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Volume 10 Number 5

AQUA CULTURE

Asia Pacific

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TARS 2014, moving industry forward

MCI (P) 014/10/2014 PPS1699/08/2013(022974)

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OUR MISSION

- We strive to be the beacon for the regional aquaculture industry.
- We will be the window to the world for Asia-Pacific aquaculture producers and a door to the market for international suppliers.
- We strive to be the forum for the development of self-regulation in the Industry.

From the editor

Reviving shrimp aquaculture in Asia at TARS 2014

In August, The Aquaculture Roundtable Series (TARS) 2014 brought key stakeholders together to address the long-term sustainability of shrimp aquaculture in Asia. With the theme, ***Shrimp Aquaculture: Recovery • Revival • Renaissance***, TARS, for the second time in this series, focused on shrimp aquaculture. Participants heralded the meeting as the best ever as they presented a united front to address challenges and opportunities aimed at the recovery and revival of the industry, especially in light of Asia's shrimp aquaculture taking a serious beating since the onset of EMS from 2009.

Although many challenges and potential strategies were discussed, there were some crucial take-away messages. The first glaring issue raised was the lack of accurate production figures for the industry. Many of the speakers presented their best estimates and we could all see there were discrepancies. Shrimp is a commodity and prices are influenced by demand and supply. Furthermore, the supply chain is only as weak as its weakest link and excess harvest at the farm would lead to wastage and inefficiency if there was a lack of processing capacity. National regulatory authorities should collect accurate official data and make it available quickly. Two year old data does not help industry. There is also a role for regional and international bodies such as INFOFISH and FAO to push for this.

The irony about data is that it is only valuable when it shows trends and allows us to learn from it. Individual shrimp farms in Asia have continuously collected data which are only waiting to be analysed. We can easily forgive farm managers and entrepreneurs when they are so caught up with day-to-day firefighting and disease outbreaks but analyses of past data could show trends and potential strategies for overcoming the same mistakes. Academic institutions would be of great help and dovetails with the needs of the industry. Academia has always been encouraged to work with and be in tune with industry and this opportunity leads to a win-win situation. The industry must open their raw data to academia or no-one will ever learn, not even the individual farms themselves. Putting this learning into practice is where individual companies show the competitive edge.

Another issue which sticks out like a sore thumb is the lack of coordinated R&D. More cooperation between government and industry to advance research collaboration within Southeast Asia is needed. The case in point is that of EMS. Although it affects more than one country and is a potential disaster for all other shrimp producing countries, it is still not treated as a common enemy. Work is still done on an individual country level with knowledge sharing at workshops and seminars. There is always the issue of intellectual property (IP) which works to the detriment of the industry and could mean that a solution would be many years away.

Like all farming, shrimp aquaculture must move from art to that of science. We may not be able to control the weather but we can learn to manage better during adverse weather conditions. Soraphat (Danny) Panakorn presented a practical guide to proactive pond management during rainy conditions. Regulatory authorities and the private sector should work together to disseminate such information to the field. Extension services of the departments of fisheries have taken a back seat in many countries and this should be a wake-up call. Education is also a weakness and TARS took up the cause of hands-on operators who are too far removed from academia. There is also a need to evolve a new generation of farm workers who are skilled and highly educated.

A major threat was highlighted with genetics. All the current SPF stocks originate from Oceanic Institute, Hawaii and there is strong belief that the genetically selected strains for growth suffer from a high level of inbreeding. There seems to be a need to improve the genetic diversity and the best solution would be to introduce wild stocks into founder populations. Easily done for genetics companies in the Americas where wild stocks are available, but what about Asia? We can only introduce domesticated and SPF stocks. Governments which have been conditioned to allow only SPF stocks into the country may have to look at alternatives to develop more robust strains in the future.

We all agree that shrimp aquaculture has not entered the recovery phase and it takes the industry to admit we have a serious issue before it can be motivated into action. TARS has united industry stakeholders as one voice and it is hoped that we will pursue the next course of action, sooner than later.

Zuridah Merican

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Optimise opportunities

Reflections on the success in 2013 with vannamei shrimp production and embarking on exports while building on the domestic market.

At the pre opening press conference, Asis G Perez, Bureau of Fisheries and Aquatic Resources (BFAR) director (right) and Raoul Flores, congress chairman. Perez also opened the congress and exhibition. His message to producers was 'to take the opportunity to further enhance output, increase domestic consumption and explore export markets.'

The Philippines produced more *Penaeus vannamei* in 2013 than in previous years. Prior to the opening of the 9th National Shrimp Congress, held in Bacolod City from 2-4 July, Asis G Perez, Bureau of Fisheries and Aquatic Resources (BFAR) director said, "This shrimp has taken over ponds previously monopolised by monodon shrimp. Back in 2011, our sugpo or *Penaeus monodon* was the major species and today, it is the vannamei shrimp. Is this good? Yes, as we can bring the shrimp industry back on its feet after years of low production. But we have many challenges and need to optimise on opportunities. It will continue to grow but we need to ensure that this growth is sustainable."

Perez added that 2013 was a good year for exports too. The PHP 10-billion (USD 23 million) shrimp industry had an export boom in 2013 with almost 20,000 tonnes exported to Japan, China, United States and Europe. The yearly increase in production is expected at 25%. He gave an estimation of total shrimp production of 50,000 tonnes in 2012 and 60,000 tonnes in 2013. These figures differed from annual production statistics published by the Bureau of Agricultural Statistics (BAS) which showed that monodon shrimp production reached 49,466 tonnes and white shrimp at only 1,871 tonnes. Perez acknowledged the disconnect between these official statistics and actual production, and this discrepancy needs to be looked into.

The biennial congress and trade show is organised by the Philippine Shrimp Industry Inc. (PhilShrimp), an 18-year organisation for industry stakeholders from all over the archipelago. The headquarters is in Bacolod, Negros Occidental, once the leading producer of monodon shrimp in the country. The group is led by President Roberto A Gatuslao and directors represent stakeholders in the major producing areas of Luzon, Visayas and Mindanao. The allied sectors are hatcheries, exporters and feedmillers. PhilShrimp leads in public private partnership (PPP) and regular consultations with government updates the public-sector on industry needs and progress.

During the congress, industry leaders and stakeholders, comprising producers, technicians, production assistants and farm operators gather together with academics, researchers and government officials to reflect on the two-year progress of their industry. In the years before the 8th congress in 2012, it was a learning process on culture technology and marketing of the vannamei shrimp, officially allowed into the Philippines in 2007. At this year's congress, stakeholders agree that as both vannamei and monodon shrimp farming are progressing well, Philippines producers should take the opportunity to further enhance output, increase domestic consumption and explore export markets.

Aptly, the theme of this 2014 congress was 'Production, Health and Marketing of the Philippine Shrimp'. The program had 18 presentations and covered some key aspects, technology updates, environment and health management. Gatuslao envisaged that similar to past meetings, this congress will generate the spirit of partnership and optimism among industry sectors as they revitalise the industry together and work to be competitive globally.

Defense against EMS

Fortunately, there are no reports of early mortality syndrome (EMS) but the industry is wary. "In 2012, BFAR reacted within two weeks of a proposal by PhilShrimp to ban imports of live shrimp from EMS affected countries. They extended this to include other crustaceans. The ban was commended by FAO as a proactive measure. Nevertheless, we do not want to have knee jerk reactions with any disease situation. We have enhanced our disease diagnostic capabilities with eight personnel attending training in the Aquatic Pathology Laboratory in the University of Arizona, USA. We have invested in equipment and in building up a cadre of 20 professionals for structured program in shrimp health management. We see diseases as the biggest threat to our industry," said Perez.

BFAR has shrimp disease diagnostic laboratories in each of the 13 regions. In addition there is a central fish health management and quality assurance laboratory, a regional fish health laboratory and the Negros Prawn Producers Cooperative (NPPC) laboratory. Raoul Flores, congress chairman said that with BFAR's assistance, the NPPC now has the most well-equipped laboratory for shrimp disease diagnosis in Negros in Western Visayas. PPP consultations are regular for the

From left, Dr Juan D Albaladejo, Dr Chalor Limsuwan, Kasetsart University, Thailand, Leo Cabassay, Blue Archipelago, Malaysia and Cyrus Regalado, Philippines. Limsuwan, a leader in the shrimp farming industry of Thailand, presented an update on shrimp aquaculture in Thailand, China and South America and covered guidelines on how to prevent EMS, based on his observations and experiences.

government to understand industry needs. White spot syndrome –WSSV is still a threat and on average one out of 4 ponds may be affected.

BFAR released a recognition card on EMS which was conceptualised by Dr Juan Albaladejo and Maria Abegial A Albaladejo for the event. To update industry on the disease situation in Asia and Mexico, in the case of EMS, there was a session on health management. Speakers included Dr Tim Flegel, Centex Shrimp, Mahidol University and Su Chen, Genereach Biotechnology who focused on the latest development in the detection of the bacteria causing EMS. Dr Loc Tran, Vietnam also discussed the EMS situation in affected countries including Mexico, EMS in India and risk management for EMS. Dr Olivier Decamp, Inve Aquaculture looked at ways to manage EMS with probiotics.

Domestic consumption of shrimp

Perez said that after serving the domestic markets, the next step for the shrimp industry is to export.

"We want to export but also want shrimp to be a commodity for the people first. The draft road map for the industry will see production targets from the current 60,000 tonnes to 130,000 tonnes. We already consume 20 kg/capita/year of seafood."

Flores said, "The vannamei shrimp has changed the affordability of shrimp for the masses. It is a lot cheaper to farm the vannamei shrimp. Cost of production is not more than PHP140/kg (USD 3.2/kg) for size 100/kg (12 -16 g shrimp) as reported by farms around General Santos in Mindanao. They sell at PHP180/kg (USD 4.1/kg) and retailers can sell at PHP 200/kg (USD 4.6/kg). Imagine that with the monodon shrimp, it retails at no less than PHP 450/kg (USD 11/kg)."

With the annual return of overseas foreign workers (OFW), the demand for shrimp was highest from December 2013 to March 2014. During this time shrimp prices rose to PHP 210/kg (USD 4.2/kg) and volumes rose to 10 tonnes/day in comparison to only 3-4 tonnes/day during off peak periods. "Prices drop to PHP 150-170/kg (USD 3.4-3.9/kg) after March 2014," said Amelyn Bravo, a shrimp farmer and buyer in Negros Occidental. May and June are the lean months for sales.

According to Gina Regalado, INTAQ Foods Inc, the demand from local markets is expanding. Aside from the repatriation of incomes (comprising 12% of GDP) from Filipinos working overseas, there is the developing call centre industry. The latter is building up a group of yuppies with high incomes. Today, imports fulfil the demand from fast food outlets for prepared and frozen shrimp which can be supplied by local processors.

A good 2013

Production is not only moving upwards but there is also consolidation in the hatchery and grow-out sectors. There are 11 hatcheries registered to import SPF vannamei broodstock for maturation and post larvae production. Current post larvae (PL) production capacity is 200 million/month whereas current demand is estimated at 120 million/month. There are 13 accredited *P. monodon* hatcheries. Based on PL sales, the estimation of vannamei shrimp production could be 40,000 tonnes in 2013. The turnover for most hatcheries is now higher as farmers complete the cycle within 75 days for extensive farms and 90 days for intensive farms for the production of size 70/kg shrimp.

Stocking is seasonal in areas such as Negros but is all year round in some other areas. Post larvae supply also comes from unregistered hatcheries and are sold at 8 centavos each (USD 1.8/1,000 PL) in comparison to average prices of PHP 25/PL (USD 5.68/1,000 PL) from registered hatcheries.

In the case of the vannamei shrimp, stocking density ranges from 80-120 PL/m^2 in farms around General Santos. Around Bacolod in Negros Occidental, farms stock at only 80 PL/m^2. More cautious farmers stock at only 40 PL/m^2.There are reports on innovative culture technology such as those using bioflocs and stocking 1,000 PL/m^2. Monodon shrimp farms such as those in Zamboanga, Mindanao use traditional systems with stocking density from 5 to 10 PL/m^2 whereas an intensive farm in Cebu stocks at 20PL/m^2.

Cost of production for vannamei shrimp ranges from PHP130 to 150/kg (USD 2.9-USD 3.4/kg) with 70% survival and stocking density of 80 PL/m^2. Harvests are partial starting with 12-14 g shrimp. Producers said that the major challenge to costs of production are energy costs at 30% and transportation and feed costs which are among the highest in Asia.

The top producers are now in General Santos, Batangas in Luzon and in the Visayas such as in Cebu, Bohol and Negros Occidental. In North Luzon, from Pampangan, Bulacan to Pangasinan, vannamei is farmed using extensive systems. Charoen Pokphand Philippines is the major feedmill integrating with hatcheries and farms. It is developing 100 ha of shrimp ponds in Davao in Mindanao. Few shrimp farming groups are fully integrated. In Bohol, Marcela Farms has hatchery, 200 ha of farming area for grow-out, processing and a feedmill. Annual production is 1,000 tonnes of vannamei shrimp. Stocking density is 60-80 PL/m^2. Marcela Farms also produces SPF black tiger post larvae from Moana broodstock.

In a presentation on the '7Ps for better productivity', young and enterprising farmer Constantine Tanchan gave an account of his experiences with culture management of vannamei shrimp. Tanchan manages farms in Pinamungajan and Asturias in Cebu, and San Carlos City, Negros Occidental and produces 100 tonnes/month. In 2013, he expanded his shrimp farming business by taking over abandoned farms and shifted to vannamei shrimp farming. Tanchan recommended stocking at 80 PL/m^2 instead of 100 PL/m^2. In the farm in San Carlos, shrimp growth at 40 DOC was 20% higher in 11 ponds stocked at 80 PL/m^2 (7.62 g) in comparison with the average size of 6.40 g in 6 ponds stocked with 100 PL/m^2.

Tanchan explained to the audience his 7Ps for success. The first is pond preparation with sun drying, removal of sludge, ploughing and liming at 10-15 tonnes/ha as critical steps. Sun drying improves the redox potential of soil whereas with HDPE liner, it is neutral. According to Tanchan, focus should be on two practices; fry quality and feed management. Fry should be from reputable hatcheries. He said, "The best time to predict the outcome of a crop will be three weeks after stocking."

On feed management practices, Tanchan uses Charoen Pokphand (CP) feeds and only uses the guide for blind feeding for the first 30

From left, Roselyn Usero who heads the NPPC laboratory, Dr Juan D Albaladejo, Dr Loc Tran, Dr Tim Flegel and Maria Abegail A Albaladejo.

days and until shrimp start to consume feed from the feeding tray. Henceforth monitoring feed consumption in feeding tray is crucial. The FCR range in his ponds is 1.3 to 1.4. Tanchan said, "It is always better to underfeed than to overfeed. Even if shrimp are aggressive feeders, do not exceed 125% of computed feed rates."

The other Ps are water quality parameters, biosecurity practices, paddlewheel positioning and personal and intimate relationship with God. At his farms, he maintains dissolved oxygen over 3 ppm with additions of 2 paddlewheels, salinity 10-15 ppt, pH not less than 7.5, ammonia below 4 ppm, luminous bacteria not more than 25 CFU/ml and alkalinity of over 125 mg/ml. On biosecurity, Tanchan warns that buyers are the unwitting vectors of WSSV and other diseases.

Related article: Marketing Philippine vannamei shrimp, p48-49.

Public comment period opens for draft Shrimp Standard for the ASEAN region

The first draft Shrimp Standard for the Association of Southeast Asian Nations (ASEAN) region is now available for public comment through October 10, 2014.

Intensive farm in Indonesia (picture provided by Poh Yong Tong, Indonesia)

A steering committee of 14 industry and non- government stakeholders designed the draft standard to be a workable tool for the shrimp industry in ASEAN. The aim is to improve the sustainability, environmental and social performance of farming, especially at the small scale, and receive recognition in key export markets.

The steering committee welcomes comments on the draft standard from farmers, experts and other stakeholders engaged in the shrimp aquaculture industry. The draft standard complements existing national good aquaculture practices and aims to align with internationally accepted environmental and social standards, including the Monterey Bay Aquarium's Seafood Watch® Program sustainability assessment criteria and the Aquaculture Stewardship Council standards.

With the formation of an ASEAN Economic Community in 2015, the region will become one of the 10 largest global economies and a major player in the global seafood industry. The creation of a single market will present an opportunity for the industry and other interested stakeholders to work collaboratively across the ASEAN region to improve sustainability of shrimp farming and promote responsible aquaculture practices in a way that continues to support food security and safeguards the livelihoods of small scale shrimp farmers.

The public comment process is open to all individuals, organisations and entities interested in providing inputs and feedback on the draft standard. This is in line with international guidelines for creating environmental and social standards defined by the ISEAL Alliance. The steering committee will use this feedback to revise the draft standard that will be piloted or field tested with farmers in several ASEAN countries. The steering committee plans to finalise the Shrimp Standard for the ASEAN Region by early 2015.

A summary of the draft Shrimp Standard is given on page 45. Full details and the template for inputs is available at this site: https://www.dropbox.com/sh/l7xiy6swfinw4aa/AADYivk6Fntfu6iCOJx8Zneza Download (i) Public Comment Feedback Form and (ii) the Draft Shrimp Standard for ASEAN. The draft is available in the Indonesian, Thai and Vietnamese languages. Please send all comments no later than October 10, 2014 to shrimp.steeringcommittee@gmail.com

The steering committee comprised the following; FAIRAGRO (Thailand); Indonesian Fishery Product Processing & Marketing Association (Indonesia); International Collaborating Center for Aquaculture & Fisheries Sustainability (Vietnam); Kasetsart University (Thailand); Network of Aquaculture Centers Asia Pacific (Regional); Tambuyog Development Center (Philippines); Socsksargen Federation of Fishing & Allied Industries (Philippines); Surya University (Indonesia); Thai Union Frozen Products (Thailand); Thai Farmers Council (Thailand); Vietnam Association of Seafood Exporters & Producers (Vietnam); Wetlands International (Indonesia); Monterey Bay Aquarium Seafood Watch® (USA); Chicken of the Sea (USA)

The development of the Shrimp Standard for the ASEAN region is being carried out with the support of the United States Agency for International Development (USAID). The views expressed in this document do not necessarily reflect the views of USAID or the United States Government.

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A renaissance in Malaysia

By Zuridah Merican and Karunanithi

Managing risks and working within the carrying capacity are the hallmarks of this sustainable shrimp farming business

The Jenang Felcra shrimp farm in Terengganu state, Peninsular Malaysia has the right attributes for biosecure shrimp farming. It is situated in an ideal location, secluded from other aquaculture activities. Left abandoned since 2008, there were initial worries on whether the farm is suitable for vannamei shrimp culture. This is now proven with high survival rates and stable harvests since 2012. The success is also the result of a slow and steady approach by farm manager Muhsin Yusoff and his team. The team has strived to overcome the risks in shrimp farming, paying special attention to improving the water quality and other environmental factors.

The 10-year old farm with 31 ponds in Kampung Jenang, Marang District has had a chequered history. In 2004 to 2008, under the umbrella of the Felcra Agro Industries Sdn Bhd of the Federal Land Consolidated Rehabilitation Authority (FELCRA Berhad), the farm complex comprising three blocks; 5 ponds with a water area of 2.84 ha and 1.17 ha reservoir in block A, 17 ponds (11.16 ha) in block B and 9 ponds (5.89 ha) in block C sharing a 3.7 ha reservoir pond was operating well.

In 2008, the removal of the government subsidy for diesel drove up operational costs. The corporate decision was to stop operations as the farm did not have access to electricity from the national grid. In 2010, the new management team decided to re-enter the shrimp farming industry. Staff was recruited in 2011, and operations began in 2012. With a supply of electricity in April 2012, production is now in full swing with 2 production cycles/year.

The first activity of the team comprising four Malaysian farm staff and four Indonesian general workers was to renovate the ponds. Block B with 17 ponds is now into its third successful year. For the first cycle in 2014, stocking was in February and harvesting started from May 27 and will continue until July 20, ready for the peak demand at the end of Ramadhan. The next cycle will start on 24 August, after a month of pond preparation. The farm closes for three months, from November to February.

On track with targets

In setting the annual budget for 2014, Muhsin uses a conservative average yield of 4.5 tonnes/pond/crop (7 tonnes/ha/crop) where pond sizes average 0.64 ha. In the last cycle in 2013, the total harvest was 55 tonnes from 13 ponds. The average yield was 6.26 tonnes/ha.

"Our target is 280 tonnes from the 31 ponds in 2014. The target for the first cycle in 2014 is 100 tonnes and we are on track in achieving this and so far we have harvested 19 tonnes from 4 ponds. This is 19% of the target and we still have 27 ponds to harvest. In the second cycle, I am targeting 180 tonnes. We are beginning to understand the productivity from each pond as we rejuvenate the ponds slowly. I have been keeping to a stocking density of 80 post larvae (PL)/m^2. In some ponds where we are not sure of pond conditions, we stock only 40 PL/m^2. We will increase stocking density as we understand better soil and water conditions in each pond. For me, being profitable is through a steady production modelling.

Muhsin added, "Yearly, my team and I are making progress in improving production. In 2013, the largest size was 12 g shrimp (size >80/kg) and the first partial harvest was 9 g shrimp (size >100/kg).

Ponds are 1.5m deep and the dykes lined with barriers (improvised with HDPE liner material) and overhead bird scare lines.

But this year, survival is higher and shrimp larger. This partial harvest (on 27 May) was shrimp of size 52/kg after 90 days of culture (DOC) and the offer price from a local broker was MYR 23/kg (USD 7.1/kg). With higher prices, we will work towards producing larger sizes. Our cost of production is also improving. In 2012, we started at MYR 12/kg but now our costs is not more than MYR 11/kg for size 15g at a survival rate of 70%.

Managing risks at the farm

Malaysia has had its share of failures and successes in shrimp farming, giving the industry a reputation as a risky business. In the 1980s, several large corporations diversified into shrimp farming, expecting quick returns. When profits fell short, the knee jerk reaction was to quit immediately. However, there are successful ventures particularly among smaller and mainly owner- operated business.

