member of the board of directors of Joseph Durda Foundation and the Harvard Varsity Club. (More information: Web: www.aireo2.com)

Global aqua sales manager

Meriden Animal Health, UK announced that **Maarten Jay van Schoonhoven** has joined the team as global aqua sales manager. The move follows Meriden becoming part of the Anpario PLC group, and a decision to focus the aqua sector under the Meriden brand. Maarten holds two MSc degrees in biology and aquaculture and has been with the group since 2009. Maarten has considerable technical and commercial experience from around the world and his experience is a welcome addition to the Meriden Team who are actively expanding activity in the growing aquaculture sector.

Maarten will continue, under the Meriden identity, to work with Aquatice - the product developed by Kiotech International - in addition to developing and supporting the Orego-Stim® Aqua and Phyconomix product ranges. Maarten is currently based in Bangkok to oversee operations in the important aqua region of South East Asia. He will also have significant input into another important region in aquaculture, that of Central South America, an area where Maarten's fluent Spanish will be an advantage. More information: Email: sales@meriden-ah.com

Proceedings on bacterial disease in tilapia and other warm water fish

A proceedings booklet summarising presentations from the symposium, titled "Bacterial Disease in Warmwater Fish: New Strategies for Sustainable Control", is now available in English or Portuguese from MSD Animal Health (known as Merck Animal Health in the USA and Canada). The 44-page color booklet features scientific papers authored by:

- Rogério Salvador, PhD, North Paraná State University, Brazil;
- Rodrigo Zanolo, MV, MSc, MSD Animal Health, Brazil;
- Neil Wendover, BSc, MSD Animal Health, Singapore;
- Melba B. Reantaso, PhD, Food and Agriculture Organization, United Nations, Italy;
- Patricia S. Gaunt, DVM, PhD, DABVT, Mississippi State University, USA;
- Mark P. Gaikowski, MA, US Geological Survey, USA.

Worldwide, production of farmed fish has skyrocketed at an annual growth rate of nearly 7% from less than 1 million tonnes/year in the early 1950s to nearly 52 million tonnes with a value of USD 80 billion (€ 61 billion). Tilapia production, in particular, has markedly increased because of the fish's large size, rapid growth and palatability. Not surprisingly, greater demands on production systems have also increased the level of disease challenge. The tilapia industry must therefore find and implement new ways to minimize or control diseases and maintain efficient production. The authors note that while bacterial disease remains a costly problem for producers of tilapia and other warm water fish, it can be managed effectively with integrated, sustainable health programs involving vaccination and appropriate treatment options, when necessary.

PDFs of the proceedings are available upon request (3MB file) or can be downloaded at http://aqua.merck-animal-health.com. For more information, contact the regional MSD Animal Health representative.

What can you expect from AQUA Culture Asia Pacific in 2013

Volume 9 2013						
Number	**1 - Jan/Feb**	**2 - Mar/Apr**	**3 - May/Jun**	**4 - Jul/Aug**	**5 - Sep/Oct**	**6 - Nov/Dec**
Issue focus *Recent developments and challenges for the next step*	Aqua feed Production	Health Management	Hatchery & breeding technology	Food Safety & Traceability	Sustainable & Responsible Aquaculture	Culture technology
Industry Review *Trends and outlook, demand & supply*	Marine Shrimp	Tilapia	Marine Fish	Catfish	Marine fish	Freshwater Fish/ Prawn
Feeds & Processing Technology *Technical contributions influencing the final value of aqua feeds*	Feed additives Processing technology	Novel feed ingredients Extrusion	Fish meal /oil replacement Feed management	Feed enzymes Product quality	Feed probiotics Good manufacturing practices	Nutrition & Formulation
Production Technology *Technical information and ideas*	Culture Management & Biosecurity	Genetic Improvement	Recirculation Aquaculture Systems	Hatchery technology	Certification and regulations	Hygiene & Food Safety
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					
Show Issue & Distribution at these events as well as local and regional meetings *Show preview	**VIV-Aquatic Asia 2013**, March 13-15, Bangkok, Thailand* **Aquaculture 2013**, Feb. 21-25, Nashville,Tennessee, USA	**10th Asian Fisheries & Aquaculture Forum**, April 30-May 4 Yeosu, Korea	**Vietfish 2013**, June 2013 Ho Chi Minh City, Vietnam	**The Aquaculture RoundTable Series (TARS 2013)** August	**18th China Seafood & Fisheries Exposition 2013** November China*	**Aquaculture Asia Pacific 2013**, Ho Chi Minh City, Vietnam, December 10-13*