After spending a large part of his working life in shrimp farming, Muhsin is aware of this history and has worked this risk into his farming practice. He started his career in 1995 with the Lion Group in Pahang state in Peninsular Malaysia, where he helped to run a large 100-ha farm. The farm was subsequently bought over and successfully continued the farming of black tiger shrimp until 2000. In 1999, he joined the Song Cheng farm, the precursor to the Agrobest farm, one of the larger and successfully run farms in Malaysia. A 4-year tenure in the aqua business of palm oil conglomerate Golden Hope, taught him how company financiers perceive risks associated with the shrimp farming business versus that of livestock production. Now returning to shrimp farming since 2011, Muhsin's aim is demonstrate how shrimp farming can achieve economic sustainability.

The first message is knowing your environment. "We have had the experience with early mortality syndrome (EMS). We have learnt to manage and prevent its spread. I believe that EMS occurs when we go beyond pond carrying capacity and stressed shrimp with high stocking density, poor aeration and bad feed management. Paramount to any success in shrimp farming are the basic requirements and optimal

Packing of size 52/kg after 90 days of culture

conditions; selection of quality post larvae, knowing pond conditions at each site and good team work."

Managing risks starts with good standard operating procedures and biosecurity. In addition, at this farm Muhsin is unyielding on two critical practices - a pond preparation step for at least one month and developing specific protocols depending on pond conditions.

Biosecurity

In farm A and B, all ponds have been fitted with barriers using high density polyethylene (HDPE) liner material against terrestrial disease carriers, and above ponds bird scare lines are fitted to frighten away birds. Ponds in block C will also have the same structures once the budget is obtained. Water is filtered using 40 micron filters and is pumped using 10 pumps, each of 8 inch (20cm) diameter. The advantage with this reservoir is that it can be dried out as it sits on higher ground and 80% of water can flow into ponds via gravity.

Currently, the farm has an open canal supplying the ponds. The next project will be to channel water using large pipes. A closed delivery system is an added biosecurity measure. Muhsin's strategy to further improve biosecurity is to have a packing station outside the pond area to limit movement of vehicles to those belonging to the farm only. He would also like to have a small reservoir for 4-5 ponds which he could keep covered and maintain water salinity at 20 ppt. The farm practices a zero exchange culture system. Workers led by 3 pond managers carry out all activities in the three blocks. The harvesting is by an in-house team for biosecurity reasons.

Water management

"The salinity of the water in the Marang River can range from zero during the rainy season to 20 ppt. Although ponds in blocks A and B are not affected by floods, water salinity during the rainy season will be too low for a successful crop. We will only pump water into ponds at salinity range of 10-20 ppt. This is to avoid the use of magnesium chloride and calcium chloride when salinity is too low," said Muhsin.

"We have seen shrimp with white muscle disease because of low potassium and soft shell disease because of low magnesium in the pond water. With daily moulting, it is essential to know when to add soil minerals. I have tried one crop starting with 5 ppt water but the costs of adding minerals as well as the anxiety on its success was too high. All in, the extra cost was MYR 2/kg. I have also learnt the importance of adding microminerals and not just calcium and magnesium. We choose to focus on doing the best with our 8 months culture cycle and staff take their holidays during the off season."

Feeding using a blower

One cycle at a time

"There is no compromise on pond preparation and shortcuts either," said Muhsin. The standard procedure can take up to 30 days depending on weather conditions.

"For me each crop has its own individual characteristics and I would like to allow the pond to fallow after every cycle. A continuous cycle system is too stressful and gives me butterflies in the stomach"

Muhsin is open to sharing the protocols at the farm. "It is critical to plough 50% of the pond bottom, covering the sludge area and margins. Sometimes, high pressure jets are also used. Next is the addition of dolomite, mineral products and 300g/0.5ha of Pondzyme (Biomin, Austria). Subsequent ploughing is recommended too after the addition of minerals and liming to ensure that the pond nutrients are released completely. The protocol for adding disinfectant is 3 days after water filling as fish eggs hatch within this time. Pondzyme is again added 3 days prior to stocking of post larvae and weekly until harvest. In some ponds, I add an artificial colourant at 2-3 kg per pond before stocking."

Culture and branding

Some of the newer ponds are being rehabilitated and these eight ponds are stocked only with 40 PL/m^2. This is a precaution as the ponds have been left abandoned and the area is high in ferrous sulphate. The farm uses up to 40 million PL10 per year, supplied by a nearby hatchery and the usual practice is for hatcheries to provide test results from their in-house laboratory tests. After using post larvae from various hatcheries, Muhsin is very pleased with the consistently good performance of the post larvae from the current supplier. However, in future, as a safe guard, he will carry out tests on some random samples at a private laboratory.

"During grow-out, a challenge at the farm is how to reduce pH fluctuations which can range from 8.1 to 7.5. A fluctuation range of 0.5 to 0.7 is achievable but the farm is working at reducing this to 0.3. We judge how well our shrimp is doing by checking shrimp at 7-10 days after stocking. Our first sampling is at 37 days. We can also check on the biomass based on the daily feed intake."

The team has learnt to modify the blind feeding schedule provided by the feed company. Through trial and error, the team cuts back on the recommended feeding amount or uses the rate recommended for shrimp at an earlier growth phase. In general, they have reduced the total feeding (of 4 meals) to 70-80% of the daily recommended amount and by day 30, the total amount was reduced to 230 kg which was 76% of the amount recommended.

At the farm, the team works on the principle of regular partial harvesting, once the carrying capacity reaches 4 tonnes/pond. In one pond stocked at 80 PL/m^2, they have carried out three partial harvests; the first at DOC 70 when shrimp reached size 90/kg; the second at DOC 80 with harvest size 70/kg and the third was DOC 90 with size 52/kg. Small volumes of the harvests are sold on cash basis directly to local retailers and large volumes to brokers supplying restaurants and hypermarkets in the east coast. "Keeping to a select group of credit worthy brokers makes good business sense and reduces risks through bad debts," said Muhsin.

"We have been told that the local retailers proudly publicise our shrimp as Jenang shrimp. This sets us apart from imported and shrimp from other farms."

Sustainable role model

As part of a large group, the Jenang farm must not only meet set targets but show continuous profitability and high margins, in view of adverse perceptions (by financiers) that shrimp farming bears high risks of failure. Country-wise, a stable production is an example of a sustainable shrimp farming business.

Although the good performance in 2013 has led to more funding to open up more ponds, the farm does need some modifications to improve its biosecurity. A plan is to have an effluent treatment system prior to release into the environment and a protocol to lock down sections of ponds in cases of diseases.

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Muhsin Yusoff and his harvest of size 52/kg shrimp

In 2015, the projection is to increase total production to 300 tonnes. This means that for some newer ponds where stocking density is only at 40 PL/m^2, Muhsin will work towards increasing stocking density. At the same time, the team will be working towards the reduction of production costs. The expansion plans for 2016 include the development of a new area for reservoir and culture ponds.

"Costs of items such as electricity, labour, feeds and chemicals have been increasing. Feed conversion ratio (FCR) is already low at 1.2. When we gradually increase stocking density and harvest to sizes 60/kg, we need to increase aeration in the ponds. We cannot reduce labour costs and chemicals as these are critical items, but we can seek ways to reduce costs of probiotics and energy, now at 10.8% and 12.5%, respectively. Energy efficient aeration devices will help with the latter.

Sampling shrimp

"In 5 years, we would like to be known as a stable producer of quality shrimp. We will share our success with others in the industry. I look forward to FELCRA's CSR (corporate social responsibility) program where we will train the future generation in the science of shrimp farming, which is sustainable, measurable and accountable," said Muhsin.

Karunanithi is director Aquaculture business development, Yogaa Bio Shrimp, Malaysia. He has 28 years of experience in farming and technical support for farmers in Malaysia. Email: karusara@hotmail.com

FELCRA's shrimp aquaculture business

In 1966, the Federal Land Consolidation and Rehabilitation Authority or FELCRA was established with the mandate of developing and rehabilitating marginal lands for economic activity. The profits it makes from these economic activities are then distributed to rural communities as dividends. It receives grants from the federal government for its activities. FELCRA was corporatised in 1997 which allows it to explore new business opportunities.

FELCRA Berhad's core activity is in the plantation sector, mainly in oil palm and rubber. The diversification into livestock and aquaculture is a new challenge. FELCRA Berhad has three shrimp projects under its agriculture portfolio; one farm in Kampung Jenang is under its direct control, while two other projects are leased out to private companies.

CEO Dato' Ramlee Abu Bakar, an accountant said, "We are very familiar with the plantation sector, on how the revenue is generated to meet our mandate and the price movements of the commodities. This has been our forte. Our profit sharing structure is 60% to the community, 20% to FELCRA, and 20% for working capital. Unlike other enterprises, we have an additional responsibility of generating dividends which are as high as possible for our communities.

"The aquaculture business is unique for us. As I see it, shrimp farming business is not just to complement our income from the plantation sector but also is an opportunity to diversify our business. However, it is a challenging business and it needs to show a high rate of return on investments before we will expand our activities in this area. Jenang will be the model for our business in aquaculture. Once this is fully commercialised and able to generate income, we can then look further into aquaculture as an alternative business for income generation.

"Although, the farm in Jenang is expected to generate MYR 1.2 million in profits in 2013, the rehabilitation of the ponds took time and electricity supply to the farm was only available in 2012. In 2014, we are looking forward to 30 ponds operational with two cycles."

During a management and board visit to the farm. From right, Dato' Hj Ramlee Abu Bakar, Hj Abdul Mutalib Tais, general manager, FELCRA Eastern region, Datuk Bung Moktar Radin, chairman and Abdul Manaf Mahamod, assistant executive, Kg Jenang Estate.

Back to basics: shrimp culture at its best

By Erin Tan

By doing this, some farms in Malaysia continue to prosper despite the prevalence of EMS in the country.

The early mortality syndrome (EMS) or acute hepatopancreatic disease (AHPND) continues to affect shrimp ponds in Malaysia since the last quarter of 2010. Production of the vannamei shrimp *Penaeus vannamei* dropped from 69,084 tonnes in 2010 to 60,322 tonnes in 2011. In 2012, vannamei shrimp production was 48,992 tonnes (Department of Fisheries (DOF), Malaysia, 2014). Unofficial data for 2013 showed that vannamei shrimp production increased to 52,638 tonnes. *P. monodon* production, on the other hand has been dropping from 18,189 tonnes in 2010 to 7,150 tonnes in 2011 and then to 6,577 tonnes in 2012. The estimate was 4,315 tonnes in 2013 (DOF). In the case of production in 2014, we are optimistic that production for both species will improve.

Initially the good days

It has been a long and hard road for Malaysian shrimp farmers as well as the supporting industry. These past 4 years have taught us several lessons: shrimp farming is not easy, and it requires careful planning, persistence and foresight. In the golden years prior to 2010, many farmers were blessed with good farming conditions, a new strain of vannamei shrimp that grew fast and gave a fantastic return on investment.

Farmers could harvest size 70/kg (14 g) shrimp within 60-70 days of culture (DOC). However with consistent yields, many farmers grew complacent. Some farmers decided that they could continue (or have more crops) into the next stocking without cleaning ponds after each cycle. Some farmers believed that the more feed they provide, the faster shrimp will grow. They were unaware of the negative effects of overfeeding which far outweigh the benefits of 'fast growth'. Other factors such as water quality and pond carrying capacity were overlooked. Many farmers relinquished the basics of good shrimp farming and this came with costs, leading to disease problems, lower productivity and loss of income.

As scientists worked at identifying and developing solutions to a seemingly plethora of causative agents of EMS, shrimp farmers struggle to sustain production. Many small and medium farms (10-50 ponds) have had to cease operations or at least break cycle for a year or more. The larger farms have been able to withstand a certain amount of losses. However, gradually more of the large farms (200 ponds and above) are also struggling for at least 2 years. Nevertheless, there is still production as can be seen by figures published by DOF. These are the result of several factors. One of them is the perseverance of small farms or really well managed farms where the owners or farm supervisors closely oversees farms with 5-6 ponds. The second factor is due to the dramatic increase in prices because of low supply such as during the last quarter of 2013 and January 2014. The vannamei shrimp price for size 70/kg reached a record high of RM 28/kg (USD 8.8/kg). This was a three-fold increase from ex farm prices of about RM 9.5 (USD 3/kg) in 2010. This encouraged many new investors to start shrimp farming. Farmers were also able to sell their harvest as early as 30-45 days, harvesting size 250/kg. With lower costs of production, this was still profitable with average prices of around RM 6/kg (USD 1.89/kg).

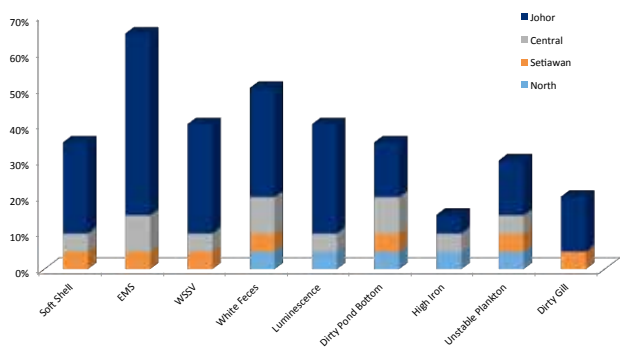
Is it EMS?

In a presentation at the Malaysian Fisheries Society seminar in April 2014, Dr Kua Beng Chu, Fisheries Research Institute (FRI), DOF reported that out of 12 samples submitted for testing, up to 50% of AHPND cases were misdiagnosed in 2011, and in 2012, only 26% of the total cases (5 out of 14 cases) submitted to the FRI were positively identified as AHPND. In 2013, up to 73% of cases (19 out of 26 samples tested) were positively identified as AHPND (Kua, pers. comm). We are not saying that AHPND/EMS is not a threat to shrimp culture, but what we would like to emphasise is that in cases where the symptoms were not positive for EMS, mortalities should be analysed carefully to determine the actual cause of mortality. Often we have farmers who complained that their shrimp were dying at DOC 55 or at DOC 65, but when samples were analysed they were negative for *Vibrio parahaemolyticus*, the bacteria causing EMS (Loc Tran et al, 2013).

In our opinion, EMS is a scapegoat for many shrimp mortality cases. Workers and supervisors have taken the easy way out and attributed mortalities to EMS. In this way, they escape blame when mortality is actually due to other reasons like poor management and bad water quality leading to stress and diseases (white faeces, white spot syndrome -WSSV and infectious myonecrosis –IMNV). We should not forget that there are plenty of other opportunistic pathogens in nature.

In a small survey done in Malaysia in April 2014 by Syndel Asia Sdn Bhd comprising 19 farms, farmers reported problems with other diseases (Figure 1). More than 30% of farmers complained of soft shell, WSSV, white faeces disease, *Vibrio* (non EMS) infection, and dirty pond bottoms. Other problems include unstable plankton bloom (28%) and dirty gills (18%). These are common issues and have been prevalent for many years. Most of these are controllable; there are solutions and can be dealt with effectively. Farmers need to be more aware that the mortalities that occur later on (past DOC 30), might not be EMS and should take precautions against these diseases or problems.

Figure 1. Diseases reported by farmers in Peninsular Malaysia



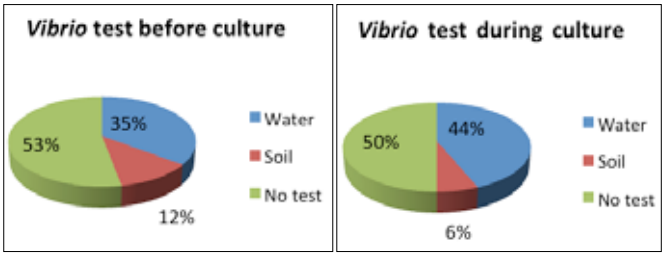


Figure 3. Percentage of farmers conducting tests for *Vibrio* bacteria

In the early days of EMS outbreaks in Malaysia, farmers tried everything they could think of to overcome this new disease. They went from heavy dependence on chemicals to disinfect ponds as well as water, to not using any products at all before and during the culture cycle. Sometimes, these strategies worked and at other times, it did not. There was absolutely no clear trend.

Many farmers used chlorine and other harsh chemicals to 'kill everything' in the pond and in the water. However of concern here is the required dosage of chlorine in the pond to effectively disinfect the water. Chlorine is easily oxidised by organic materials, ammonia and nitrites in the pond. When applying an effective dose, the amount of free chlorine residuals must be in the range of 1-3 mg/l (Boyd, 2008). The dosage also depends on the pH of the water; a low pH of 2-6 is most effective for disinfection, but at pH of 7.5 and above (which is the general pH of seawater during pond preparation), the disinfectant qualities of chlorine is reduced. Therefore the actual amount of chlorine that has to be applied in a pond is quite high, at around 20-30 mg/l (or ppm) of the 65% calcium hypochlorite that is commonly used by farmers (Boyd, 2008). From our observations, farmers in Malaysia apply about 6-8 ppm of calcium hypochlorite which is just enough to kill the plankton, but not actually disinfect the pond of unwanted pathogens. At the correct dosage, cost becomes a factor. In the long term green water is difficult to obtain, pond water colour is unstable, water quality parameters fluctuate and this in turn causes stress to shrimp.

Other farmers took the opposite route, they did not use any pond products other than the normal lime and feed. Sometimes, they would be successful. However, as we know now, the disease is caused by *V. parahaemolyticus* which probably originated from infected post larvae, but the bacteria have now infested the pond environment. Nine times out of ten the farmers were not successful in controlling the disease. This paints a very dismal picture for the future of the shrimp culture industry.

However there are farmers who could consistently continue to culture with successful harvests. How do they do this?

Back to basics

We find that the majority of these farmers have gone back to the basics of shrimp culture. They are content with harvest size 100/kg after more than 100 days and to harvest 4-6 tonnes of shrimp per 0.5 ha pond (8 tonnes/ha). They observe good pond preparation where after each cycle, the ponds are cleaned, allowed to fallow for 4-6 weeks. No harsh chemicals are used during any part of the culture cycle, feed management is strictly controlled, and post larvae quality is well scrutinised. They do not rush the cleaning and fallowing process and lastly, they only culture one to two crops a year.

If there was a disease outbreak in the pond, for the next cycle, the soil and water will be thoroughly disinfected and soil bacteria used to help clean and break down any organic material that could be harbouring pathogens. For the most part, stocking density is reduced to 80 PL/m^2 for vannamei shrimp (In Sabah, however, many farmers still practise high stocking densities- averaging about 150 PL/m^2). Most importantly, they maintain good water conditions throughout the culture. In the same survey of farmers in April, we found that the farmers were maintaining pond conditions through application of pond bacteria (65% of farms were using Pond Plus and Pond Dtox) and the judicious use of potassium monopersulphate disinfectant (40% of farms were using Remedor Aquatic) which is safe to be used in the pond during culture. They were also adding mineral supplements (30% of farms), vitamins (5% of farms were using Baysan and other multivitamins and multiminerals) and yeast cell extracts (30% of farms were using Aquate Defender) as a top dressing to the feed to improve the shrimp health. Last but not least, about 54% of farmers used crusticides (Neguvon) to ensure that virus carriers were eliminated before stocking the pond (Figure 2).

Coupled with this is to ensure that all water quality parameters are checked and optimal conditions maintained regularly. In this way, if there is a problem it will be quickly noticed and rectified. We also recommend that farmers check *Vibrio* levels in the pond, soil and water, before and during the culture to make sure that the levels of *Vibrio* are within safe levels. In our survey, we found that up to

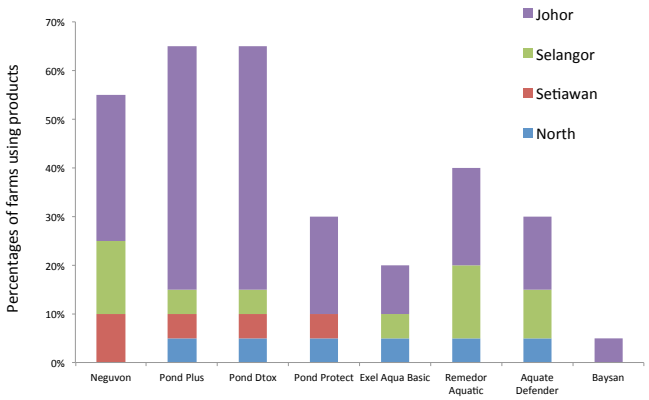


Figure 2. Products used in different areas

53% of farmers were not testing for *Vibrio* in the water or soil before and during the culture (Figure 3). Using TCBS agar plates which are selective for *Vibrio* bacteria, is a fairly simple method to detect levels of pathogenic *Vibrio* (green colonies) versus other species of *Vibrio* (yellow colonies, not as pathogenic as green colony forming ones). Ideally, the number of green colonies should be less than 10^5 CFU/ml of the total bacterial count on the plate. This means if total CFU/ml is 1 x 10^7, then the numbers of green bacterial colonies should be less than or equal to 1 x 10^2 CFU/ml.

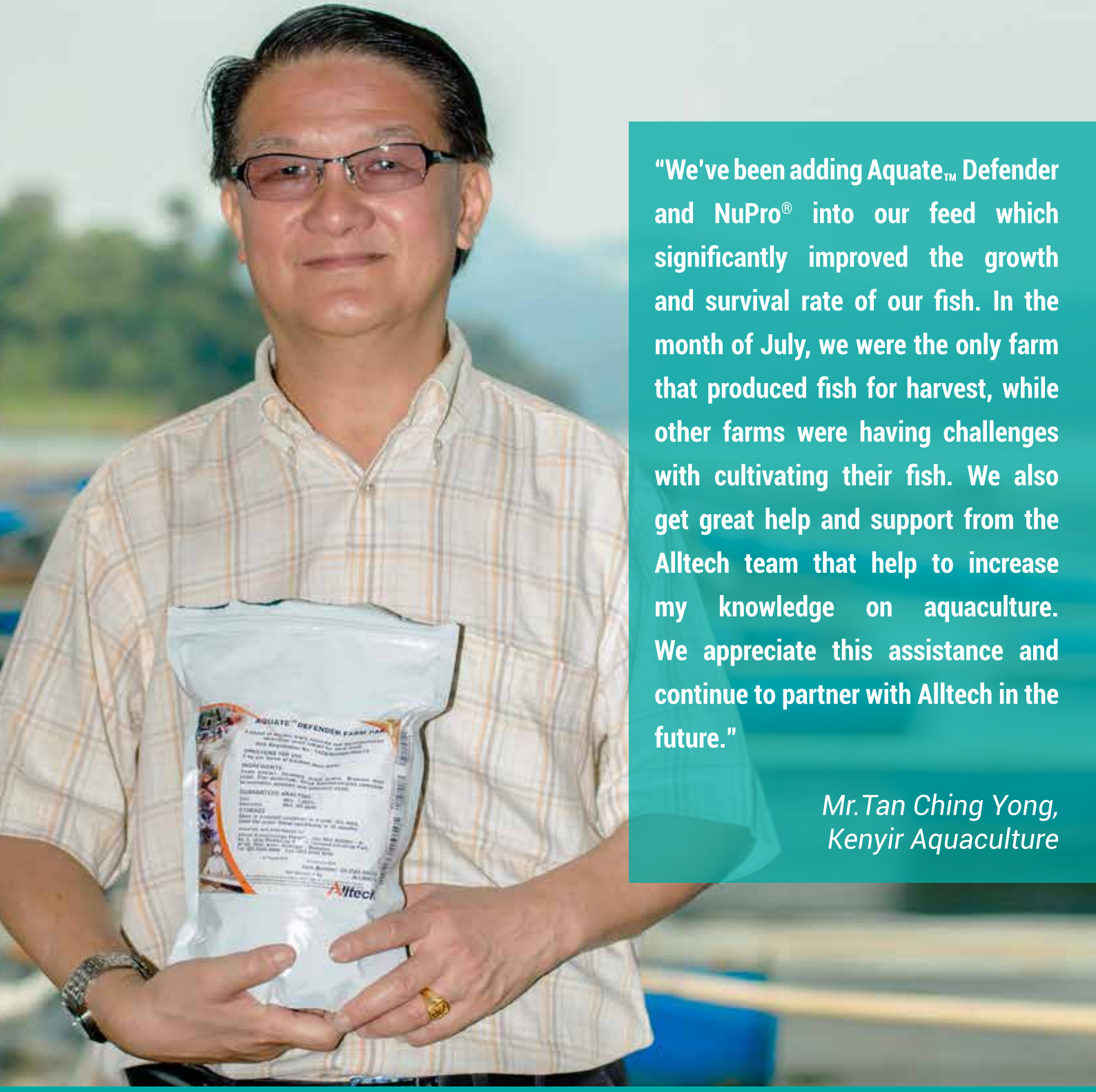
Another factor that we have noticed which favoured these successful farmers is the isolated location of their farms. For example, there are farmers who are located in Johor, Sabah and Penang who are doing well. Their farms are not totally free of EMS but they have been able to control shrimp mortalities and do not have successive crop failures. Although, we understand that having farms away from other farms is beneficial in terms of biosecurity, it is not always possible. As such, the next best thing is to have cooperation amongst neighbouring farms.

Figure 4. TCBS agar plates showing high numbers of green Vibrio bacteria from a disease infected pond

Plating TCBS agar plates with water samples taken from various ponds

Training a farmer on how to test for Vibrio so that they can monitor the levels of Vibrio bacteria in the ponds regularly

"Farming. It's what we do."



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

Mr.Tan Ching Yong,
Kenyir Aquaculture

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Alliances and cooperation

When farmers assume responsibility to the industry and form alliances, then with any outbreak, they will inform and cooperate with one another. The other farms are able to take biosecurity measures, for example stop drawing water from the sea and use a closed system for a period of time. Farmers with disease outbreaks should also practise adequate biosecurity measures and make sure that the affected ponds are properly cleaned. They should sterilise effluent water before releasing it into the shared environment. We also noticed that many farmers are now more open to new ideas and new approaches, and they realise that they cannot survive on their own anymore. They need to help one another and to find common solutions and techniques. However we need to see more cooperation amongst farmers and other stake holders in the industry.

Constant monitoring of diseases

Another important aspect in this battle against EMS is the need for more trained technicians to help diagnose and monitor the disease situation in Malaysian farms. In general, there is a shortage of trained personnel who can make a quick diagnosis or if unable to do this, send samples to laboratories for testing in a timely manner. Ideally every farm should have a laboratory and a biologist on hand to test water quality parameters, conduct routine *Vibrio* tests, perhaps even carry out PCR tests on post larvae to test for common diseases such as WSSV. They should also be able to help the farmer to set up standard operational procedures-SOPs and troubleshoot simple problems.

However the reality is that many small and medium farms are unable or unwilling to invest in such personnel. There is a dearth of trained aquaculturists in Malaysia who can perform this important task. Many opt to send samples to private or government laboratories but often these are too far away and have a backlog of samples to process at any one time. Farmers then lament on the late results which can take up to a month to be released by government laboratories. This is usually too late to help farmers. Ideally, there should be diagnostic centres set up in culture areas, to conduct these tests routinely and for a reasonable fee. However, despite the late diagnosis, it is still important to send samples for testing to find out what has happened in the pond. Even though the current culture cannot be saved, the information will be useful for future remedial action if the same situation occurs.

In general, although EMS continues to have a severe impact on shrimp production, we do see signs of improvement. Farmers are going back to basics and making sure that pond conditions are optimal before and during culture. More farmers now realise that overfeeding is detrimental to production and ultimately is more costly. Farmers are being more realistic on their production goals and are more aware of other disease issues. Hopefully this trend will continue and we will have better production in the years to come.

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Controlling *Vibrio* spp. in shrimp farming

By Rui Gonçalves and Jutta Zwielehner

Early Mortality Syndrome (EMS), also known as acute hepatopancreatic necrosis disease (AHPND), is an emerging disease caused by *Vibrio parahaemolyticus*. EMS typically affects shrimp that have not reached marketable size (40 days or younger). It causes large-scale mortality among farmed shrimp and infected shrimp ponds can be entirely wiped out.

Although several companies have already promoted solutions to EMS, the reality is that most of the products in the market have yet to prove their efficiency in the field. As such, farmers are still looking for the 'silver bullet' that can effectively solve their problem.

Up to now, the most important developments for counteracting EMS/AHPND have been preventative husbandry techniques and improvements in pond management. Among those practices, screening post larvae (PL) for quality, the introduction of nurseries, semi-biofloc systems and polyculture with tilapia seem to have led to improved results (although sometimes not on a consistent way).

Green water development is fostered by the semi-biofloc system or the early introduction of tilapia in the pond. This accelerates water maturing so that the virulent EMS *Vibrios* are not able to dominate the pond and therefore cannot cause EMS after stocking with shrimp. This also stabilises the pond ecosystem and reduces the fluctuation of water parameters, in particular pH.

Another change introduced by shrimp farmers, particularly in Thailand, is the use of nursery ponds. The smaller size and volume of the nursery ponds allow better control of pond conditions during the first 30 days of culture. Ideally, those pond management techniques are assisted by effective feed or pond additives that can reduce the vibrio presence and their virulence.

To combat EMS, it is important to know the enemy

All Vibrios are indigenous to water and adapt well to the pond environment. They have a good appetite for all nutrients that are widely available in the pond, such as chitin from shed shells, feed waste and excreta. They are able to withstand a drastic change in their environment, such as the drying-out of the pond during a drought by entering a viable dormant state. This is why a complete eradication of vibrios in aquaculture ponds is practically impossible. Pathogenic *Vibrio* investigations have clearly shown that pathogenicity varies greatly and is a complex process affected by many variables, including host, *Vibrio* species and strain, developmental stage, physiological condition, environmental stress, dose, time and infection method.

We also know that *Vibrio* bacteria possess the ability to communicate. *Vibrios* excrete small chemical communication molecules that allow them to sense the density of fellow *Vibrios* they live with. Once they reach a critical mass, virulence factors are expressed, allowing them to cause disease. Preventing *Vibrios* from reaching such a critical mass might therefore be a useful way to prevent EMS.

An available tool for the pond: probiotics

The use of probiotic bacteria to improve the pond environment and control the vibrio population has been one of the most common strategies used by farmers to fight the EMS outbreaks.

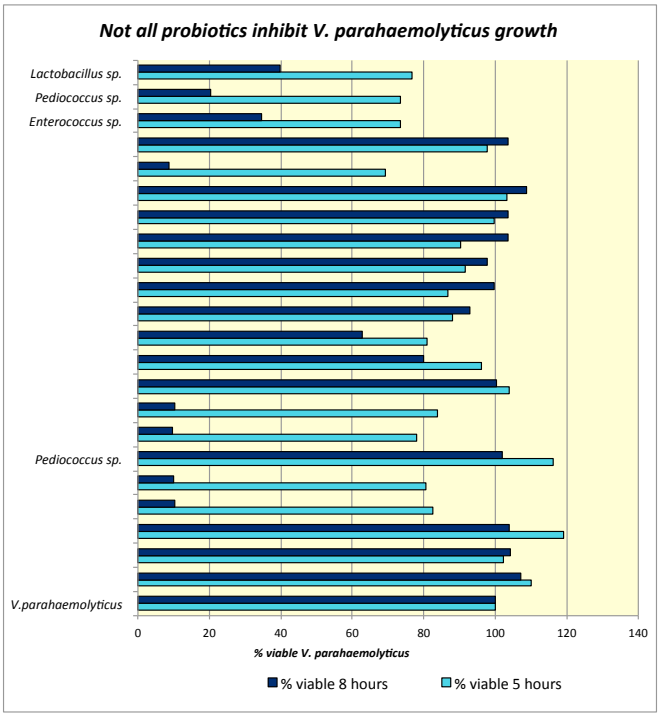


Figure 1: The survival of pathogenic *Vibrio parahaemolyticus* was tested by adding the culture medium of many different probiotics to the *V. parahaemolyticus* growth medium (source: Biomin Research Center). The black line indicates 100% growth compared to untreated control.

Several probiotics on the market claim to counteract pathogenic *Vibrio parahaemolyticus*. But when many of those strains were put to the test (figure 1), it became apparent that not all organisms were able to inhibit *Vibrio* growth *in vitro*. Some probiotic species seem to be more effective than others at inhibiting the growth of the pathogenic *V. parahaemolyticus*.

The probiotic strains in the AquaStar® (Biomin) product line such as *Lactobacillus* sp., *Pediococcus* sp., *Enterococcus* sp. and *Bacillus* sp. were shown to inhibit *V. parahaemolyticus*. This experiment furthermore demonstrated that pathogen inhibition is a strain-specific property. Even in different strains of the same species *(Bacillus subtilis)*, there is considerable variation (only five out of 11 *B. subtilis* strains were able to inhibit the growth of virulent *V. parahaemolyticus* by 90%). This shows the importance of selecting effective probiotics to control vibrios and that not all probiotics have similar effects.

Probiotics in *V. parahaemolyticus* contaminated farms

In a trial carried out in the Marine Station of Aquaculture (FURG, Rio Grande University – Brazil) we investigated the effect of the simultaneous application of probiotics in shrimp cultured in an intensive biofloc technology system contaminated with *V. parahaemolyticus*. In this experiment we compared the performance of the AquaStar® probiotic against a control.

In the treatment group we used two multi-strain products;

- AquaStar® Pond, water application of *Bacillus* sp., *Enterococcus* sp., *Thiobacillus* sp. and *Paracoccus* sp.
- AquaStar® Growout, feed application of *Bacillus* sp., *Enterococcus* sp. and *Lactobacillus* sp.

Treatments were randomly assigned to six 3.5m^3 lined raceways enclosed in a greenhouse. Each tank was stocked with 10,500 *V. parahaemolyticus* infected shrimp, for a final stocking density of 300 shrimp/m^2. Feed (38 % CP) was supplied 3 times/day using feeding trays. The experiment lasted for 70 days.

Better survival

Results from this trial shows that the treatment group improved survival by 37% (figure 2). In the control group only 52% of shrimp survived, compared to 83% of shrimp in the probiotic tanks. This strongly suggests that the probiotic bacteria in the product were effective in preventing a *V. parahaemolyticus* associated disease outbreak. This is mediated through various modes of action:

- competitive exclusion of the pathogens through modification of the gut microbiota composition and aquatic culture environments
- direct killing / growth inhibition of vibrios by anti-vibrio substances (figure 1)
- preventing *Vibrio* spp. from switching on their virulence factors (quorum quenching)
- Improvement of the shrimp immune response, helping the animals to help themselves

Influence on growth performance

The modified microbial communities in gut and surrounding environment will have a great impact also on other factors that in last instance will improve the overall productivity of the system. The establishment of the probiotic bacteria as part of the indigenous gut microbiota will improve the nutrient digestion. It has been well described that some probiotic strains aid digestion because they synthesise extracellular enzymes (figure 3) such as proteases, amylases, and lipases as well providing growth factors such as vitamins, fatty acids, and amino acids.

Therefore, nutrients are absorbed more effciently when the feed is supplemented with probiotics. In the present trial a 48% improvement of feed conversion rate (FCR) (Figure 4) became evident in the shrimp fed treatment diets. Improved feed utilisation is reflected also in a 3.73% improvement of the specific growth rate (Figure 5). The 48% improvement in FCR due to the better nutrient absorption will decrease ammonia emissions through decreased nitrogen losses to the environment. To better illustrate how big the impact of this 48% improvement in FCR can be on the environment, table 1 shows a simple

calculation on how much we can save on excreted matter simply by using a powerful multi-strain probiotic. Based on several peer-review papers for this species, we assumed an apparent digestibility coefficient (ADC) of 80%. Considering the difference in final biomass obtained in this trial due to the 37% difference in survival, the treatment prevented the excretion of 274,182kg of organic matter (table 1) to the rearing system during the 70 days of this trial.

However, if we assume control treatment with a similar biomass as the treatment group , the amount of organic matter being excreted from control shrimp to the rearing system for the whole trial would be 4.2 tonnes, 2 tonnes more than from the other group.

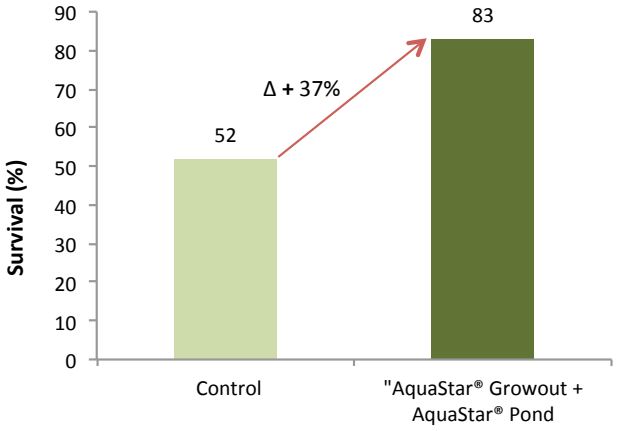


Figure 2. Shrimp survival during experimental period for control and treatment (source: FURG, Brazil)

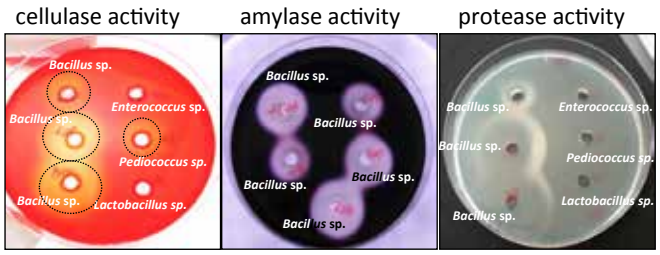


Figure 3. *In vitro* tests reveal that many probiotic *Bacillus* species possess cellulase, amylase and protease activities and that they excrete these enzymes. Also for a probiotic *Pediococcus* strain cellulase activity was demonstrated. The probiotic organisms' digestive enzymes help the host animal to improve its feed utilisation.

Environmental and gut probiotics: working together

The excellent results obtained in this trial are a combination of several factors that lead to an overall improvement of the production system. In this *V. parahaemolyticus* infected tank facility, the application of the probiotics prevented a disease outbreak through several modes of action:

- Reducing nutrient excretion also means less available nutrients in the water for opportunistic pathogens to grow.
- The probiotic organisms in feed colonised the shrimp's gut and had a chance to compete with pathogens for attachment space and nutrients.
- It is furthermore imaginable that they had direct inhibitory effects against *Vibrio* spp. as in vitro data shows that the probiotic organisms inhibit the growth of *V. parahaemolyticus*.

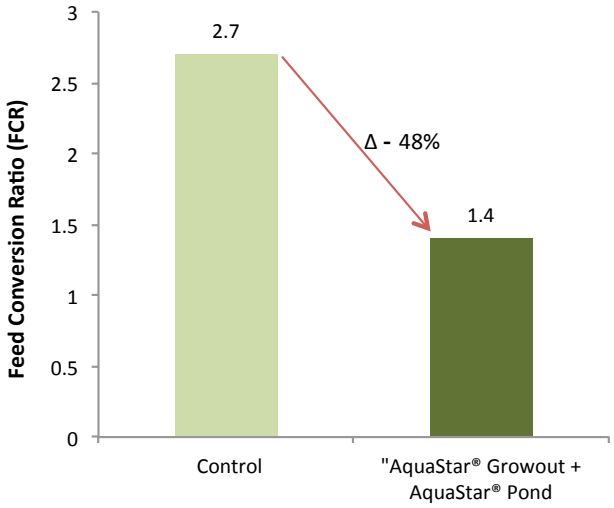


Figure 4. The feed conversion rate during experimental period for control and treatment (source: FURG, Brazil).

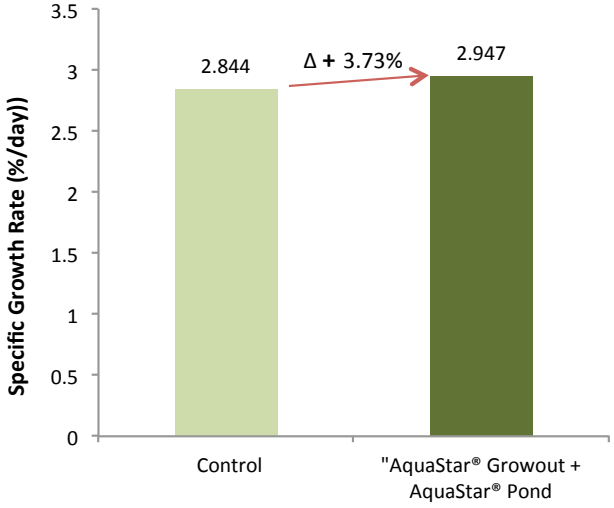


Figure 5. The specific growth rate during experimental period for control and treatment (source: FURG, Brazil).

Table 1: Theoretical estimation of excreted matter during experiment, assuming a ADC of 80%

Treatment	Final biomass (kg)	FCR	Feed used (kg)	ADC[1] (%)	Excreted matter (tonnes)
Control	45,973	2.7	124,127	80	2.5 -0.3 tonnes
AquaStar®	78,870	1.4	110,418	80	2.2 -2 tonnes
Control2	78,870	2.7	212,949	80	4.3

[1]ADC=Apparent digestibility coefficient (%); This value was not calculated, was obtained as a mean value from several peer-review papers for the specie in study.
[2]Control group assuming a similar final biomass as AquaStar® (+/- same survival)

A proportion of the probiotic cells present in feed (AquaStar® Growout) will pass through the digestive system and exert their effects on the environmental microbial communities together with the environmental/bioremediation bacteria in the water (AquaStar® Pond). Together they will lead to a slower accumulation of slime or organic matter in the pond bottom and compete with pathogens.

The bioremediation bacteria will optimise nitrification rates to keep ammonia concentration low;

- optimise denitrification rates to eliminate excess nitrogen from ponds as nitrogen gas;
- maximise sulfide oxidation to reduce accumulation of hydrogen sulfide;
- maximise carbon mineralization to carbon dioxide to minimise sludge accumulation;
- maximising primary productivity that stimulates shrimp production.

Exposing shrimp to inappropriate levels of dissolved oxygen, ammonia, nitrite or hydrogen sulfide can lead to stress and diseases. Analysing the water quality parameters like ammonia, nitrites and nitrates (Figures 6, 7 and 8), during this experiment, we can easily see the beneficial effect of the probiotic treatment. In the final week of the trial, where the accumulation of waste materials would become apparent as a decline in water quality, the probiotic treatment led to healthier environmental parameters in the treated tanks. This is particularly remarkable, as these tanks harboured approximately two times the biomass of the control treatment due to the better survival.

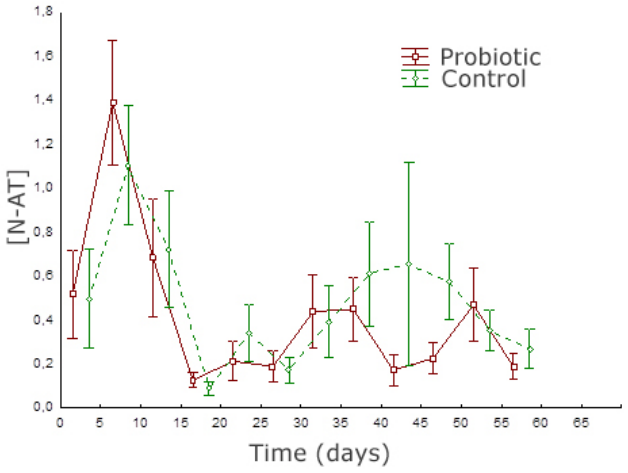


Figure 6. Ammonia measurements during experimental period for control and AquaStar® treatment (source: FURG, Brazil).

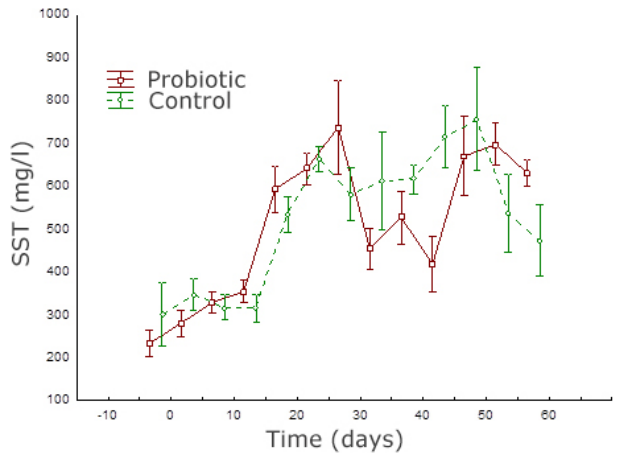


Figure 7. Nitrites measurements during experimental period for control and AquaStar® treatment (source: FURG, Brazil).