19th Annual Practical Short Course on Aquaculture Feed Extrusion, Nutrition and Feed Management

September 23-28, 2012, Texas A&M University, USA

A one-week Practical Short Course on Aquaculture Feed Extrusion, Nutrition and Feed Management will be presented on Sep. 23-28, 2012 at Texas A&M University by staff, industry representative and consultants. This program will cover information on designing new feed mills and selecting conveying, drying, grinding, conditioning and feed mixing equipment. Current practices for preparing full-fat soy meal processing; recycling fisheries by-products, raw animal products, and secondary resources; raw material, extrusion of floating, sinking, and high fat feeds; spraying and coating fats, digests and preservatives; use of encapsulated ingredients and preparation of premixes, nutritional requirements of warn water fish and shrimp, feed managements and least cost formulation are reviewed.

Practical demonstration of sinking, floating, and high fat aquafeed, are demonstrated on four major types of extruders - (dry, interrupted flights, single and twin screw), using various shaping dies. Other demonstrations include: vacuum coating and lab analysis of the raw material for extrusion. Reservations are accepted on a first-come basis.

More information: Dr. Mian N. Riaz, 2476 TAMU; Food Protein R&D Center, Texas A&M University; College Station, TX 77843-2476, Phone: 979/845-2774; Fax: 979/845-2744, Email: mnriaz@tamu.edu; Website: www.tamu.edu/extrusion

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

August 15-16

The Aquaculture Roundtable Series 2012 - Shrimp Aquaculture
Phuket, Thailand
Email:conference@tarsaquaculture.com
Web: tarsaquaculture.com

August 23-26

AES Issues Forum &
And 9th International Conference on Recirculating Aquaculture
Roanoke, Virginia, USA
Email: aquaconf@gmail.com
Web: www.recircaqua.com

September 1-5

AQUA 2012
Prague, Czech Republic
Email: worldaqua@aol.com
Web: www.was.org

September 5-7

Aquamar Internacional
Cancun, Mexico
Email : coordinacion@aquamarinternacional.info
Web: www.aquamarinternacional.com

September 23-28

19th Annual Practical Short Course on Aquaculture Feed Extrusion, Nutrition and Feed Management
Texas, USA
Email: mnriaz@tamu.edu;
Web: www.tamu.edu/extrusion

October 17-19

Offshore Mariculture 2012
Izmir, Turkey
Web: www.offshoremariculture.com
Email: ktolley@mercatormedia.com

November 6-8

China Fisheries & Seafood Expo
Dalian, China
Email: seafoodchina@seafare.com
Web : www.chinaseafoodexpo.com

November 6 – 8

GLOBALG.A.P. Summit 2012
Madrid, Spain
Web: www.summit2012.org

December 6-8

International Fisheries Symposium- IFS 2012
Can Tho, Viet Nam
Email: ntnlien@ctu.edu.vn or caf@ctu.edu.vn (Nguyen Thi Ngoc Lien)
Web: www.ctu.edu.vn/colleges/aquaculture/ifs2012/

December 7-9

Shanghai International Fisheries & Seafood Expo 2012 (SIFSE 2012)
Web: www.sifse.com/en
Email: kim.yang@gehuaexpo.com (Kim Yang)

THE
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The Aquaculture Roundtable Series
15-16 August 2012

SHRIMP AQUACULTURE – SHAPING THE VALUE CHAIN

15-16 August 2012, J W Marriott Phuket Resort & Spa, Phuket, Thailand

TARS 2012 – THE AQUACULTURE INDUSTRY'S FOREMOST OPINION-LEADING EVENT IS HERE!

Shrimp aquaculture has crossed the threshold to become an industrial business with a value chain starting from breeding and genetic selection to hatchery; farming and health management; feeds and feeding and processing to marketing and branding. However, this value chain suffers challenges within each of its segments to the integration of all these segments.

Shrimp aquaculture needs to make the quantum leap into the next phase of growth but to be successful it has to be an industrial supply chain which is self-regulated.

As one of the industry's foremost opinion-leading events, **The Aquaculture Roundtable Series (TARS 2012)** focusing on **Shrimp Aquaculture Shaping the Value Chain** aims to take a holistic approach to tackle these challenges. This conference is a follow-up to the successful inaugural series (TARS 2011) held in Singapore where 180 participants convened to deliberate on the status of the aquaculture sector and identified steps to reduce redundancy and improve production efficiency to take the industry forward.