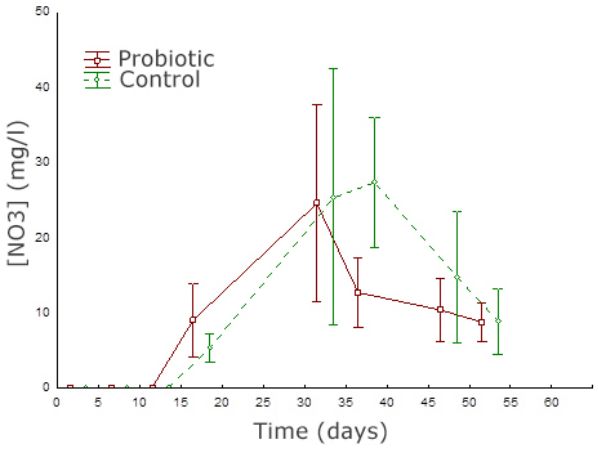


Figure 8. Nitrates measurements during experimental period for control and AquaStar® treatment (source: FURG, Brazil).

A way to achieve a sustainable industry

The increasing awareness for sustainable shrimp production has led to a run for quality and sustainability certification in the recent years. Therefore, the shrimp industry invested in the development of sustainable shrimp farming practices in order to meet international market requirements. One of the hottest certification programs, ASC (Aquaculture Stewardship Council) is built on 7 main pillars, including: legal compliance; land and water use; water pollution and waste management; genetics; feed management; health medicines and chemicals management and finally, social responsibility.

From those issues, aspects such as: nutrient utilisation efficiency, water quality, pond environmental improvement, sludge control, reduced use of medicines and antibiotic growth promoters and survival improvement, can be achieve by using feed additives.

As the Brazilian example shows, powerful multi-strain probiotics are particularly efficient in achieving sustainable shrimp culture. As observed in this trial, AquaStar® Pond and AquaStar® Growout were able to increase the survival by 37% and to reduce the FCR by 48%. This represents 1 tonne of saved feed to produce the same amount of shrimp and a 2 tonne reduction of excreted wastes. At the same time an overall improvement of the production system was achieved and medicine use avoided , even in *V. parahaemolyticus* contaminated shrimp.

Rui Gonçalves

Jutta Zwielehner

Rui Gonçalves is technical manager – Aquaculture and Dr Jutta Zwielehner is product manager, Biomin Holding GmbH

A nutritional additive increases survival and reduces parasitism in Nile tilapia during masculinisation

By Santiago Benites de Pádua, Roney Nogueira de Menezes Filho, Marco Antônio de Andrade Belo and Mariana Midori Nagata

Ectoparasites are key agents responsible for causing diseases in farmed fish. The Nile tilapia, in particular, has been shown to be susceptible to infestation by trichodinids and monogeneans. These agents are the main parasites that impact super-intensive tilapia culture, although other ectoparasites may also be involved, such as *Epistylis, Apiosoma, Chilodonella, Ichthyophthirius, Ichthyobodo, Cryptobia* and *Piscinoodinium*.

Ectoparasites are traditionally responsible for causing lesions on the skin and gill, which facilitate the access of opportunistic bacterial infectious agents such as *Streptococcus, Aeromonas, Pseudomonas, Flavobacterium, Acinetobacter* and *Francisella*. These bacterial agents act as the main causes of mortality in the different stages of tilapia rearing. For greater efficiency in the control of these bacterial diseases, the control of ectoparasite infestations (Pádua and Cruz, 2014) is fundamental.

The incidence of parasitic infections in farmed fish is strongly related to the environmental conditions and water temperature. Poor water quality is often detected during the masculinisation of tilapia in hapas, since the very fine mesh size of hapas favours the rapid clogging from a proliferation of periphyton. Subsequently, this drastically reduces water movement and water renewal. The use of powdered feed during this rearing phase also promotes the proliferation of periphyton besides a loss of nutrients into the water column. Under these conditions, high infection rates of ectoparasites in fry and fingerlings occur, leading to large losses and mortality of animals.

In this context, the aim of this present study was to evaluate the effect of a natural nutritional additive (Aquate Fish™, Alltech, USA) on the incidence of parasites and its effect on the productive performance of Nile tilapias during masculinisation (sex reversal).

Study design and methodology

The test was performed in the hatchery of New Fish, Alterosa municipality, State of Minas Gerais, Brazil. In this study, 42,000 larvae of Nile tilapia were used after absorption of the yolk sac. Fish were stocked in 6 hapas with 1 mm mesh installed in a single earthen tank that was in continuous use throughout the 2013/2014 harvest. As such it contained remnants of fish escapees from hapas from previous lots. The test comprised two groups, G1: test group containing 6 g of Aquate Fish/kg of dry feed (Supra®) + masculinising hormone; and G2: control group which received the same diet + masculinising hormone, but omitting the nutritional additive. These animals were maintained in this system for 12 days until the first hapa exchange, in which they were distributed into 12 hapas (1 mm mesh) for a further 18 days.

Diagnosis of parasites

Parasitological analyses were performed *in situ* on days 0, 10, 20 and 30, by a random capture of fish and assessment of fresh shaved skin, fins and gills using optical microscopy. In each evaluation, 60 animals were analysed per treatment, while 42 animals were analysed in the baseline collection. A total of 402 fish were subjected to diagnostic tests. The diagnosis of the parasite prevalence rate was calculated as proposed by Bush et al. (1997), and then unranked in the Parasite Intensity Score or PIS (working methodology established by Aquivet Saúde Aquática).

Production performance

Every 10 days 100 larvae/hapa were captured and biometry performed. The weighing included the evaluation of a pool of 10 larvae/fry, using a scale of 0.001g accuracy. Total length was performed using a digital pachymeter. For productive performance the following parameters were evaluated:

1) Weight Gain, where WG = (final body weight - initial body weight)
2) Specific Growth Rate, where % SGR=100 [(ln final body weight - ln initial body weight) /experimental days]
3) Survival Rate, where %SR = (final number of fish / initial number of fish) *100

Data were subjected to analysis of variance (ANOVA) and when significant, the means were compared by the Student t-test (0.05).

Diagnosis of ectoparasites

Table 1 presents data related diagnoses of ectoparasites in Nile tilapia during the masculinisation phase. The use of nutritional additive showed a positive effect on the control of some ectoparasites, such as reduction of ($p < 0.05$) the prevalence rate of *Trichodina compacta* and *Apiosoma* sp., both ciliated parasites, and reduction ($p < 0.05$) of the PIS (Parasite Intensity Score) for the group of trichodinids.

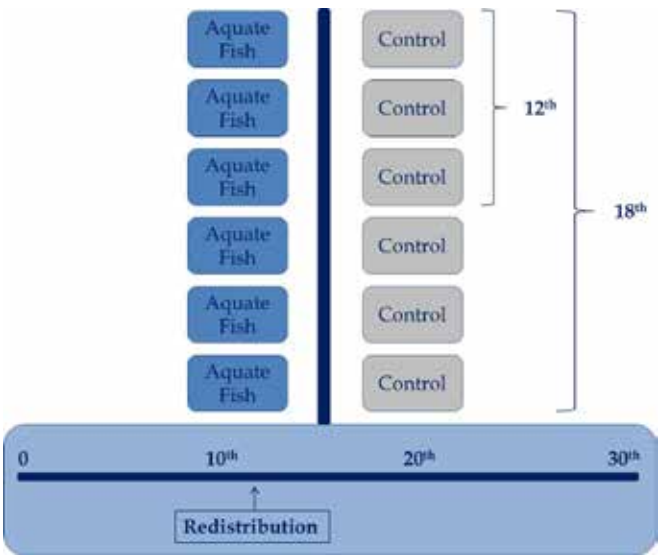


Figure 1: Layout of experimental hapas and study design

Table 1: Effect of nutritional additive on the incidence of ectoparasites in Nile tilapia during masculinisation.

Etiologic agents	Basal sample		Aquate Fish™		Control	
	P (%)*	PIS**	P (%)	PIS	P (%)	PIS
Protozoa						
Trichodinids	0.0	-	100.0	1.4 a	100.0	1.7 b
Paratrichodina africana	0.0	-	3.9	1.0	4.5	1.0
Trichodina heterodentata	0.0	-	95.6	1.1	96.6	1.3
Trichodina centrostrigeata	0.0	-	54.4	1.1	52.8	1.1
Trichodina magna	0.0	-	75.6	1.1	74.4	1.3
Trichodina compacta	0.0	-	11.1 a	1.1	23.9 b	1.0
Ichthyophthirius multifiliis	0.0	-	17.2	1.0	18.8	1.0
Apiosoma sp.	0.0	-	51.7 a	1.1	60.2 b	1.3
Chilodonella hexasticha	0.0	-	0.0	-	1.7	1.0
Ichthyobodo sp.	0.0	-	17.2	1.0	33.5	1.1
Epistylis sp.	0.0	-	4.4	1.4	0.0	-
Cryptobia sp.	0.0	-	24.4	1.1	28.4	1.2
Piscinoodinium pillulare	0.0	-	57.2	1.0	65.3	1.0
Monogenea	28.6	1.0	22.2	1.0	27.8	1.0
Dactylogyridae	0.0	-	20.6	1.0	19.3	1.0
Gyrodactylidae	28.6	1.0	6.7	1.0	9.1	1.0
Mollusca						
Lasidium larvae	7.1	1.0	0.0	-	1.1	1.0

*P (%): Prevalence rate. **PIS: Parasite Intensity Score. Different letters in the same row indicate statistical difference by Student's t test ($p < 0.05$).

Table 2: Production performance of Nile tilapia fed nutritional additive during masculinisation in hapas.

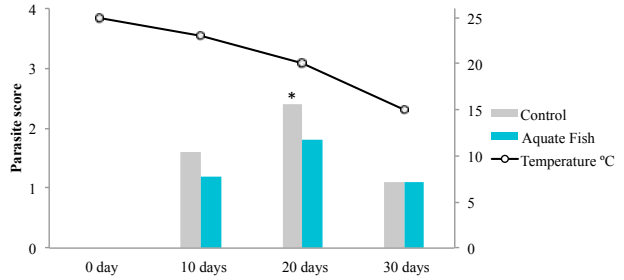
	Treatment Diets	
Parameters	G1	G2 (control)
WG* (g)	0.145 ± 0.011	0.149 ± 0.023
SGR**	8.10 ± 0.23	8.16 ± 0.46

Different letters in the same line indicate statistical difference by Student's t test ($p < 0.05$).

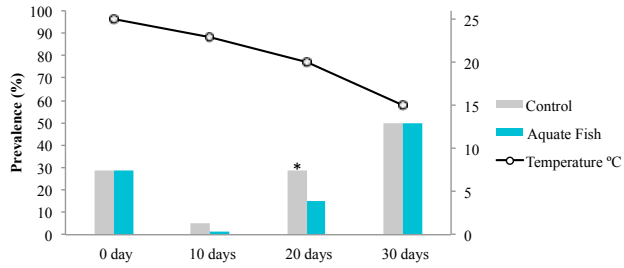
Tilapia larvae

In the assessment on the incidence of ectoparasites among different days of collection, it was observed that treatment diets provided specific responses in the control of Trichodinids, Monogeneans, *Piscinoodinium pillulare, Apiosoma* sp. and *Ichthyobodo* sp. (Figure 2).

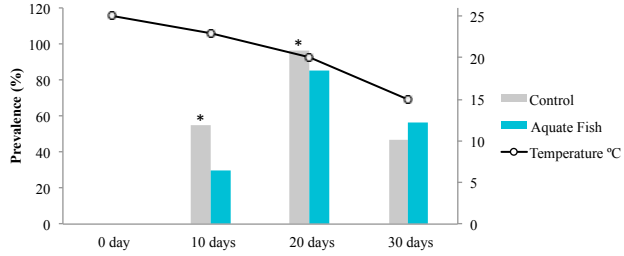
Trichodinids



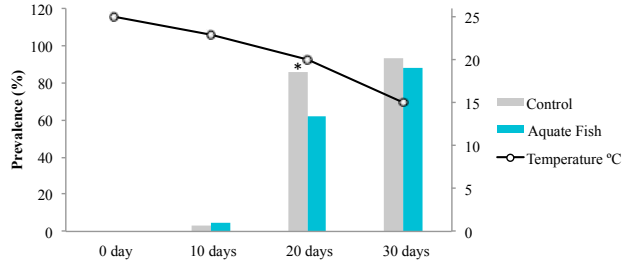
Monogeneans



Piscinoodinium pillulare



Apiosoma sp.



Ichthyobodo sp.

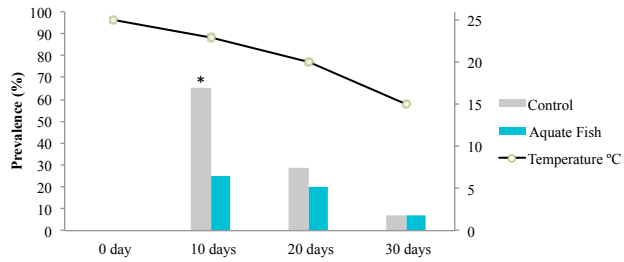


Figure 2. Effect of nutritional additive on the incidence of ectoparasites on Nile tilapia during masculinisation. The presence of an asterisk indicates statistical difference by Student's t test ($p < 0.05$).

Production performance

The addition of the nutritional additive during the masculinisation of Nile tilapia did not significantly influence weight gain or specific growth rate among the tested groups (Table 2). However, a significant increase ($p < 0.05$) in the survival rate of fish fed with the additive (Figure 3) was observed.

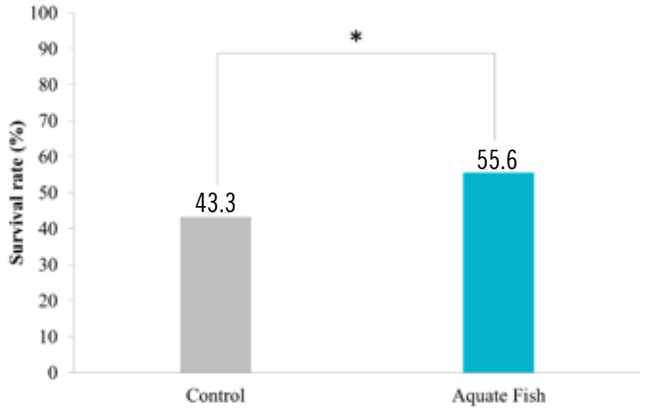


Figure 3. Effect on the survival rate of Nile tilapia during masculinisation in hapas. The presence of an asterisk indicates statistical difference by Student's t test ($p < 0.05$).

Optimisation of production

The use of the nutritional additive as a food additive resulted in a decreased PIS of trichodinids, as well as a decrease in the prevalence rate of the group of monogenean worms, *P. pillulare* and *Apiosoma* with 20 days of feeding. With 10 days after the initiation of a diet containing the additive, lower prevalence rates of *P. pillulare* and *Ichthyobodo* sp. were observed. During the initial phase of rearing Nile tilapia, these ectoparasites are responsible for lesions on the skin and gills, which in turn favours the occurrence of secondary infection by opportunistic bacteria (Valladão et al., 2014). Therefore, the decrease in ectoparasitic infestation has optimised productive performance, obtaining higher survival rates, as observed in this study in which fish fed diet with diet G1 showed an increase of 12.3% in the survival rate.

Decrease in parasitism

The incidence of ectoparasites on farmed fish is strongly related to the rearing conditions, climatic aspects and environmental quality (Hossain et al., 2008; Jerônimo, 2010; 2011). In the present study, there was a decrease in the PIS for trichodinids, as well as the prevalence of *P. pillulare* and *Ichthyobodo* for treated and control groups on the 30th day of analysis which coincided with a period of an abrupt drop in water temperature. This decrease on ectoparasites incidence is related to ecological aspects and seasonality during the cold season. However, in the period with water temperature ranging between 25-20°C when there was increased pressure by parasites, differences in the incidence of ectoparasites were observed among the groups with and without the nutritional additive.

In this study, no significant difference ($p > 0.05$) was observed in the productive performance of fish fed with G1 diets compared with the control group. On the other hand, the group fed with the additive showed a higher survival rate ($p < 0.05$), which has resulted in increased stocking density obtained in hapas with 486 fish/m^2, while the control group showed a mean of 378 fish/m^2. We showed that despite a difference in the final stocking density (it was 28.6% higher in fish fed with diet G1), both groups showed equivalent productive performance. Currently, it is known that the stocking density represents a key parameter on the productive aspects of tilapia breeding, since the higher stocking density generally yields lower productive performance (Garcia et al., 2013).

Conclusion

The addition of 6g Aquate Fish/kg of diet resulted in lower parasitism of tilapias during the masculinisation process in hapas, optimising the survival rate.

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Shaping India's aquaculture further

By P.E.Vijay Anand and R. Umakanth

Strategies and actions that will significantly steer towards positive growth in aquaculture and utilise feed production capacity.

India is recognised as a large contributor to global aquaculture production. It enjoys the status of being the second highest in aquaculture production after China with a production of 4.20 million tonnes in 2012 (FAO, 2014). It is also the fourth largest shrimp producing country. Even with these hallmarks, the country's aquaculture production can be better. This will need speedy strategies and actions that will significantly steer it towards positive growth.

The country has undergone significant changes in its aquaculture development. In the past, it has relied on a single group of farmed fish, namely carps, which are still farmed using traditional management practices. The majority of fish production is sent to a single market, namely West Bengal which has large demand for fish. However, the setback is that transport of farmed fish is still using traditional methods. Fish are packed in plastic boxes and ice added. The transportation time is 24-48 hours depending on the destination. In shrimp aquaculture, until recently, India has relied on a single species of shrimp *Penaeus monodon*. This describes the rather narrow base on which Indian aquaculture depended upon.

An aquafeed mill

Towards modernisation

Changes have come but in a slow way. Since 2008, farmers have begun to use extruded feeds to feed fish and allowed pond resources to be better utilised to increase productivity. Owing to the influx of extruded floating feeds, a small quantity of pelleted feed is now being used. The single group of farmed fish is gradually transformed to about four groups of fish which are packed more hygienically in insulated boxes and transported to different markets.

There has been a total shift in shrimp farming since the Indian Government allowed the farming of *Penaeus vannamei* in 2010. In addition, India now has a small quantity of shrimp and fish which are processed and sold in the domestic market in contrast to the previous practice of exporting almost all of its production. The industry started believing that India with its huge population base and rapidly changing life styles and better incomes, will gradually demand convenient and hygienic fish products.

There have been significant changes in fish feed production. Between 2010 and 2013/14, fish feed production showed a 59% increase in actual feed sales from 430,000 tonnes in 2010 to 684,000 tonnes in 2013. However, there has been an unplanned growth in fish feed mill capacity. The capacity grew by 306% from 507,000 tonnes per year (tpy) in 2010 to 1.55 million tpy in 2013/14. Looking at the figures for feed sales versus milling capacity, a huge discrepancy is evident. In order to utilise excess feed milling capacity, there should be some planning and strategies.

The change to farming vannamei shrimp has spurred growth in the last 2-3 years. Shrimp seed demand has seen increases from 7 billion to 20 billion (186%), shrimp production from 160,000 tonnes to 325,000 tonnes (87%), shrimp feed production from 272,000 tonnes to 572,000 tonnes (110%), installed capacity of shrimp feed from 390,000 tpy to 1.33 million tpy (241%); processed shrimp from 130,553 tonnes to 228,620 tonnes and revenue from shrimp exports increased from USD 735 million to USD 1.803 billion (MPEDA, March 2013). The main concern is to ensure sustainability in this sector.

Cages for carp

Debate on data

There is a serious gap in the country on the availability of aquaculture production data. Estimates between FAO data and the Indian Government differ substantially. Moreover, the industry has to rely on data that are one or two years old. This makes business planning and market assessments ineffective especially with this rapidly changing aquaculture scenario. The only current option for industry operators is to 'deduce' and to depend on calculations and best estimates.

Shrimp ponds

Fish feed pellets

Aquafeed demand

Due to rapid changes seen in the shrimp and fish farming sectors, India's ability to produce commercial aquafeeds has grown significantly. The country has 26 feed mills with a total capacity of 2.88 million tpy of both shrimp and fish feeds. However only 1.25 million tonnes was sold in 2013 (43.40% capacity). The difference between what can be produced at 85% efficiency and what was sold in 2013 was 1.19 million tonnes. This is the available opportunity/potential. The industry should work on strategies to better utilise feed milling capacity and through this, help modernise aquaculture further.

The country has 13 shrimp feed mills. The total installed capacity for these mills is 1.33 million tpy and 572,500 tonnes of shrimp feed was sold in 2013. The capacity utilisation is 43%. If we project 85% utilisation, production is 1.13 million tonnes. This means that there will be an additional 558,000 tonnes available for the expansion of this sector.

In fish feed production, the total installed capacity is 1.55 million tpy. In 2013, 684,000 tonnes was sold and this translates to 44.12% of capacity. If these mills were to run on 85% efficiency then 626,000 tonnes of feed exists as additional opportunity. Therefore the country has adequate aquafeed capacity and what would be needed to harness this capacity will demand building strategies. It would help if the government can support some development strategies on these lines.

Feed utilisation plan

A strategic approach to utilise existing feed capacity is to relook at possible aquaculture sub-sectors. We suggest that the industry considers a plan to utilise aquafeed in these ways;

- new markets (200,000 tonnes);
- feeding more carps on commercial feeds (50,000 tonnes);
- feeding more Pangasius on commercial feeds (80,000 tonnes);
- feeds for new fish species (45,000 tonnes);
- expansion in shrimp farming (200,000 tonnes)
- 50,000 tonnes of processed fish will require additional fish production and use 150,000 tonnes of feed
- feeding juvenile fish (50,000 tonnes);

Following this strategy, about 775,000 tonnes of additional feed could be used over 2-3 years.

Small fish feed sub sector

Feed production for juvenile fish in India is an important subsector. The current practice is that only fish in the grow-out systems are fed. If the country is producing more than 4 million tonnes of fish then a corresponding number of fish seed/fingerlings are produced. If these fingerlings were to be fed, the sector will definitely require feed. In addition to feed utilisation, the aquaculture industry will benefit with healthier fish seed stock which would perform better during grow-out.

Fed versus non-fed species

According to FAO (2012) the non-fed groups of fishes in aquaculture in the world has dropped from 50% in 1980 to 33.30% in 2010. In India, there is a major reliance on just a single fish group; the Indian major carps. Carps, form 71.9% of world farmed fish (FAO, 2012) and 27.7% of the carps fall into the non-fed class because they are predominantly filter feeders. However, the majority of carps are farmed with feed especially in China.

India could expand production by diversification of farmed fish species, and in particular focus on more high value species such as the tilapia, sea bass, cobia and pompano. The walking catfish, climbing perch and the snakeheads too are high value species. Many Asian countries farm these species which offer a huge opportunity for the feed sector. The key to encouraging the farming of such species is the development of commercially viable hatcheries.

Post-harvest handling and marketing

Logistics and post-harvest handling processes especially for farmed freshwater fish in India is in a very poor state. In contrast, the shrimp industry uses internationally accepted norms for processing, preservation and transport. For example, fish from Andhra Pradesh (where fish is commercially grown in large quantities) is transported by about 250-300 trucks every day, over 1,248 km to markets taking about 25-35 hours. Daily, about 2,500 tonnes of fish are packed in ice and transported. There is an urgent need for aquaculture stakeholders in the country to address this issue, add value, take advantage of modern markets and earn additional revenue.

In India, fish processing methods, marketing and fish consumption have a long way to go. However, given the fast changing life styles and customer demand, there is large potential for marketing hygienic and ready to cook fish products. Investors in the aquaculture industry should also realise that, in addition to the export markets for shrimp, there exists a good demand for fish within the country. Three prominent business groups with feed mills and fish farms have invested in fish processing plants and produce and market different products. The quantity sold was about 4,000 tonnes in over two years. This is a small volume now but is bound to catch up in future. Opportunities exist and India producers should take advantage of this emerging market. Creating a market for processed fish actually leads to higher feed consumption because more fish has to be produced to deliver a required amount of finished product.

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Shrimp pellets

Domestic market

The per capita fish consumption at 2.85 kg for India in 2010 (FAO 2014) is almost close to that of chicken meat consumption in India. While fish production existed historically and was far higher than chicken production in the country, the rate at which the per capita consumption of chicken meat rose is astonishing. Chicken is well marketed and is seen in every place but the same does not apply to fish. Indians have made chicken and milk available everywhere in the country but the same scale of success is not evident for fish. There is a desire among the consumers to buy and eat fish but many factors stop them from doing so. Overall per capita consumption of chicken and fish is very low in India compared to other countries and compared to protein intake standards. Addressing the need to bridge this protein gap definitely holds great opportunities for distribution and marketing of fish.

Fish protein

Although India is second in farmed fish production globally, ironically, the contribution of fish protein (per capita/day) to total animal protein consumption in India is less than 2g (FAO, 2012). This perhaps explains the poor per capita fish consumption and the rather low popularity of fish in Indian diets. USSEC (US Soybean Export Council) in one of its fact finding mission with customers in India listed the following reasons that contribute to a low popularity of fish. The reasons include: fish smell bad, too cumbersome to prepare and cook, fish markets are dirty and fish have bones. In addition, many respondents say that they do not know what fish to buy and how to buy fish. Demographic analysis for India predicts that the country will add 22 million young adults (15-34 age groups) in the next five years. Popular news also states that 50% of India's population is under the age of 25. Interestingly it is this part of the population that will determine customer demand and drive for various products, including fish.

Diversification of culture systems

Cage farming, both in Inland waters as well as in coastal and deep sea waters has been discussed often. However, fish production from cages is still insignificant. Now that there is extra capacity for producing extruded floating feed, this should propel fish farming in cage systems. The slow uptake in cage farming is also due to the absence of data from demonstrations that could show returns on investments to entrepreneurs. India boasts of good reservoirs, and natural water impoundments but they have hardly been used to increase fish production. This is food for thought. Well planned development will help India augment its aquaculture production. This is a good solution to add to the road map on utilisation of available/additional feed milling capacity in the country.

New feed markets

Market diversification to sell feed is an option for feed mill investors to consider and increase feed capacity utilisation. Two markets accounting for the highest fish production in the country are Andhra Pradesh and West Bengal. Feed sales in Andhra Pradesh is close to 57,000 tonnes per month (tpm) while all other states combined use 5,000 tpm. Among the latter, West Bengal uses 3,500 tpm but produces more fish than Andhra Pradesh. West Bengal has a lot of resources in terms of water, fish species and a steady market demand. It has the potential to expand production. Similarly, the opportunity is in establishing feed markets in other states.

Raw material input

Raw material risk management needs to be addressed by all feed millers. Many new feed millers lack the experience in raw material procurement especially on a volatile trading platform as we see in India. Ironically, feed mills are sandwiched between two very volatile processes. One is raw material input management and the other is to face the price and market fluctuation involved in marketing fish in India. Among these, input management surely can be addressed by adding tools, people and improving efficiency in dealing with this segment.

Water resources

Finally, the availability of good quality water is the biggest issue for aquaculture. India has 2.4% of world's land mass, 4% of the world's water resources and carries 17% of the world's population. The country cannot afford to waste or underutilise its water resources. The aquaculture industry has to rapidly adopt better farm management techniques, introduce better and efficient species, apply genetics in aquaculture, ensure optimal use of formulated feeds and improve water management systems.

Conclusion

In this article, we have addressed the most significant issues governing India's aquaculture industry. Some solutions are proposed. By analysing gaps and utilising opportunities, we believe that India could increase its aquaculture production, firstly to meet the domestic demand from its own growing population and its need for protein. Based on our industry experiences since the early 90's, a few segments of the aquaculture value chain have been addressed and it is hoped that all responsible Indian aquaculture stakeholders take note of these points and contribute towards the progress of the industry.

This article is based on the presentation by Dr. P.E.Vijay Anand (USSEC) at Aqua India 2014, Society of Aquaculture Professionals, Chennai, India, 24-25th January 2014.

Dr. P.E. Vijay Anand heads India Animal Feed and Soy Meal Program for USSEC (US Soybean Export Council) covering poultry and aquaculture applications. Vijay has 10 years of varied business unit management, technical and trade experience. He has been with the USSEC for 20 years and has Bachelors, Masters and PhD degrees in animal and fisheries sciences.

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Can immunobiotics improve growth performance and enhance the immune system of shrimp?

By Nguyen Van Nguyen, Satoru Onoda, Takeshi Endo, Yoshitaka Hirose and Tran Van Khanh

Aside from improvements in weight gain, trials in Vietnam showed that when challenged with microbial infection, shrimp mortality decreased with the inclusion of the immunobiotic product in the diets.

During the past decades, global shrimp farming has suffered severe economic losses because of disease outbreaks mainly caused by virus, rickettsial-like bacteria, true bacteria, protozoa, and fungi (Lightner, 2011). Therefore, prevention and control of diseases are of great importance. Probiotics, as 'biofriendly agents' such as lactic acid bacteria (*Lactobacillus, Carnobacterium, Streptococcus, Leuconostoc,* and *Lactococcus*) and *Bacillus* spp., can be introduced into the culture environment to control and compete with pathogenic bacteria as well as to promote the growth of the cultured organisms and to enhance innate immune system of a host (Balcázar et al., 2006b; Farzanfar, 2006).

An immunobiotic product (Feed LP20) contains 80% dextrin and 20% of heat-killed *Lactobacillus plantarum* strain L-137 (HK L-137) which boosts the immune system in not only humans but also aquaculture or livestock animals. Its efficacy in animals as well as shrimp and broiler chicken has already been evaluated in several Asian countries, and has shown that this immunobiotic product improves growth performance and feed utilisation (in terms of body weight gain and feed conversion ratio, FCR) in these animals. The product also enhances phagocytic activity (PA), an important indicator of immune function in shrimp. It is a light brown powder and free of unfavourable organoleptic properties. In particular, it is easy to process because it is heat stable.

The aim of this study was to evaluate the effects of LP20 on growth, feed efficiency and immune response of white leg shrimp, *Litopenaeus vannamei.*

Experimental design

Following a 30-day acclimation period, shrimp juveniles, initial body weight 1.39 ± 0.006 g were randomly stocked at 30 individuals per tank in 15 units of 120-L glass tanks. Five treatments were designed with three replicates. These consist of a control diet (Basal diet-DC1) which contained no supplemented additive (0 ppm), a diet with a commercial supplemented feed (Pzpro:Live microbial added at a dose of 10,000 ppm and which served as a positive control (DC2) and three test diets containing different levels of LP20 at 50 ppm, 100 ppm and 500 ppm referred as NT1, NT2, NT3, respectively. Pzpro is a commercial additive containing *Lactobacillus plantarum* strain in live microbial and other ingredients. Pzpro is commonly used in the market for aquaculture and has the same function as LP20. This is the reason for using this product as a positive challenge.

Feed LP20 was weighed and thoroughly mixed with shrimp feeds before feeding. LP20 is completely soluble in water; it has a sticky and viscous property. Before feeding, LP20 was weighed and dissolved in water. The solution was sprayed onto shrimp feeds and mixed well. Shrimp feed was continuously coated by a thin layer of fish oil. The feed was then dried for 10-15 minutes in room temperature before use.

The effectiveness of the immunobiotic feed was evaluated via growth performance, feed utilisation and immune function of shrimp. These were expressed as weight gain (WG), specific growth rate (SGR), feed conversion ratio (FCR) and survival rate (SR). The determination of PA was carried out following the method of Weeks-Perkins et al. (1995). After injection, haemolymph of shrimp was collected from the ventral sinus and mixed with sterile anticoagulant, and then the sample was treated to determine for PA. Shrimp were challenged with *Vibrio parahaemolyticus* with the injection of 100 µl of bacterial suspension 10^6 CFU/ml into the ventral sinus of the cephalothorax. Mortality rate of shrimp was observed after shrimp were injected with the bacterial suspension.

Growth performance

Growth performance of white shrimp fed the treatment diets is presented in Table 1. After 60 days of the trial, there were no significant differences in WG and SGR of shrimp between NT2 and NT3 as well as DC2 and NT1, but there were significant differences in WG and SGR of shrimp fed diets NT2 and NT3 as compared to shrimp fed other treatments (DC1, DC2 and NT1). In particular, shrimp fed the NT2 (100 ppm of LP20) and NT3 (500 ppm of LP20) had the highest values of WG and SGR while the lowest growth was observed with shrimp fed the basal diet.

Shrimp fed diets NT2 and NT3 showed an improved FCR compared to shrimp fed the other treatments. The highest FCR was observed with DC1 diet, but there was no significant difference in FCR between the controls (DC1, DC2) and NT1 as well as between NT2 and NT3. There were no significant differences in survival rates among the treatments. We presumed that good husbandry and management during the experimental period resulted in high survival rates.

Table 1. Growth performance, feed utilisation and survival rate of shrimp fed the experimental diets

Parameters	Treatments				
	DC1 Basal diet (0 ppm)	DC2 Pzpro (10,000 ppm)	NT1 LP20 (50 ppm)	NT2 LP20 (100 ppm)	NT3 LP20 (500 ppm)
Initial weight (g)	1.40^a	1.39^a	1.38^a	1.39^a	1.40^a
Final weight (g)	6.89^a	7.19^b	7.15^b	7.98^c	8.03^c
WG (%)	391.83^a	417.93^b	418.44^b	473.88^c	472.65^c
SGR (%/day)	2.65^a	2.74^b	2.74^b	2.91^c	2.91^c
FCR	2.14^b	1.98^b	1.97^b	1.64^a	1.63^a
SR (%)	92.22^a	93.33^a	94.44^a	97.78^a	97.78^a

Values are means. Data in the same row with different superscript letters are significantly different (P< 0.05).

Experimental facilities at Research Centre for Fish Nutrition and Postharvest Technology at the Research Institute of Aquaculture, Vietnam (RIA2).

Sampling haemolymph of infected shrimp for analysis of phagocytic activity.

Challenge tests

The mortality rate of shrimp following infection with *V. parahaemolyticus* is given in Table 2. The results showed significant differences in mortality between the group containing LP20 and the controls, in which the lowest shrimp mortality (7.93%) was observed with diet NT3, while the highest (26.37%) was found with shrimp fed the DC1 diet. However, there was no significant difference between shrimp fed DC1 and treatment diets. Mortality rate of shrimp decreased with increasing inclusion of the immunobiotic product in the diets. The possible reasons for the reduced mortality of shrimp with increasing content of LP20 may be due to the enhancement of immune response of shrimp and resistance to the *Vibrio* infection.

Table 2. Growth performance, feed utilisation and survival rate of shrimp fed the experimental diets

Challenge test	Treatments				
	DC1	DC2	NT1	NT2	NT3
Mortality rate (%)	26.37^{c} ± 2.397	22.59^{c} ± 0.804	15.19^{b} ± 2.852	11.37^{ab} ± 1.210	7.93^{a} ± 1.034

Values are mean ± standard deviation. Data in the same row with different superscript letters are significantly different (P< 0.05).

Phagocytic activity

Phagocytic activity (PA) of shrimp fed the diets NT2 and NT3 was significantly higher ($p<0.05$) than shrimp fed control diets (DC1 and DC2) after 30 days of feeding. After 60 days, phagocytic activity of shrimp was significantly higher ($p<0.05$) for shrimp fed diet NT1, NT2 and NT3 as compared to the control diets (DC1 and DC2).

In general, after injection with *V. parahaemolyticus* on day 60 of feeding, the PA decreased in all treatments after 5 to 15 days. However, PA of shrimp fed 100 and 500 ppm LP20 was significantly higher ($p<0.05$) than that at the basal and commercial diet (DC1 and DC2). Moreover, PA of shrimp fed LP20 quickly recovered compared to shrimp at the DC1 and DC2 (Figure 1). There are a few possible reasons for higher PA of shrimp fed LP20 as compared to shrimp fed the control diet. Shrimp fed the diets containing the immunobiotic product at 100 ppm and 500 ppm doses showed enhanced immune function or that the product triggered PA of shrimp resulting in the increase of immune ability.

Conclusion

Based on our observations, we have made the following conclusions:

- The immunobiotic product LP20 has positive effects on growth performance, feed utilisation, survival rate and cellular immune function in white shrimp.
- Shrimp fed the diets containing the immunobiotic product showed better growth performance, feed efficiency and survival rate compared to those fed the basal diet and the positive control, respectively.
- Increasing the inclusion level of the immunobiotic product in the diets significantly reduced the mortality rate of shrimp infected by *V. parahaemolyticus*.
- Shrimp fed the treatment diets were associated with increases in its immune ability by increasing the phagocytic activity and they quickly recovered their immunity after challenge with *V. parahaemolyticus*. LP20 can be supplemented in the diets as an immunostimulant to increase the immune ability of shrimp and disease resistance.
- The inclusion rate of the immunobiotic product of 100 ppm to 500 ppm in the diets promoted growth, feed efficiency and immunity. However, the level of 100 ppm has been considered as the optimal dosage for shrimp farming.

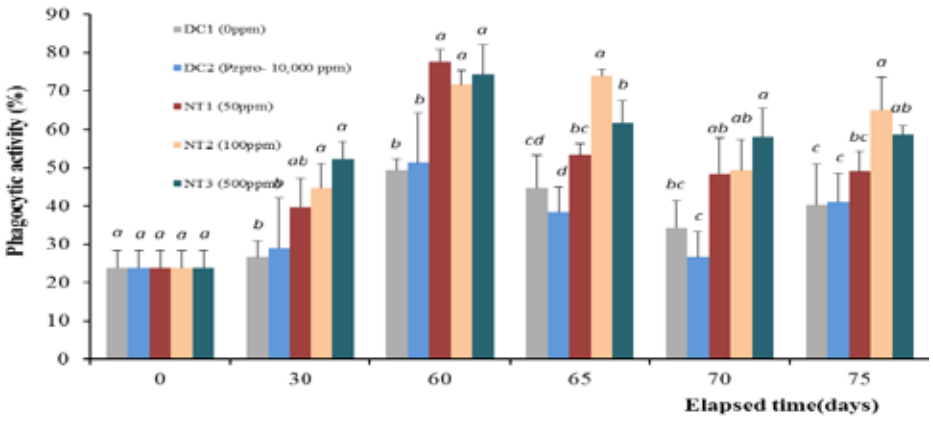

Figure 1. Phagocytic activity (PA) of L. vannamei at the treatments. Values are mean (± SD). Each bar represents the mean value from three determinations with standard deviation (SD). Data at the same exposure time with different letters are significantly different ($p<0.05$) among treatments.

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House Wellness Foods is involved in the health food business. It was established in 2006 as a group company of House Foods Corp. The Research Centre for Fish Nutrition and Post Harvest Technology at RIA2 was established in 1987. It has laboratories for chemical, microbiological analysis, digestibility evaluation for feed ingredients and trials for fish and shrimp.

Subsequent to this, pond trials were conducted. Above is a picture of the harvest

Current trends in global aquaculture nutrition R&D

By Wing-Keong Ng

The 16th International Symposium on Fish Nutrition and Feeding (ISFNF) was recently held at the coastal town of Cairns in Queensland, Australia from 25 to 30 May, 2014. Cairns is perhaps best known as the departing point for visits to the magnificent Great Barrier Reef. About 360 delegates from both academia and the aquafeed industry came from 38 countries to attend this premier fish nutrition symposium that is held biennially in different parts of the world.

Delegates to the symposium were kept updated on the latest trends in aquatic animal nutrition research through a total of 88 oral, 3 keynote and 180 poster presentations. Despite the phrase 'Fish' in the title of this series of symposiums, oral and poster presentations covered a variety of aquatic species including shrimp, lobsters, abalone, microalgae, seahorses, etc., albeit, the major focus of most presentations were on teleost fish of commercial importance.

Presentations consisted mainly of research data that are new and have yet to be published in scientific literature. As is the tradition of ISFNF, there are no concurrent sessions and all delegates attend the same highly informative presentations and ensuing discussions. Eminent scientists, graduate students and technical personnel from the aquafeed industry are therefore similarly informed of any new findings in this field of research.

Over the course of four days, delegates gathered to present, discuss and debate the latest innovations in aquatic animal nutrition. The symposium was divided into several plenary sessions such as 'Alternative proteins and alternative lipids', 'Nutritional physiology', 'Nutrigenomics and cellular nutrition', 'Nutrition and health', 'Feed management and adaptive nutrition', 'Nutrition and product quality' and 'Nutritional requirements'. A gap day was inserted into the symposium program for tours to nearby areas and a symposium dinner so that delegates had ample time for more informal networking and catching up with colleagues from around the world. A student symposium 'Getting published and finding employment' was also organised. The editors of the journals *Aquaculture, Aquaculture Research* and *Aquaculture Nutrition* as well as top management personnel from selected aquafeed companies gave talks to the students. It was well attended and well received by the many graduate students that attended the symposium.

Dr. Brett Glencross, CSIRO (left) was the chair of the local organising committee of ISFNF 2014 and Prof. Ronald Hardy, University of Idaho, USA was chair of the international scientific committee.

Fish nutrition research has come a long way since the 1960s and has contributed much to the development of the ever expanding global aquaculture industry. It was therefore timely and appropriate that the symposium started off at the opening ceremony acknowledging the significant contributions of some of our colleagues that had recently passed away. Dr Kevin Williams (Australia), Prof Colin Cowey (United Kingdom) and Prof John Halver (United States) were given honourable mention at the start of the symposium. The first keynote presentation was given by Prof Ronald Hardy who spoke on the topic 'John Halver Oration: Accidental Fish Nutritionist Who Changed Everything' and highlighted all the major achievements of John Halver who is widely regarded as the 'Father of Fish Nutrition'. John Halver passed away on October 24, 2012 at the age of 90.

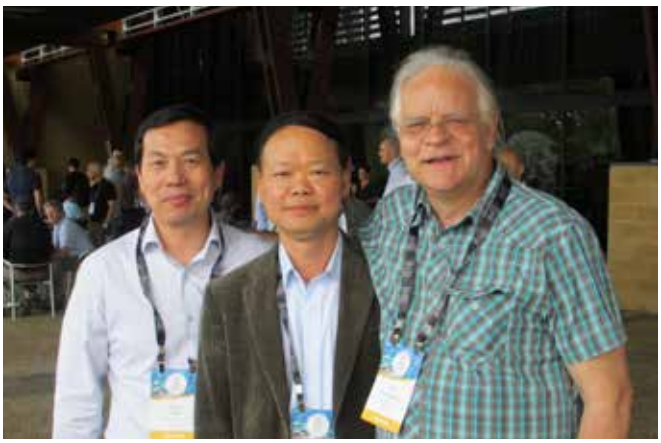
It was very interesting to see the role Halver played in making fish nutrition a legitimate scientific field. We were also taken on a journey of how fish nutrition research has progressed over the years from basic monitoring of the effects of diet on parameters such as growth and feed intake to the measurement of biochemical parameters to enzyme analysis and the pioneering efforts in making formulated pelleted feeds. We have much to thank John Halver for the advances currently being made in this thriving field of research which would not have been possible if he did not develop the first useful purified diet for conducting nutritional requirement studies in fish from way back in 1953.

Some of the highlights from this symposium that I find interesting but in no way a complete coverage of what was presented in the entire event, are listed in the following paragraphs below.

From Turkey, from left, Professors Murat Arslan, Ataturk University, Kenan Engin Mersin University, Mustafa Yildiz, Istanbul University and Orhan Tufan Eroldogan, University of Cukurova.

Alternative lipid sources and fatty acid metabolism

One of the hot topics presented by many researchers at ISFNF 2014 was the use of alternative lipid sources as fish oil replacement in fish feeds. Considering that the aquafeed industry is the major user of limited global fish oil supplies, the focus on this area of research is much needed. The current research and feed development trend is leaning towards total replacement of marine fish oil. Research on the biochemical and physiological changes in fish fed fish oil-replaced



From left, Professors Qingjun Shao, Zhejiang University, Kangsen Mai, Ocean University of China and Trond Storebakken, Norwegian University of Life Sciences

Associate professor Giovanni Turchini, Deakin University, centre, together with two of his PhD students

diets are being augmented with newer molecular techniques such as proteomics, genomics, metabolomics, etc. Fundamental research into fatty acid metabolic pathways and the discovery of unique desaturase enzymes in various aquatic animal species were also highlighted and contributed further to our understanding of fatty acid metabolism.

In his keynote presentation 'Omega-3 reflections: where we've been and where we still need to go', Prof Douglas Tocher (University of Stirling) outlined that the essential fatty acid (EFA) requirements of fish can be divided into three levels: physiological EFA requirement to prevent EFA deficiency which is low and can be satisfied with C18 PUFA in some species, EFA requirement for optimal growth and health which is higher, but unknown and variable, and lastly for nutritional quality meeting the omega-3 long chain polyunsaturated fatty acids (n-3 LC-PUFA) levels for human consumers.