TARS 2012 presents a neutral forum for multiple stakeholders from the public-private sector, academia and non-government organisations to share new knowledge and expertise, and provide substantial input to improve the sustainability and profitability of shrimp production in Asia. This will be critical as the industry faces economic uncertainties and vulnerabilities resulting from the changing market conditions, including food safety and quality standards, and the threat of diseases.

TARS 2012 is organised by Aquaculture Asia Pacific Magazine and Corporate Media Services and supported by the Department of Fisheries, Thailand.

PLENARY AND BREAKOUT SESSIONS

WHERE ARE WE TODAY?

Participants will benefit from updated overviews from leaders in their respective fields. This will form the starting point for the break-out sessions.

WHERE DO WE WANT TO BE TOMORROW?

Taking into consideration the current market situation, participants will get to brainstorm and propose new direction(s) to take the industry forward. It is likely that many groups will work on similar topics, giving a wider approach to related industry challenges. Participants will then regroup to report on the proposals resulting from break-out sessions.

WHO WILL BENEFIT

TARS 2012 targets key players in the shrimp culture supply chain – from geneticists to hatchery operators, integrators, producers and technicians, feed producers, seafood processors, marketers, to suppliers of equipment and services, academia and governments.

Organisers:

Aquaculture Asia Pacific

corporatemedia The Total Communications Company

Supported by:

Department of Fisheries Thailand

Sponsors:

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Biomin

DSM

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Alltech

Media Partner:

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REGISTRATION

The number of participants is limited to 200. Pre-registration is required and walk-ins are not encouraged. Register online or complete the registration form to reserve your space. You will be asked to specific your preferred area of interest for the breakout session.

More Information

Program and Speakers, click on: www.tarsaquaculture.com
Registration, click on: http://www.tarsaquaculture.com/registration.html
Email: conference@tarsaquaculture.com

REGISTRATION FEE SGD 800

**Fee includes opening day cocktail reception, tea breaks, lunch and conference materials.*

PROGRAM

DAY 1 – WEDNESDAY, 15 AUGUST 2012

PLENARY SESSION: WHERE ARE WE TODAY?
International experts will present an overview of the state of each sector in the supply chain; covering hatchery and disease management, production technology and culture methods, feed technology to certification, processing and marketing.

0745 hrs – 0800 hrs
Registration

0840 hrs – 1040 hrs
Session 1: Breeding and hatchery models

- **Growth, disease resistance, and reproduction: So many traits and so little time**
  Shaun Moss, Oceanic Institute, USA
- **Taming the Tigers: Need of the Hour**
  Ravi Kumar Yellanki, Vaisakhi Bio-Resources and Vaisakhi Bio-Marine, India
- **Hatchery protocols – A comparison of Asian and Latin American models**
  Olivier Decamp, INVE Aquaculture, Thailand

1040 hrs – 1100 hrs
Tea Break

1100 hrs – 1300 hrs
Session 2: Managing shrimp health

- **Current major disease threats for Asian shrimp farmers**
  Tim Flegel, Centex Shrimp, Faculty of Science Mahiodol University, Thailand
- **Balancing the basic pond management and biosecurity set up to reduce losses**
  Pornlerd Chanratchakool, Novozymes, Thailand
- **Probiotics in shrimp farming: Do they work?**
  Pedro Encarnação, Biomin, Singapore

1300 hrs – 1400 hrs
Lunch

1400 hrs – 1600 hrs
Session 3: Targeted nutrition and feeding

- **Nutrition and health for the shrimp – A gap analysis**
  Jacques Gabaudan, DSM, Thailand
- **Extruded feeds for better management in automated and intensive systems**
  Joe Kearns, Wenger Manufacturing, Inc, US
- **Feeding shrimp for health performance and profit**
  Fuci Guo, Alltech Southeast Asia

1600 hrs – 1620 hrs
Tea Break

1620 hrs – 1820 hrs
Session 4: Culture systems and management

- **Extra nutritional additives: Feed is more than a source of nutrients**
  Peter Coutteau, Nutriad
- **Biofloc technology in Asia: Does it work?**
  Dr Nyan Taw, Blue Archipelago, Malaysia
- **Production planning for integrated systems**
  Francisco Gomes, Novus International