Based on our understanding of the fatty acid metabolic pathways through research so far, it would seem that our ability for dietary manipulation to enhance the levels of n-3 LC-PUFA, especially for the latter two EFA requirement levels, is limited, if not impossible. As nature would have intended it, the biological systems of fish can only be pushed so far and definitely not to the levels of accumulating high amounts of n-3 LC-PUFA in their flesh for the health benefits of human consumers. In the coming years, the trend of fish oil replacement studies may increasingly lean towards the use of transgenics whereby microorganisms (eg. yeast) and oilseed crops are genetically modified so that the oil they produce are rich in n-3 LC-PUFA.

Monica Betancor (University of Stirling) presented new data showing the successful use of high eicosapentaenoic acid (EPA) oils derived from transgenic oilseed *Camelina* sativa in the feeds for Atlantic salmon. Salmon fed the EPA-*Camelina* oil diet showed higher weight gain compared to fish fed the fish oil-based diet. Another approach that can be used was presented by Bernard-Antonin Dupont Cyr (University of Quebec) where Arctic charr, brook trout or their hybrids were selected for new fish strains that can better elongate and desaturate linolenic acids (found in linseed oil) into the physiologically important n-3 LC-PUFA. This can then be developed into a selective fish breeding program where fish can be bred for their better ability to utilise plant-based oils.

Some researchers presented new findings on the effects of water temperature on fish physiology including topics such as the impact on fatty acid metabolism. This new trend of fish nutrition and feeding research is highly relevant, especially to the farming of temperate and cold-water fish due to increasing ocean temperatures as a result of global warming. Dietary interventions might be one way to better prepare farmed fish to cope with increasing water temperatures. For example, in presentations given by Fernando Norambuena (Deakin University) with Atlantic salmon or Orhan Tufan Eroldogan (University of Cukurova) with European sea bass, it was found that in higher water temperatures, fish metabolise more fatty acids into arachidonic acid, probably since this omega-6 LC-PUFA is related to the production of physiological compounds and hormones that are stress-related and may help the fish better cope with non-optimal temperature stress. This is especially important where fish is farmed in cages located in shallow coastal waters that are more prone to water temperature fluctuations compared to deep water cages. Much more focused dietary intervention research will be necessary to address this issue of rising seawater temperatures as it becomes more pervasive in the years to come.

Alternative protein sources

Replacement of fish meal in the formulated feeds of farmed aquatic animals is another favourite topic of research. An interesting new

From left, Dr Kok-Leong Wee, Behn Meyer, Malaysia, Dr Ooi Ei-Lin, consultant, Singapore and Prof Wing-Keong Ng, Universiti Sains Malaysia.

From industry in Asia, from left, Dr Dhanapong Sangsue, Evonik, Singapore, Dr Daranee Sookying, Gold Coin, Thailand, Prof Chutima Tantikitti, Prince of Songkla University, Thailand, Dr Rutchanee Chotikachinda and Prof Suichi Satoh, Tokyo University of Marine Science and Technology.

Keynote presentation by Ronald Hardy on John Halver Oration: Accidental Fish Nutritionist Who Changed Everything

trend is the development of non-GMO improved plant proteins specifically for use in aquafeeds. Alex Buentello (Navita Premium Feed Ingredients, USA) presented a study on the use of two improved non-GMO soy products to replace fish meal in the feeds of yellowtail. When these soy protein sources provided 40 to 60% of the dietary protein, growth performance of yellowtail were better compared to fish fed the fish meal-based or commercial feed.

It would seem that future research trends in alternative proteins may need to focus not so much in finding 'new' sources but rather in further improving and enhancing the nutritive value of the plant, microbial or microalgal strains that are already known to have good potential as fish meal replacement in aquafeeds. The role of taurine was given emphasis by some researchers due to the fact that more and more fish meal are being replaced by plant protein sources in fish diets and the role of supplemental taurine might become more important. Several reports on the use of lupins, yeast, soybean meals, blends of various plant proteins, corn protein concentrate, bean protein concentrate, insect meals, etc. were presented as oral or poster presentations during the symposium.

Another interesting trend in alternative protein research is the selection of fish strains that can better utilise plant protein sources. Shouqi Xie (Chinese Academy of Sciences) presented evidence which would suggest that certain strains of gibel carps are better able to utilise soybean meal in their diets and these fish should therefore be selected for farming. Going one step further, Rachid Ganga (Centre for Aquaculture Technologies Canada) compared the capability of transgenic Atlantic salmon with non-transgenic diploid and triploid fish, and reported that transgenic fish grew three times faster and consumed 20% less feed compared to their non-transgenic counterparts; no negative effects were observed on their growth performance or FCR by including plant proteins up to 68% of dietary protein in their feeds. The transgenic salmon are equally efficient at protein, lipid and energy utilisation when fed a plant protein relative to a fish meal-based diet. They further concluded that transgenic salmon could likely be a net producer of marine protein thereby contributing to the sustainable development of aquaculture.

Functional feed additives

Feed additives with roles other than nutrition are becoming increasingly important in modern day optimised aquafeeds. Functional feeds are feeds with additional function, usually health-promoting or disease preventing properties beyond their nutritional value. The role of dietary organic acids was the subject matter in three separate oral presentations. Wing-Keong Ng (Universiti Sains Malaysia) presented both laboratory and field-based data showing the positive impacts a new microencapsulated organic acids blend can have on the growth, immunity, hepatopancreatic integrity and resistance against vibriosis in penaied shrimp. Given the current outbreak of vibriosis in global shrimp farming with subsequent huge financial losses to shrimp farmers, such practical research needs to be given more priority. Zhigang Zhou (Chinese Academy of Agricultural Sciences) showed that

Delegates listening to Prof Ashild Krogdahl, Norwegian School of Veterinary Science, explaining new findings on the biochemical and physiological characteristics of the Atlantic salmon digestive tract which included an inside look of the fish gut using a miniature camera.

microencapsulated sodium butyrate can be used to repair or prevent damage to the gut of common carp fed oxidised dietary oils. Using a novel bacterial storage compound, poly-ß-hydroxybutyrate (PHB), which is basically polymers of butyric acid, Peter Bossier (Ghent University) reported its successful use for the control of bacterial diseases in aquaculture. Other than improving the health status of several tested aquatic animals, PHB was also shown to improve the growth performance and larval survival of treated animals.

Apart from organic acids, other functional feed additives given prominence at the symposium were the use of probiotics, yeast cell wall extracts, phytogenics, carotenoids and others. Many of the presentations on functional feed additives were close collaborative studies between private companies in the aquafeed and ingredient industries with research universities and institutions. Such research collaboration between industry and universities should be strongly encouraged to make fish nutrition research and development highly and immediately relevant to the end users. It was encouraging to see these type of collaborations happening more and more in the presentations coming out from the ISFNF series of symposiums.

Concluding remarks

To conclude, whatever goes in must come out of the fish. An interesting presentation by Mark Schumann (Fisheries Research Station of Baden-Wurttemberg) showed how by adding cork to the feed of trout, faecal buoyancy can be modified and the expelled fish faeces will float thereby allowing optimal removal of solid wastes in a semi-recirculating aquaculture system. This novel approach will result in improved water quality without adversely affecting growth, FCR or histology of the fish gut. This and many other interesting presentations are what make the ISFNF the premier symposium for everyone involved in aquaculture nutrition research and development. Congratulations to the organising committee of ISFNF 2014 for making this yet another successful and highly informative symposium. The next ISFNF is scheduled to be held at Sun Valley Resort, Idaho, USA.

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Recovery • Revival • Renaissance

At TARS 2014, shrimp aquaculture stakeholders discuss impact of diseases on production and marketing and solutions to mitigate diseases

The 2-day TARS 2014 (The Aquaculture Roundtable Series) recently concluded on 21 August in Phuket, Thailand. The theme for this edition in 2014 was **Shrimp Aquaculture: Recovery • Revival • Renaissance** and looked at impacts of diseases along the supply chain. It was attended by 196 participants with 16 presentations and 4 breakout themes.

This year, the presentation on the state of the shrimp industry set the scene at TARS 2014. The subsequent three presentations then gave different perspectives for market driven production (as opposed to production driven) at the global, country and farm levels.

State of the industry

With more than 30 years in the shrimp industry in Asia, **Dan Fegan**, Cargill Animal Nutrition, Thailand is the best candidate to summarise the state of the industry. Fegan said that the 'game changer' in Asia's shrimp farming was the introduction of specific pathogen free (SPF) vannamei in the early 2000s. The combination of healthy shrimp stocks and Asian farmers' intensive culture technology led to yields increasing by 3-4 times over those achieved with the monodon shrimp. In the last 20 years, global shrimp production grew to more than 3.5 million tonnes in 2011.

Since then Asian shrimp producers have enjoyed 10 years of fast growth although the year-on-year growth rates have been uneven; rapid growth interspersed with period of slower growth and period of negative growth associated with diseases. Fegan gave an overview of the industry status as per shrimp health, production systems, domestication and genetics, nutrition and feeding, markets, prices and customer and finally a swot analysis.

"After 10 years of growth with relatively few disease issues, we now face what is probably the most serious disease epidemic to date with early mortality syndrome or EMS. This experience clearly revealed weaknesses in how we deal with disease outbreaks as an industry and as governments in the region. Failure to recognise and inform on the EMS outbreaks at the beginning led to a two-year delay in response. Few people are trained in disease surveillance and as a result, we often do not get reports of new disease outbreaks until it is too late. We lack sufficient resources and capacity to effectively conduct epidemiological studies to support improved biosecurity. This is an area that requires good collaboration and coordination between industry and government to provide the appropriate level of resources and focus."

Dan Fegan

"In hindsight, EMS was an accident waiting to happen. Looking back, the relative ease of vannamei culture led to a relaxation of standard procedures developed to cope with disease challenges in monodon. Ten years ago, we routinely tested for *Vibrio* bacteria at farm and hatchery levels but this is no longer widely practised. Given that the *Vibrio* that causes EMS shows as green colonies on TCBS agar, we might have identified the problem and taken action much earlier."

The importance of good pond preparation has also been forgotten which may have exacerbated the problem. Fegan also reiterated that it is important to understand SPF (specific pathogen free) and SPR (specific pathogen resistant) technologies, and particularly that these alone do not guarantee success or replace the need for good management, site selection and biosecurity.

Although industry is enjoying high prices, this is a dynamic situation as these high prices mean that fewer people in the US are buying shrimp and restaurants are cutting back on shrimp in menus. "Asian producers need to understand their role and responsibility as part of the global food chain. We need to see ourselves as producers of food and focus on responsible production, food safety, environmental sustainability, traceability and as we have seen recently, worker and social rights. Despite the many improvements in farming technology, the outside perception of Asian shrimp farming needs to improve and so we need to find ways to work together and present ourselves better.

"Summing up, the Asian shrimp industry has come a long way but, as EMS has revealed, it is still fragile," said Fegan. "As the pioneering generation of shrimp farmers reaches retirement, future success will depend on how we cope with competition for resources, including human

The team from Avanti Feeds, India, from left, Dr P. Srinivasa Rao, Konda Suresh, Dr Anuj Tyagi, Mohanty, K.V.Raju and B. Satyanarayana with Dhanunjaya Goud, Lallemand Animal Nutrition on the right.

From left: Panisuan Jamnarnwej, Manoj Sharma and Tim Flegel

Industry from China, Taiwan, Vietnam and USA, Ju Peng (left), Dr Yang Yong (centre) and Benjamin Dong (right), Guangzhou Hinter Biotechnology, China, Cui Luo Sheng (second left) and Chuang Jie Cheng (third left), Sheng Long Bio-Tech International, Vietnam, Andy Pei, Cargill, USA (third right) and Allen Wu, Nutriad, Taiwan (second right).

Government and industry from Malaysia. From left, Mohammed Faizal, Malaysian Biotechnology Corporation, Ismail Abu Hassan, Department of Fisheries, Akazawa Noriaki, Agrobest, Abu Bakar Ibrahim, Blue Archipelago, Abdul Basir V Kunhimohamed, Infofish, Ronnie Tan, Blue Archipelago and Kodi Isparan Kandasamy, Malaysian Biotechnology Corporation.

resources, challenges in health management, cost efficient production, globalisation and market demands. What this might mean for the independent small farmer is an open question since the pressures we face are driving towards greater integration. As an industry we face a time of great change and our mission should be to work together to build a modern food production sector to compete against beef, pork and chicken as alternative sources of animal protein."

Perspectives on market driven production

Herve Lucien-Brun, consultant, France gave a global perspective on market driven production. He said that the local market could be a good option but is only an important market when it can absorb enough quantity each time. When producers have to look at export markets, they need to understand the characteristics of each market. It is important to target production to specific markets as each requires different products. The US mostly requires peeled deveined (PD) and other added value presentations (Easy Peel, PPD, etc), while premium markets in Europe demand for head on shell on (HOSO) and Japan requires headless shell on (HLSO) and peeled deveined tail on (PDTO). The exporters must also consider the needed organoleptic specifications for each market for each presentation.

The production cycle should cater for the high seasons when demand is highest. China is a new market but information is lacking on its preferences. Some recent changes in markets which are related to the high shrimp prices are that Japan is not importing as much shrimp because of the weak yen and Spain, the largest vannamei shrimp importer in Europe is actually buying more of the cheaper wild caught Argentinian shrimp. In France and Spain, the cooker market for HOSO shrimp is very exigent on stable quality. Value added shrimp imports are increasing in Japan too.

"To be profitable, producers should be aware of the seasonality when shrimp are in demand. In Japan, demand increase from June; in the EU 30% of demand is from Christmas to New Year. There is also the impact of shrimp size on price. In the early 1990s, when shrimp prices were high (USD 7/kg) size 80-100/kg was preferred. But when prices went down to USD 3.10/kg, the trend was larger shrimp which customers could afford. Now we are at USD 5-6/kg, so the size has shifted down again. Buyers love to buy from integrated operations for better control of the traceability, as consumers are now asking what the shrimp is eating. Usually, integration makes certification easier."

Lucien-Brun said, "In the case of disease affecting supplies, when the shipment schedule is disrupted, buyers will lose confidence in the supplier. Each buyer works with the least possible inventories and develops markets according to specific sizes. So it is really important to deliver on time and the correct size.

"Gradually certification has become a requirement for some markets but the producer is confronted with a jungle of certifications. Nevertheless, certification could be a good option to increase the value of the product only if the selected one is really adapted to the need and the demand of the client."

Uncertainty with EMS

In his country perspective, **Dr Panisuan Jamnarnwej**, Thai Frozen Foods Association explained the consequences of EMS on marketing shrimp from Thailand. Since late 2011 to 2013, EMS brought down production in Thailand, once the leading producer and exporter of farmed shrimp to global markets. The problem created was 'uncertainty'. Farmers decided to adopt the 'take no risk approach' and harvest as soon as shrimp has a price.

Jamnarnwej said that its shrimp industry had several adverse incidents affecting production and marketing, such as the flotation of the Thai Baht in 2002, it's anti-dumping tariffs since 2004, and the tsunami occurrence in Japan in 2012. However, production and exports continued to rise until 2012. An impact of low production with EMS was the reduction of its share in the US market which was 35% in 2010. This gradually declined to 21% for the January-March period in 2013 and then 10% for the same period in 2014.

Thailand's shrimp export sector was known for its ability to deliver large quantities of shrimp on time. With an annual production of 630,000 tonnes, the processing industry in Thailand had these selling points –availability, reliability and affordability. Today, with production reduced by more than 54% and less than 30% of processing plant output, exporters could not promise long term delivery and plan

From left; Dr Eduardo Leano, NACA and Dr Pikul Jiravanichpaisal, Fish Vet group, Thailand and R Natarajan, Avanti Feeds, India

Chu-Fang Lo *Han-Chin Wang*

marketing activities. The processing sector shifted to products which could take more time to produce such as peeled shrimp and value added products.

Vannamei – the BT way

Dr Manoj Sharma, Mayank Aquaculture has a successful shrimp farming business, initially with the black tiger shrimp and more recently with the vannamei shrimp. He has moved to farming vannamei shrimp the black tiger (BT) way because he envisaged that the future of high stocking density as is practised by most large farms in India has its limits to growth. The outcome of their farm trials showed that stocking density of 15-20 PL/m^2 and producing 40-50 g shrimp was the most profitable and sustainable. The bigger the shrimp, the better the returns which can be as high as 107% above costs for size 21-25/kg. According to Manoj, "The BT way is to focus on one cycle, low stocking and large size. A single crop is low risk for a niche market. Post larvae requirement is less demanding and pond carrying capacity is maintained. Until we have optimum quality and quantity of post larvae, this should be the way for vannamei shrimp. We carried out different strategies in farms in five locations."

The Indian shrimp farming industry has its limitations. "For the last 35 years, we have been producing the black tiger shrimp and when vannamei was allowed into the country in 2009, basically the infrastructure was for low density black tiger shrimp farming. The readiness to farm vannamei shrimp in higher density was lacking. India has never seen shrimp production over 100,000 tonnes until we produce vannamei shrimp. Now production is 90% vannamei shrimp. We were losing money with repeated failures of black tiger shrimp farming but we also had problems of overproduction of vannamei shrimp in year 2011 and 2012. At our farms we started farming vannamei at different stocking density and nobody believed that we could produce large size vannamei especially those with size 20/kg. In a single crop, we had better profits with big sizes and as a farmer, I need to farm shrimp for a profit."

In his presentation, Manoj reiterated on the farming protocols and his message was, "The environment is most crucial for survival in shrimp farming."

Living and surviving diseases

The plenary presentations in this session covered the challenging times and then moved into the future. The session was led by **Dr Tim Flegel** who at Centex Shrimp in Thailand continues to lead a team of researchers in disease in shrimp aquaculture. In the earlier days, it was white spot syndrome virus (WSSV) and more recently, it has been on acute hepatopancreatic necrosis disease (AHPND) or EMS. Flegel gave an overview of the situation with diseases in Asia. Flegel said that the decline in biosecurity in shrimp culture was due in large part to the complacency of the hatchery sector since the adoption of SPF-specific pathogen free vannamei broodstock. He referred to the feeding of live polychaetes to SPF broodstock by hatcheries just to get more nauplii production. Whereas for many years, broodstock have been fed frozen polychaetes.

"The rapid regional spread of AHPND and the simultaneous prevalence of the microsporidan *Enterocytozoon hepatopenaei* infections, caused by distinctly different pathogens, suggests that there is a currently a decrease in rigour in biosecurity measures in shrimp hatcheries and rearing ponds. Any decline in biosecurity leaves the industry extremely vulnerable to the emergence of new pathogens."

Although EMS has taken centre stage in recent years, WSSV is still a clear and present danger. In her presentation on 'identification of key host markers as anti WSSV genetic markers for a shrimp breeding program', **Professor Chu-Fang Lo**, National Cheng Kung University, Taiwan said, "The WSSV is unique but has the fundamental objective of infection and replication. To better understand how the host might combat WSSV successfully, our research focussed on the genetic background of how the shrimp copes with WSSV infection. By increasing the capacity to conduct high throughput transcriptomic and proteomic analysis we have been able to make significant scientific advances that can be developed into practical anti-WSSV strategies. To date we have found that some individuals from populations have gene expression patterns that look like they might be ideal for use in a genetic breeding program."

Lo and her team in Taiwan played a major role in the development of sequence code in the initial and subsequent PCR protocols for the detection of the AHPND causing strain of *Vibrio parahaemolyticus*. In her presentation, she discussed the study on the plasmid, speculated to be the source of toxicity in AHPND cases.

Contrary to the belief that shrimp have primitive immune system, **Dr Han-Chin Wang**, also from the National Cheng Kung University, Taiwan, suggested that there is some adaptive immunity in her presentation. Her pioneering work has led to the possibility that shrimp DSCAM (Down Syndrome Cell Adhesion Molecule) may be used to

The State of Industry and Marketing round table

Round table on Living and Surviving Diseases

Thomas Gitterle *Tim Goossens*

From left, Roeland Wouters, Pedro Encarnação and Fernandao Garcia Abad

stimulate specific pathogen resistance in conditioned or vaccinated shrimp. Wang has applied DSCAM, an antibody like molecule which can recognise and distinguish a very large number of antigen, and showed the responses after stimulation.

The future

In what can be strategies for the future, **Dr Thomas Gitterle**, SyAqua Siam, discussed 'developing a robust shrimp through genetic selection. He started by comparing the production targets by region. In the Americas, with large ponds and low stocking density, it is 70% disease resistance and 30% growth. Here in Asia with small ponds, high stocking density, it has been 30% resistance and 70% growth.

"In smaller ponds, it is easier to apply biosecurity measures to exclude pathogens. Before EMS, the selection pressure was on growth and after EMS, the target shifted to robustness. When diseases are difficult to eradicate, selection for host resistance or tolerance would be an attractive option. However, if the impact of disease is very low and the effort to make disease resistance is so high, too expensive or too complicated, the effect is reduced."

Gitterle discussed the theory in breeding for disease resistance and its actual practice. Natural selection when based on survival could be affected by the environment. Survival is a trait related to disease resistance and only a few diseases have been successfully improved by selection based on family means such as taura syndrome but not WSSV or yellowhead virus syndrome. Development of WSSV resistant populations has been an elusive goal with family based selection programs. Nevertheless WSSV resistant lines have being developed in South America using survivors and applying high selection pressures. Within each family, there are variations and the individual with the mutant genes that confer resistance can only being identified when strong infections are applied. However using survivors as breeding candidates also poses biosecurity risks.

"In cases like WSSV or AHPND resistance, that show very low heritabilities estimates, it is difficult to gain a significant resistance using only family means information. In such cases genes from small group of survivors should be introgressed into the breeding population (by backcrossing) but reducing as much as possible any risk of cross contamination," said Gitterle.

Another strategy is fighting pathogens through a range of molecular mechanisms. **Dr Tim Goossens**, a molecular biologist at Nutriad Belgium looked at several classes of functional additives that have been demonstrated to have potential in reducing bacterial pathogenicity.

"EMS has highlighted the fact that bacterial infections remain a major challenge for the shrimp industry. It emphasises the need for a multifaceted sanitary program; combining biosecurity protocols at the hatchery to the farm and including the use of alternatives to antibiotics."