1820 hrs – 2030 hrs
Cocktail Reception

DAY 2 – THURSDAY, 16 AUGUST 2012

0800 hrs – 0840 hrs
Session 4 cont'd: Culture systems and management

- **Production technology for the future**
  Addison Lawrence, Texas A&M, USA

0840 hrs – 1040 hrs
Session 5: Marketing, Branding & Certification

- **Case study of Thailand – Shrimp to the world**
  Panisuan Jamnarnwej, Thai Frozen Foods Association,Thailand
- **Shrimp farm certification – Where are we now and where do we go from here?**
  Dan Fegan, Cargill, Thailand
- **European shrimp market and the importance of the right certification**
  Herve Brun, Consultant, France

1040 hrs – 1100 hrs
Tea Break

1100 hrs – 1300 hrs
BREAK OUT SESSION:
WHERE WILL WE BE TOMORROW?

Participants will break into groups of 10 to discuss the challenges facing the sector of their choice. (Participants will be required to select their sector or industry of choice in the registration form prior to the meeting and will be allocated to the groups) Led by a facilitator, there will be multiple groups discussing the three or more industry topics. The expected output would be a list of key challenges, priority areas for improvement and recommended strategies to take the industry forward.
The choice for industry groups are:

- **Breeding and Hatchery**
- **Culture and Health Management**
- **Feeds and Feeding Strategies**
- **Marketing, Branding and Certification**

1300 hrs – 1400 hrs
Lunch

1400 hrs – 1830 hrs
Report Session

A total of 6 facilitators, each representing 3-4 groups, will present a summary of the output from the breakout sessions. This will be an interactive session.

1830 hrs
End

http://www.tarsaquaculture.com/

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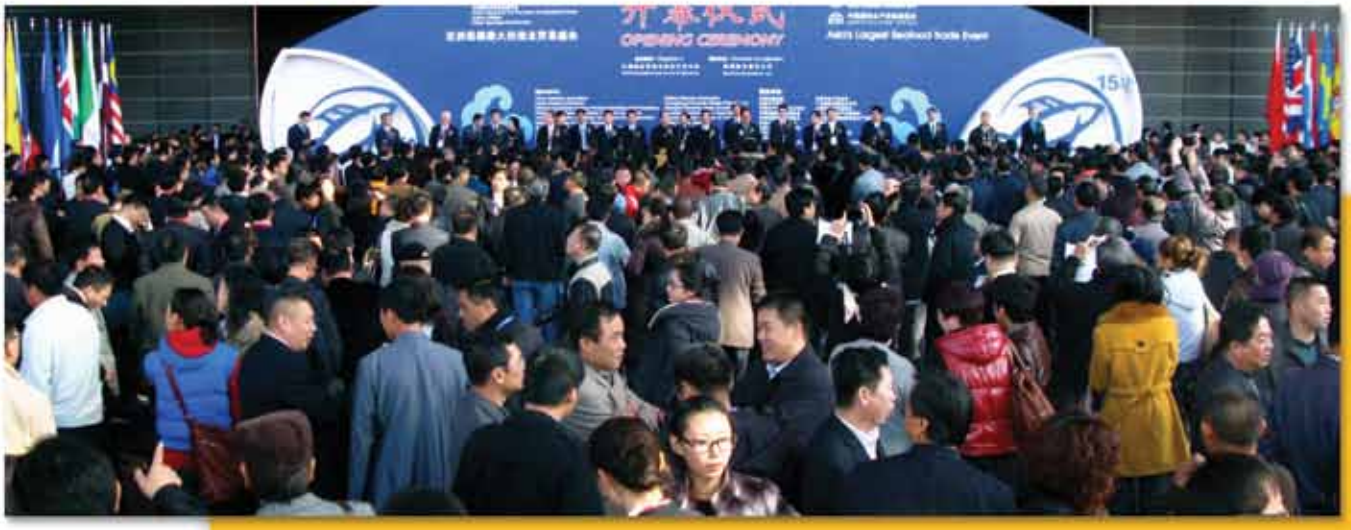

Dalian World Expo Center, Dalian, China
November 6-8, 2012

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Sea Fare Expositions, Inc.
2360 W. Commodore Way, Suite 210
Seattle, WA 98199
Tel: 206-789-5741
Fax: 206-789-0504
E-mail: seafoodchina@seafare.com

Sea Fare China Ltd.
16 F/A No. 58 Freetown Center
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