Goossens added that functional feed ingredients (FFIs) can be used to decrease dependence on antibiotics but their mechanisms are more complex. Their impact will depend on context and what is the most limiting optimal performance in a farm. He discussed some studies on immunomodulators, organic acids and phytogenics. "Our vision of yeast cell walls, for example, is that it is more than just glucans and mos (mannan oligosaccharides). This is like reducing a car to just its wheels and engines. There are other components in yeast cell walls which can have immune stimulation system functions.

"The challenge is how to select bioactive ingredients for FFIs, suppressing bacterial pathogens. To do so, investigating their modes of action will be crucial, as this knowledge will help us in developing the appropriate assays to select the most performant compounds. At the moment, developing FFIs still comes with educated guessing, but by studying their molecular mechanisms, we can make this guess as educated as possible."

Culture technology and practices

Moving on, the meeting looked at culture technology and practices. Upstream at the hatchery level, **Roeland Wouters**, Inve Aquaculture, Belgium, looked at how hatchery management can be improved to obtain more robust post larvae (PL), and consequently how PL quality is linked to grow-out performance.

Wouters showed results from studies on the parameters that have been correlated to PL quality. On the effects on hatchery nutrition, a

Rudi Bijnens, Inve Aquaculture, Thailand

Nguyen Duy Hoa , Cargill Vietnam

S Santhana Krishnan, Marine Technologies, Thailand (middle) with A Octo Rachnalim, Global Gen, Indonesia (left) and Partha Bandyopadhyay, Biostadt India

Dr Puth Songsangjinda, Marine Shrimp Research and Development Institute, DOF, Thailand

Abu Bakar Ibrahim, Blue Archipelago Bhd, Malaysia

Herve Lucien-Brun

study evaluated the effect of different *Artemia* replacement levels, showing that hatchery managers should not replace *Artemia* totally to cut costs, because growth potential of PL that received no *Artemia* will be compromised. In addition, Wouters showed how nutraceuticals can increase disease resistance during transfer of PL to nursery and to grow-out ponds.

Without doubt, every production phase is influencing the next one - from maturation, larviculture and grow-out. The cost of PL production is about 20 times less than the costs of grow-out production. This means that producers should spend slightly more money on buying quality-tested PL rather than allow the hatchery to cut costs by using inferior feeds and poor health protocols. A hypothetical cost benefit on the effect of PL quality on shrimp grow-out gave a 37% difference, in favour of improved PL quality versus regular PL quality.

Wouters' message was, "Hatchery operators should not compromise on hatchery performance by cutting costs on essential feeds, health products and microbial management. They should invest from the start on high-quality PL and look at cost per million PL instead of total cost input. At the farm level, we need to better understand the link between PL quality and grow-out."

Nursery

Perhaps the biggest change the industry has seen recently is the use of a three phase culture system. A nursery phase is already a common practice among integrated groups in Latin America where grow-out production reduced by 20-30 days and feed conversion ratio (FCR) reduced by 10-30%, said **Dr Fernando Garcia Abad**, Epicore Bionetworks Inc, USA. In Asia this is a common strategy to mitigate EMS by stocking larger size shrimp in grow-out ponds.

"There are mixed results in farms in South-east Asia. The main bottleneck has been selecting the right transfer technique. Rather than reinventing the wheel, producers should adopt the Latin American methodology and refine it for Asia. In Mexico, attention is placed on the transfers of PL to grow-out facilities. Since 2012, transfers use pumps which reduce stress and mortality at transfers to only 3-5%. In 2013, the maximum transfer distance was 3 km and transfer capacity was 15 kg/minute.

"The three phase system has its benefits for the whole supply chain. During the grow-out phase, the animal is acclimatised to the environment and this increases efficiency of production resulting in more crops a year. Hatcheries sell more PL, producers have more crops and the system also takes advantage of the compensatory growth on shrimp when shrimp are stocked into open ponds. This reduces cycle duration and improves FCR. In Mexicio, growth of 7-8 g in the first 30 days was achieved with the three phase system as compared to 3-4 g with regular stocking."

Garcia's message was, "Farmers are now enjoying good prices and they should use this opportunity to invest in and use the proven new technology. In this way, we can move away from artisanal shrimp farming towards more controlled sustainable shrimp farming."

Grow-out

Since the outbreak of EMS there has been widespread use of probiotics. During TARS 2012 which focussed on the shrimp aquaculture industry too, **Dr Pedro Encarnação**, Biomin, Singapore, looked at whether probiotics worked in shrimp farming. At TARS 2014, Encarnacao concluded that there is enough evidence that probiotics are effective tools for aquaculture application (see article on pages 19-23).

"With the extensive research on probiotics, we now understand how they work. The success of probiotic application depends on the clear understanding of the bacterial strains, together with the use of its functions, concentration and management. It has been shown that well defined probiotic strains are able to reduce pathogenic bacteria, improve gut health, and prevent the degradation of the surrounding environment, thus enhancing performance and production efficiency."

The practical approach of managing and overcoming disease infection is through proactive management as described by **Soraphat Panakorn**, Novozymes Biologicals, Thailand. He said that his presentation not only covers the technology used in Thailand but also perspectives on culture practices. Farmers only realise the severity

The Nutrition and Health Interaction session with from left, Brett Glencross, Camilo Pohlenz and Kabir Chowdhury

Juadee Pongmaneerat, DOF, Thailand (middle) at a Nutrition and Health Interaction round table.

Round table on Culture Technology and Practices

Dang Quoc Tuan, Viet Uc, Vietnam (left) and John Diener, Gold Coin Group

Soraphat Panakorn

of infections when shrimp mortality is high. Hence, the implementation of proactive management is critical to achieve success. To keep disease away, we have to start from the beginning and I recommend the following: evaluate the pond carrying capacity, provide sufficient oxygen for a whole crop, learn to manage organic matter, only stock clean and healthy PL, look for early signs of diseases, analyse daily and carry out future forecast for physical and biological parameters, manage labour well, learn to see the EMS and weather link and always obtain updates on current situation and increase knowledge on shrimp farming.

Panakorn also took the opportunity in his presentation to demonstrate some unique features of the industry in Thailand - the family based employment system and the support by industry leaders. In the former, he said that the whole family is usually employed at a farm. Housing for the whole family is provided and this allows the farm manager or technician to concentrate on the production and stay with the farm despite adversities. In the latter, there are several groups who have set up online chat groups to help farmers overcome problems. This is in addition to several publications by industry leaders such as Dr Chalor Limsuwan guiding farmers on best practices.

Soraphat's message was simply; *invest reactively = disaster, invest actively = losses, invest proactively = benefits*

Nutrition and Health Interaction

In other animal production industries, nutrition directly influences animal health and the same goes for the shrimp. **Dr Brett Glencross**, CSIRO Aquaculture program, Australia set the scene in this session by doing a gap analysis in developing the ideal feed for shrimp. Glencross said that the nutrient requirements are known for 38 out of the 45 required parameters for the monodon shrimp. While for the vannamei shrimp, only 19 out of 45. However, in a comparison of known requirements for amino acids, minerals, and other nutrients, it is clear that there are not big differences in the requirements between either shrimp species when considered at the same animal size.

"Now we need to focus on the known unknowns. Where are the gaps? The knowns are protein, energy, most of the amino acids and fatty acids. However, we still do not know on some amino acids, fatty acids and minerals and vitamins. Another emerging class of nutrients is the unknown unknowns. Examples of these are some of the bioactive factors in squid, crustacean, microbial and algal meals. On what will the future hold, Glencross said that this included the understanding of nutrient demand, future alternative ingredients and impacts of genotype effects.

"On nutrient demand, we should focus less on dose response and more on mechanistic demand. This is understanding the process that drives the demand of nutrients under certain culture conditions. There are increasing demands on selection for growth traits. In selected shrimp, feeding traditional diets will constrain growth. Diets must match the new demands such as the protein amount per day and the better conversion to growth."

In aquaculture, it is quite accepted that managing health in marine fish through nutrition is far ahead of shrimp. As the shrimp industry is spiralling downwards, it will be appropriate to look at what is done in the marine fish industry. **Dr Camilo Pohlenz**, BioMar, Costa Rica tells us that for both fish and shrimp, the establishment of a defense state triggered by disease is a costly metabolic process and involves a shift of nutrients to the immune system. Thus, the appropriate nutrition is not only for growth but to retain proper health. With a higher level of knowledge, disease management is easily implemented in fish which as vertebrate has adaptive immunity. He detailed out what the fish industry has learnt in this field and compared this to the shrimp.

However, he added that as the immune system of the shrimp is different, it will not be possible to translate the information from fish to the shrimp. The difficulty is also with the lack of information. Pohlenz showed some published research on the effects of beta-glucan and polysaccharides in shrimp health.

The shrimp industry has been at crossroads with NGOs for its wonton use of fishmeal and fish oil. As we look towards replacement of marine protein meals and getting the most from feed ingredients, we also have to look at enzymes. **Dr Kabir Chowdhury**, Jefo Nutrition Inc., Canada addressed the role of enzymes and also the skepticism of feed manufacturers on the viability of enzymes undergoing harsh manufacturing conditions in pelleting and extrusion.

"Most enzymes being used today are for improving digestibility of phosphorus and carbohydrates from plant protein sources. Apart from phytase for phosphorus, other minerals and some amino acids, carbohydrases such as cellulase, ß-glucanase and xylanase are being tried in shrimp feed targeting different components of a plant ingredient. There is also a growing interest in the use of various alkaline proteases and lipase to improve protein and lipid digestibility, respectively, and for the latter, also to improve emulsification properties of fats and oils.

In his brief review of scarcely published articles, he showed that dietary protease significantly improve growth in vannamei shrimp fed low fish meal diets. "We know that enzymes are essential for physiological functions. However, environment, age or size, diets and moulting stage affect the content and composition of digestive enzymes that can be balanced by dietary enzymes. Dietary supplementation may have some positive effects but it depends on factors such as heat stability, dosage and whether they are multi or single enzymes. In addition, enzyme selection should be based on raw materials used, culture environment and species."

The theme of TARS 2015 will be ***Aquafeeds 2.0: from farm to plate.*** It will be held from 19-20 August 2015 and the venue will be announced soon. It will focus on the aquafeeds industry, the requirements and implications along the value chain; from breeding to processing, from farm to plate across all species.

Shrimp Standard for the ASEAN Region: Draft for Public Comment (August 2014)

Today, more than 30 aquaculture standards exist, all with distinct scopes that address social and environmental issues through different methods. None of these were defined explicitly for the ASEAN region. This makes it difficult and costly for farmers and processors to select a path to certification that will be rewarded in the market. As a result, each works on different standards to meet buyer requirements, adding significantly to costs. Due to the high cost of compliance with recognised standards-including auditing-and the lack of tangible financial benefit, a significant number of ASEAN producers struggle to attain certification, if they are interested at all. The few farms that are certified using international standards have not seen significant increases in revenue as a result. This lack of incentive has discouraged other farmers from making improvements in their practices.

At the 2nd Meeting of the ASEAN Public-Private Taskforce for Sustainable Fisheries and Aquaculture in 2013, the Taskforce, public and private sector representatives identified the harmonisation of shrimp standards and efforts to reduce the costs associated with certification, particularly for small-scale producers, as a priority for the region.

Vision and scope

The draft Shrimp Standard for the ASEAN region is designed as a workable tool for the shrimp industry to improve the sustainability, environmental and social performance of farming, especially at the small-scale, and receive recognition in key export markets. The standard is composed of interim targets incorporated from national good aquaculture practices (GAP), and the most achievable and important requirements of internationally recognised environmental and social aquaculture certifications schemes and ratings systems such as the Seafood Watch system. Building a standard that couples ASEAN realities with the most important sustainability requirements will result in direct benefits to farmers and ideally lead to a greater willingness by farmers and other supply chain actors to make the investments required to further improve sustainable and responsible production practices. It is critical that any benchmark set is achievable by a sufficient number of shrimp farmers in the ASEAN region, including small-scale farmers, and would offer manageable targets to serve as a catalyst in encouraging compliance.

Pathway to the Shrimp Standard for the ASEAN Region

The standard is being developed through a transparent, inclusive multi-stakeholder process. The development of the Shrimp Standard for ASEAN aligns with the ISEAL Alliance's globally recognised guidelines for setting environment and social standards. The standard is being developed with support of the United States Agency for International Development (USAID).

Shrimp Standard for the ASEAN Region

The proposed standard was first developed by consolidating the existing national GAP in the ASEAN region including the Thai GAP, Indo GAP, Viet GAP, the Thai Code of Conduct and the ASEAN Shrimp GAP. The Steering Committee included additional indicators from the Seafood Watch Aquaculture Sustainability Assessment Criteria (SFW) to raise the environmental performance level.

Section I-Farm Level Standard

Traceability

Traceability is defined as the ability to follow the movement of shrimp after harvest or inputs such as feed and seed, through specified stage(s) of production. This is critical for improving sustainability. The section highlights the most important traceability indicators that can be audited at the farm level.

Shrimp Health Management

Optimising health, minimising stress, reducing shrimp disease risks, and maintaining a healthy culture environment at all phases of the production cycle are critical to minimising the environmental impacts of disease. This section addresses the monitoring of diseases and the use of chemicals, including antibiotics.

Source of Stock

This section addresses the use of shrimp species in production and ensures that the species used are from sustainable sources.

Feed Sourcing and Management

This section addresses sustainability and efficient use of wild fish resources in shrimp aquaculture feed that can be verified at the farm level.

Environmental and Habitat Management

This section seeks to manage the impacts that shrimp aquaculture operations can have on biodiversity through activities such as farm siting, predator control, or water quality discharges. Topics covered include mangrove and habitat impacts; use and discharge of waters; predator control, escape management and socio-economic aspects (general working conditions, health and safety, contracts and wages and community issues).

Section II- Hatchery Standard

One important way to minimise the environmental impacts of shrimp farming is to ensure that species used are sufficiently domesticated and screened for disease. This section is designed to be audited at the hatchery and may require a visit by the auditor or an official declaration.

Section III- Feed Mill Standard

The use of fishmeal and fish oil is one of the most harmful environmental impacts associated with shrimp production. This section is designed to be audited at the feedmill and may require a visit by the auditor or some sort of official declaration. It is important to minimise or eliminate the use of fishmeal and fish oil from illegal, unregulated, or unreported fisheries.

Issues for Input from Interested Parties

The Steering Committee charged with the preparation of the Shrimp Standard document seeks input from all interested parties on the following fishmeal sourcing issues:

- How to address feed sourcing for shrimp, including the use of trash fish from regulated and unreported fisheries;
- How to integrate human rights issues in shrimp farm operations;
- Issues of traceability from the fishing port to the fishmeal plant and finally to the feedmeal plant.

Full details and the template for inputs is available at this site: https://www.dropbox.com/sh/l7xiy6swfinw4aa/AADYivk6Fntfu6iCOJx8Zneza
Download (i) Public Comment Feedback Form and (ii) the Draft Shrimp Standard for ASEAN. The draft is available in the Indonesian, Thai and Vietnamese languages.
Please send all comments no later than October 10, 2014 to shrimp.steeringcommittee@gmail.com

NGOs versus the right to ocean aquaculture

By Katherine Hawes

An insight into the legal support for non-governmental organisations regarding environmental protection of the seas

Along with the development of offshore and ocean aquaculture comes the legal challenges brought about by non- government groups (NGOs) who challenge development approval. It is not an easy process for NGOs to start legal proceedings leading to many of them resurrecting *acto popularis* as a legitimate means of public participation in environmental human rights.

For any individual to take action in the courts, there must be an actual case or 'controversy'. This means that they must have suffered an actual injury, or an injury is imminent which has been caused by the party they wish to take action against. In law terms this means that a person must have 'sufficient standing' to make a complaint.

In recent years, the U.S. Court of Appeals for the Ninth Circuit issued a decision on a very important lawsuit about ocean fish farming. In this lawsuit, several NGOs had taken action to stop the National Marine Fisheries Service NMFS (the federal agency responsible for conservation and management of ocean resources) from issuing a permit to an ocean fish farming company based in Hawaii.

Initially, the court ruled against the NGOs, stating that since aquaculture was a form of fishing, the NMFS had the right to issue the permit. In addition, the court also stated that they were under no obligation to study the impacts of allowing fish farms in federal waters, once the facility's activities had terminated.

However, an appeal was lodged on this decision and the International Convention Appellate Court reversed some of the lower court's decisions including the agency's argument that the NGOs did not have sufficient standing to take action.

In law, a larger scope

Within the legal world, it is generally accepted that a person who has suffered an injury has access to support from the legal system. However, when it comes to environmental human rights, this has a larger scope than the individual as it may affect a whole community. As a result, the Aarhus Convention has provided unlimited community access to justice, thereby re-establishing the concept of *acto popularis*.

The need for legal support for communities relating to environmental matters is not a new initiative and has been widely recognised. Principle 10 of the Rio Declaration of 1992 committed governments to the proposition that 'at the national level…. effective access to judicial and administrative proceedings, including redress and remedy, shall be provided'. Due to this, a legal re-think commences of who should have access to justice.

The Aarhus Convention entered into force on October 30, 2001. This Convention is a unique international legal instrument, which combines the subject of environmental protection with human rights and the responsibilities of public institutions and their associations towards the environment. It also distinguishes between public participation in decision-making and access to justice.

Environmental protection

Article 9(2) of the Aarhus Public Participation Convention states that access to justice should be available to the public when they are likely to be affected by, or having an interest in, environmental decision-making. This is called 'public concerned'. However, this is still a

restriction as Article 9(2) states that they must only have a 'sufficient interest' or who can assert 'impairment of a right'.

There are also further restrictions as although the Convention explicitly requires that NGOs 'be given the status of the public concerned' (and therefore allowed to sue), this is further qualified by allowing parties to put a stop to legal action by imposing 'other requirements under national law'. However these must be interpreted as 'consistently with the objective of giving the public concerned wide access to justice within the scope of this Convention'.

The Convention also requires the parties 'to ensure' that members of the public have access to information and have access to judicial review. In part, the Convention draws on notions of international human rights law and it is intended to provide for participatory, informational and procedural rights in environmental matters, and a failure to do so implies a breach of human rights.

Instead of defining who may participate in environmental decision-making in terms of 'private' and 'public interest', the Convention refers to the 'public concerned'; meaning: the 'public affected or likely to be affected by, or having an interest in, the environmental decision-making; for the purpose of this definition, non-governmental organisations promoting environmental protection and meeting any requirements under national law shall be deemed to have an interest'.

The provision establishes a broad class of persons concerned, and it presumes that environmental NGOs are concerned in a legal sense. The parties to the Convention are also required to generally provide for the recognition of and support to environmental NGOs. Moreover, drawing on earlier European Conventions as well as the OECD recommendations on pollution policies, the Aarhus Convention prohibits discrimination with respect to the person's citizenship, nationality, domicile and, in the case of a legal person, the place of its registered seat or effective centre. This applies to access to information, participation in decision-making, and access to justice.

Although the wording of the Convention is vague; it sets out five means for enhancing participation:

1) Parties need to provide for '*early* public participation, when all options are open and effective public participation can take place'. This is essential, since the later the public gets involved, the more difficult it is to influence the decision.

2) Each party must *inform* the public concerned, by public notice or individually, about the proposed activity, the nature of possible decisions, the envisaged procedure and possibility of participating, the time-frames, and the place where information is being held.

3) The public is to be allowed to *submit comments*, either in writing or at hearings or inquiries that it finds relevant to the proposed activity.

4) Each party is to ensure that in the decision due account is taken of the outcome of the public participation. This is a critical moment in the decision-making process, since 'due account' is not very precise and thus provides leeway for the decision-making authority. Even though it does not amount to a veto of the public, the decision-making authority cannot simply do away with the comments and opinions without considering them seriously. Moreover, the decision must state the reasons and considerations upon which it is based.

5) The right to have the decision legally reviewed. Basically, access to justice, as defined by the Aarhus Convention, is a means of having erroneous administrative decisions on *environmental issues* corrected by a court or another independent and impartial body established by law. The right to access to justice pertains to two kinds of situations. First, any person who considers that his or her request for environmental information has been ignored, refused or not dealt with in accordance with the Convention, must be ensured access to a review procedure before a court or another independent and impartial body. Second, any member of the public having a sufficient interest or maintaining impairment of a right, must be ensured access to a review procedure before a court of law or another independent and impartial body, to challenge the substantive and procedural legality of any decision, act or omission concerning specific activities, which may affect the environment. Therefore, access to justice is not limited to cases where the participatory or informational rights of the Aarhus Convention are infringed, but must also be granted in order to challenge the substantive legality of a decision. In addition to decisions concerning specific activities, the parties are required ensure access to justice in cases concerning other relevant provisions of the Convention (e.g. decisions on plans and programmes) 'where so provided for under national law'.

The vague language and the fact that it essentially remains a matter for national law to determine what constitutes a sufficient interest and an impairment of a right, indicate the difficulties in drafting this part. Nevertheless, what is a sufficient interest and an impairment of a right should be defined in a manner consistent with the objective of the Convention, namely to give the public concerned 'wide access to justice'.

Two key things should be observed in this regard. First, according to the Convention, environmental organisations are deemed to have an interest in environmental decision-making and in the judicial review procedure sufficient interest to grant standing. Second, contrary to the principles established on access to the European Community Judicature, the Aarhus Convention does not require the persons 'concerned' to be more affected or more likely to be affected than the public in general. If the entire population in an area is likely to be affected, then all persons may participate and bring the case to court for review.

In conclusion, the right of groups and individuals to unfretted access to justice has not been fully embraced by the Convention. The vague language of the Convention and the fact that it essentially remains a matter for national law to determine what constitutes a sufficient interest and an impairment of a right, indicate the difficulties in expanding access to justice for public participation.

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Marketing Philippine vannamei shrimp

With vannamei shrimp production expanding, the potential of domestic and export markets was discussed at the 9th Philshrimp Congress. The weakest link in the shrimp supply chain is the processing sector.

The Philippines used to be a major exporter of wild and farmed shrimp. According to **Albin M. Ganchero**, Department of Trade and Industry (DTI), the shrimp trade from the Philippines was mainly block frozen monodon shrimp to Japan but volumes have been decreasing in the last 4 years. In 2009, the export to Japan was 7,678 tonnes, 6,911 tonnes in 2010, 6,857 tonnes in 2011 and 4,219 tonnes in 2012. The value in 2012 was USD 43 million.

Data presented by **Chingling R Tanco**, MIDA Trade Ventures International Inc, and president of the Fisheries and Aquaculture Board – the group that was responsible for the lifting of the ban on the vannamei shrimp farming in the Philippines, showed that exports to the US totalled 2,468 tonnes in 2013, up 100% from that in 2012 at 1241 tonnes. In the first quarter 2014, exports totalled 964 tonnes and it was estimated that the volume in 2014 could be double that of 2013. The proportion of vannamei shrimp was estimated at 75% in 2013 and 94% for the first quarter of 2014.

In her overview on the international trade in shrimp, **Fatima Ferdouse**, Infofish, Malaysia showed that there was a shortfall in supply since 2012. "Increased production in Indonesia, Vietnam and India could not offset the large shortfall in Thailand, China, Vietnam and Malaysia. Consequently shrimp prices remained record high worldwide till early this year and affected consumption in major markets, Japan, USA and the European Union (EU). Supply shortfalls in East and Southeast Asia prompted strong inter-regional and intra-regional imports for domestic consumption. Shrimp prices remained at a record high. However, this curtailed demand in the three major markets, US, EU and Japan."

Fatima expects the international trade in shrimp to be less vibrant in 2014. "The yen continues to restrict imports into Japan where import price increased by 30% since 2013. However, higher import volumes were seen in China, Korea and Vietnam in 2013. In 2013, imports rose 34% in China. Vietnam imports of shrimp from Ecuador increased four times in 2012 versus 2011. In 2014, higher imports will continue in these countries."

During the first year of vannamei shrimp production in 2009, the domestic market could easily absorb this small production (4,500 tonnes/year) and as demand was for small size shrimp (10-15 g), this was what the farmers produced. However, production has been creeping up and producers need to find markets for their shrimp aside from the local chilled shrimp market. The message at the 9th Philippines Shrimp Congress in Bacolod in July was to supply the domestic market first and then the export markets (see pages 4-6). The marketing session reviewed options in marketing farmed shrimp and the bottlenecks in the supply chain.

Potential of domestic markets

Gina Regalado, vice president for marketing, INTAQ Foods Inc, said that the Philippines is the 12th most populous country in the world with approximately 100 million people. Rising incomes are spurring demand for shrimp. The country earns 12% of GDP from Overseas Foreign Workers' (OFW) remittances. The burgeoning business process outsourcing (BPO-IT) industry, popularly known as call centers, contributes around 5% of the GDP. These two developments are strengthening the local retail industry. Food is the highest expenditure in the Philippine household with an average of 35% of income spent on food. Increasing urbanisation of the local population has changed the local retail food market and is the driving force for the lifestyle change. Manila is still the largest market for seafood products followed by Cebu.

In her presentation on local shrimp market trends, Regalado who is responsible for the shrimp trading business unit, gave some details on the distribution chain for live and chilled farmed shrimp. These comprised brokers/consignacion, wholesalers, viajeros and wet markets. The price mark-up at the retail level will be 25 to 30%. In this distribution chain, chilled shrimp is air freighted from producing regions outside of Luzon Island. The transport costs are high and Regalado said that it is cheaper to import seafood from Vietnam to Davao in the south, than to bring chilled shrimp from Bacolod to Manila.

According to Regalado, some 15,000 tonnes of shrimp can be channelled to the domestic markets annually. Supermarkets and supercentres are the primary distribution channels for the retail market and cater to 20% of the middle class and upper class Filipinos. The trendsetter brands in the local food market include Puregold, SM, Robinsons and Rustans. Aside from seafood counters within the

From left; Fatima Ferdouse, Chingling R Tanco and Gina Regalado

Local and international suppliers to the shrimp industry supported the event. Left picture, the team from Santeh Feeds Corporation was led by Patricia Rico (centre left). The company produces fish and vannamei shrimp feeds under the Tateh brand. Right picture, Jimmy Wang (on the right) and his team from Uni President Taiwan which markets imported extruded and pelleted shrimp feeds as well as those containing probiotics.

supermarkets, many have smaller outlets. "The local horeca market includes fast food restaurants which have shrimp on the menu and are already importing their supplies of frozen shrimp. There is an increasing number of restaurants with various concepts and their demands include contracts for 3-6 months supply, consistent quality, uniform size and delivery every week. This means that producers need to process and store the products," said Regalado.

"The product forms required for supermarkets and horeca markets are now a far cry from the chilled shrimp that we are currently supplying to wholesale and retail markets. These range from individually quick frozen (IQF) or block frozen head on shell on (HOSO) or headless shell on (HLSO) of large shrimp for high end restaurants and various forms of peeled shrimp IQF packed in retail packs for supermarkets. There are certain requirements on packaging: the shrimp need to be vacuum packed, complete with labels with information on nutrition facts, bar codes, production and best before dates. There is a demand for high volumes of nobaishi, the product form where 11g, 13g, 15g and 18g peeled deveined tail-on (PDTO) stretched mostly for Japanese all-you-can-eat buffet meals and also in supermarkets. If this is available direct from processors, it saves the restaurant or supermarket this preparation step."

Exporting Philippine shrimp

Processors and exporters from the Philippines are familiar with exporting to Japan, its major trade partner for the last 35 years. In her presentation on the US and European markets, Tanco said the US is still the price setter and the biggest volume market for vannamei shrimp. The EU market is largest at 780,000 tonnes annually of several species but with different standards and specifications. With different requirements for each market within the 27 EU countries, the administrative work can be colossal. The EU requires plants to be approved by competent authorities with an EU number. Russia is a possible market but again it needs to approve importers.

"All in all, before we can start exporting, the challenges are also in price, food safety, sustainability and environmental and social responsibility. There is also the traceability issue for the EU and premium USA markets; only 88 farms are BFAR (Bureau of Fisheries and Aquatic Resources) certified for vannamei shrimp production and 111 farms for black tiger shrimp. Both markets increasingly require third party certification as this is an important demand from retailers. Second party certification (government) is not enough. For the EU market, labelling in 8-12 languages will be required. For the US markets, some major markets require 1-2 star BAP certification and some with BSCI (social responsibility).

In the EU market, the Philippines have the advantage of the GSP (generalised scheme of preferences) and soon to be approved GSP+ as compared to Thailand and Malaysia which may face tariffs of 12% by January 2014. Exports to Japan already enjoy zero tariff under the Philippines Japan trade agreement (PJEPA). In terms of product form, Tanco listed them as raw headless and EZ peel or 'Zipper back' or Quick peel, raw peeled and cooked peeled n deveined tail-on for the US market and raw peeled, and HO (head on) or whole shrimp for the cookers market in France and Spain.

The processing link

Although production has been increasing, the processing sector has not developed in tandem. "There are too few plants or the capacity is too small. The average capacity is 3 tonnes/day. Some equipment are too old and inefficient. IQF equipment is still few or too new. There is no cooking capacity at all. Processors use few workers, having been used to producing mainly large shrimp for Japan while non-commodity products from the vannamei shrimp need at least 300-500 people to regularly do 5-10 tonnes per day. Third party certification is not yet understood. The government is still insisting on their certification scheme and confusing basic GMP and HACCP with a more complicated EU standard or requirement. In comparison in India which developed IQF a few years ago, Philippine plants still focus on block freezing."

Tanco drove home the message on the bottleneck in the processing sector, "The chain is farmer-processor-market and we must work together. As production is increasing, the processing sector must develop together, whether it is for domestic or export markets. The domestic market cannot depend on the chilled product as the auction houses have limited demand. Producers in the Visayas depend on processors as it costs them PHP 30-50/kg to transport shrimp to Luzon. The number and locations of processing plants and cold storage facilities is small or shared with meat and poultry products. There is only one dedicated shrimp processing plant in General Santos."

Regalado said, "Producers need to increase production volumes first and then solve their one-crop/year and disease problems. Processing plants need to do product developments to cater for the value-added local market"

In summary, Tanco said, "Although we have some new plants in 2014, support for the processing industry is just as important as that for the farming community. As such, BFAR and PhilShrimp should enlist the help of the DTI to help develop the seafood industry. This may include financing, duty free import of equipment and simplify bureaucracy. The authorities should also deal with issues on food safety, environmental and social responsibility and adopt modern seafood processing. They also should encourage third party certification of plants, farms, hatcheries and feed mills. The seafood processing sector should organise an association to address these concerns. This is the only way the government will listen to them."

Focus on Malaysian seafood and aquaculture in Asia

Various marine fish marketed by the GST group which is also a leading producer of marine fish in floating cages.

This third in the series to showcase the Malaysian seafood industry was held from 19-21 June 2014 in Kuala Lumpur. The three-day Malaysia International Seafood Exposition (MISE) 2014 trade show was accompanied by a two-day aquaculture and seafood trade conference on 'Ensuring the Future through Sustainability'. The event was organised by the Fisheries Development Authority and co-sponsored by the Department of Fisheries and the Federal Agricultural Marketing Authority, in collaboration with the international non-governmental organization, INFOFISH.

Some 70 companies took up a total of 145 booths at the trade show with Malaysian exhibitors having a strong presence. Also represented were several government, academic, finance and fisheries support service organisations. International exhibitors included those from Bangladesh, China, Fiji, India, Indonesia, Japan, Maldives, Papua New Guinea, Singapore, Taiwan, Thailand, the Philippines and Vietnam. The aquaculture and trade conference was attended by more than 200 participants and featured 26 paper presentations. The presentations were organised into seven sessions: plenary; finfish aquaculture: challenges and opportunities; crustaceans; aquaculture certification and trade; food safety and market access; feed, fish health and nutrition. The two-day conference ended with a debate on aquaculture. Some presentations are discussed below.

In his plenary presentation, **Derun Yuan**, program manager, Education and Training, Network of Aquaculture Centres in Asia-Pacific noted that aquaculture demand is on an upward trend with a shift in consumer preference for healthier food. However, he added that a holistic approach is needed to maintain sustainable growth of the sector including strengthening research, adopting appropriate farming technology and systems, capacity building for better farming practices, adoption of good governance at institutional and operational levels, facilitating efficiency of value chains, and regional and international collaboration.

Jacky Le Gosles, European Commission Principal Administrator, Health and Consumer Directorate General, Belgium emphasised on the importance the EU places on food safety in the food production sector. With regard to aquaculture, there is a focus on good farming and hygienic practices at the farm level and the 'prevention rather than cure' principle to avoid stress to farmed animals and thus reduce the need for treatments. With regard to live bivalve molluscs, the emphasis is on reducing risks to human health from the viruses and other contaminants. Import of aquaculture products into EU is regulated through a health certificate issued by a registered/approved in-country competent authority and inspection controls at EU border inspection posts. The product may be subject to further controls in the member states. Sanitary traceability must be ensured through all steps of production.

More finfish

Five presentations focused on marine finfish aquaculture in various countries. Status papers on marine finfish farming in Thailand, Malaysia, Indonesia and the Philippines were also presented which gave delegates a valuable insight into the industry in these countries. After giving some background information on the growth of finfish aquaculture and trade, **Erik Hempel**, director, Communications, The Nor-Fishing Foundations, Norway, noted that the country has been a leader in the development of modern science-based culture of marine finfish, notably Atlantic salmon. Today, aquaculture accounts for almost 70% of the value of its seafood exports. From 1970 until now, the focus has been on technological and economic improvements in production; unit production increased from 64 tonnes per employee in 1994 to 333 tonnes per employee in 2012, while production cost per kg dropped dramatically from USD 15/kg to USD 2/kg in 2005. In recent years, unit production cost has increased somewhat due to stricter regulations and greater focus on fish health. Hempel highlighted the massive advances in cage technology in Norway with cages being as much as 100 times larger than in 1980 and moored farther from the coast, often in very rough seas.

Mohamed Razali of Aquagrow Corporation, discussed his company's plans to develop large scale marine fish farms in Malaysia. Two production sites are being developed, one in Langkawi on the Andaman Sea and the other at Tok Bali on the east coast of Peninsula Malaysia facing the South China Sea. The company aims to produce 4,000 tonnes of fish in 5 years. Challenges faced include securing investment, land approvals from local authorities, technology, suitable sites for sea cages, diseases, farm certifications, logistics, management expertise, skilled workers, hatchery, processing and marketing.

Neils Svennevig, senior consultant at the Research Institute for Aquaculture No 1, Vietnam, questioned why despite the large

John Lee (left) and Dr Nguyen Huu Dzung.

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From left, Fatima Ferdouse, Daniel Gruenberg and Dr Emilia Quinitio who discussed the status of mud crab farming in the region. Production increased to 173,000 tonnes in 2012 and she indicated that mortality of mud crab during grow-out was often associated with white spot syndrome virus

The team at Dindings, a major producer of fish feed in Malaysia; from left; Mei Ling, Chong Kam Kin, Elaine Enyu, Chu Sze Yan, Chu Ying Loong and Ang Tai Heng.

area available, sea farming in Southeast Asia is still largely in the pioneering stage and lagging behind other regions. His presentation discussed some issues which have to be overcome to turn the region into a vibrant 'Asian seafood basket'. He believes that the current approach is still small scale and targeting the live fish market. Corporate investors do not trust marine fish farming because of the risk factor with high mortality. The industry needs to transform to high volume production and efficient farming with best practices. Some species amenable to high volume production are pompano, seabass, cobia, seabream, yellowtail and long fin pompano. Staff must be qualified and institutional support and risk management are important.

In the freshwater finfish session, **Shirlene Maria Anthonysamy**, senior trade promotion officer, Infofish, presented a global overview of freshwater finfish aquaculture. Carps, which comprise 44% of Asian aquaculture production, are mostly marketed in the producing countries. However, tilapia and pangasius have made a significant foothold in the global seafood market with export value of each surpassing USD 1 billion in 2013. Robust economic growth, rising disposable income, changing consumer lifestyles and a strong preference for seafood are among the key drivers of Asian aquaculture and trade.

The status of freshwater finfish aquaculture in four important countries (Bangladesh, Philippines, Vietnam and India) was discussed in separate presentations. In particular, Dr Nguyen Huu Dzung, vice chairman, Vietnam Association of Seafood Exporters and Producers (VASEP), revealed that Vietnam's pangasius is the world's fastest developing farmed fish industry with annual production of 1.35 million tonnes, representing 45% of national farmed fish production. Several new programs are being implemented including farming technology improvement, vaccine production, establishment of a distribution centre and auction in the EU market, electronic traceability and development of sustainability in the supply chain.

Shrimp trade and updates on farming

In her overview of global shrimp production and trade, **Fatima Ferdouse**, chief, trade promotion at Infofish showed the impact of the early mortality syndrome (EMS) on world shrimp production. The short supply resulted in increased shrimp prices in the international market throughout 2013, reaching record levels by the end of that year and affecting demand in the traditional developed markets, Japan, USA and EU. In contrast, shrimp imports in Asia increased to top up supplies for local consumption and reprocessing (see also page 48-49).

Daniel Gruenberg, CEO of Acquestra, Thailand, called for a paradigm change in the approach to tackling EMS in shrimp aquaculture. It is clear that EMS is more complicated than what is known, according to Gruenberg who has tried to find solutions at farms in Thailand. He hypothesised that genetic inbreeding is an important factor in the problem and suggests that postlarvae from well designed and managed breeding programs will be a way out of the problem. These postlarvae will need to be raised in hatcheries that control *Vibrio* activity throughout the larval rearing process. Once on the farm, more natural pond management methods need to be used instead of the currently used methods of disinfecting ponds prior to stocking based on the SPF paradigm.

Market access

According to **Roy Palmer**, Market Development manager, Global Aquaculture Allaince, USA, sustainability certification (e.g. ASC, BAP and GLOBAL GAP) is a market-based approach that addresses environmental and social issues. As the appetite for sustainability grows, challenges will arise for producers to raise production performance to meet the exacting requirements of sustainability standards. The cost to the farmer will depend on how well the farm is organised and will be judged at the pre-audit stage. In Australia, one example of how certification is required for market access is Tassal, a producer of salmon in Tasmania. **Geoffrey Muldoon**, strategy leader, business and industry, WWF Coral Triangle Program, introduced Aquaculture Improvement Projects (AIPs) as a stepwise approach to delivering continual improvement in performance towards a sustainability standard. AIPs are a multi-stakeholder effort that utilises the power of the private sector and markets to initiate positive changes and may include producers, NGOs, fishery managers, governments and members of the supply chain.

Alvin Lee, director, Institute for Food Safety and Health, Illinois Institute of Technology, USA, said that a number of innovative food processing technologies, including high pressure processing (HPP), have been used to mitigate risk posed by viruses. HPP has been shown to be relatively effective in inactivating foodborne viruses although more research is needed to maximise its effectiveness in seafood safety. The presentation focused on intervention strategies currently examined by NoroCORE, a USDA-NIFA Food Virology Collaborative initiative funded by USDA. **Dr John Lee**, CEO and director at the Sino-Singapore Jilin Food Zone Development, NE China presented on branding for premium pricing and overseas expansion. He said that the potential for premium pricing is often not recognised. Gaining consumer confidence is important and to achieve this costs money.

Successful biofloc seminar in Indonesia

With the recent increased focus on disease prevention and management, biofloc technology has been on the uprise. This aquaculture technique used in shrimp grow-out ponds is aimed at improving the water quality by finding the right symmetry between nitrogen and carbon. Besides the obvious advantage of disease control, it allows for high stocking densities and limited water exchange, offering numerous possibilities to farmers across the world.

Realising this, INVE Aquaculture organised a week-long workshop in Indonesia on biofloc and semi-biofloc for its senior technical staff from Latin America and Asia. The workshop included theoretical and applied training with an internationally recognised expert (Prof Wilson Wasielesky, Universidade Federal do Rio Grande, Brazil) and a respected Indonesian consultant (Agus Saeful Huda), as well as hands-on work at a successful farm in East Java.

Recent presentations from the "Workshop on Biofloc Technology and Shrimp Diseases" that had been held in Vietnam in December 2013, were discussed in more detail. The outcome of the workshop was to offer the staff a better understanding of the science behind the products and protocols used in semi-biofloc and biofloc culture systems. Once back in their markets, Inve Aquaculture's senior field staff will organise local follow-up seminars to share the acquired knowledge and experiences with the local farmers.

Inve Aquaculture is a global supplier of health and nutritional products for the aquaculture industry, more specifically for fish and shrimp hatcheries and farms. Founded as Artemia Systems NV in 1983, Inve Aquaculture has always been a true pioneer in the aquaculture industry. From being the first to market *Artemia* cysts with specific characteristics, to launching the first dry diets for use in fish or shellfish hatcheries, and offering today's best balance between the use of live food and formulated diets, the company has strived to offer products that will maximise the customers' profitability and improve the industry as a whole.

Aquaponics GAPs food safety certification program

Quality Certification Services (QCS) has launched its Aquaponics certification program to address food safety requirements applicable to aquaponic operations.

Crops and fish/shellfish are covered under this new program developed by a team of crops and aquaculture experts. Aquaponic farmers of any size will be able to apply for QCS Aquaponics certification. The growing number of aquaponic producers worldwide will also have the option to request organic or other certifications of their crops and fish/shellfish and therefore streamlining their certification needs and demonstrating responsible production practices to their customers. The certification body looks forward to receiving feedback from industry and other aquaponics stakeholders and enthusiasts.

"QCS has long recognised the importance of symbiotic and integrated multi-trophic production systems to improve sustainability and food security. The intent of this new certification program is to better serve aquaponics producers in meeting good production practices, food safety, and sustainable consumer demands that will benefit us all in a practical and effective manner," said Food Safety Program manager Mario Velasco.

"The program was specifically developed to be both robust and affordable so that it is accessible to small scale producers," said COO Ramkrishnan Balasubramanian. "QCS has 15 years of experience in this developing sector and we are proud to continue to support its growth."

Based in Gainesville, QCS offers the following certification options including Certified Organic, Certified Transitional, Certified Hormone/Antibiotic Free, Organic Aquaculture, GlobalGAP (several scopes), specific trade practices and Food Justice Certification, which will allow for consumers to choose to support a more just agricultural system. More information. www.qcsinfo.org

First small-scale pangasius farmers to receive aquaculture group certificate

From left to right: 4 representatives of Tra Vinh Cooperative; Truong The Van, vice chairman of the Tra Vinh Fisheries Association; Le Tran Truong Thuy, lead aquaculture auditor and Richard de Boer, manager director of Control Union Vietnam.

In August, GlobalGAP announced the first aquaculture group certification for small-scale pangasius farmers in Vietnam. Part of the Public Private Partnership – Sustainable Pangasius Supply Chain Programme (PPP-SPSP) in Tra Vinh province, the producer group Tra Vinh Co-operative expects strong growth in the coming years.

At the workshop that at Vietfish on August 6, 2014, Truong The Van, the vice chairman of the Tra Vinh Fisheries Association, shared the challenges and benefits for small-scale producers of GlobalGAP certification in general, and its group certification in particular. He specifically highlighted the co-operation in promotion among farms. He also outlined how raising producer awareness of Good Aquaculture Practices and environmental protection, benefits the aquaculture sector as a whole and consumers world-wide.

An added advantage of this group certification for small-scale producers in Vietnam is that they immediately comply with the national government's decree requiring all pangasius farming activities to be certified against sustainable certification systems by December 31, 2015.

This is a milestone in GlobalGAP aquaculture group certification and a major step forward in the aquaculture sector. Small-scale aquaculture producers organised in groups with a shared quality management system can now reap the benefits of a long established and successful form of GlobalGAP certification, one that GlobalGAP certified fruit and vegetable producers have been benefiting from for years.

"I congratulate the Tra Vinh Co-operative for pioneering this aquaculture group certification in Vietnam and around the world," said Kristian Moeller, GlobalGAP CEO. "Almost 100,000 fruit and vegetable farmers, that is more than 70% our certified producers world-wide, are organised in groups and covered under this group certification. The first group small-scale farmer certificate in aquaculture confirms that achieving our high integrity requirements for food safety and sustainability systems on farms via a group, generates benefits to small-scale producers that can also be enjoyed by the aquaculture sector. The European retail markets have a particular interest in connecting to smaller producers to secure their sourcing. I am pleased to announce that the majority of our German retailers are introducing and implementing policies that require GlobalGAP aquaculture certification as a food safety baseline for their entire aquaculture range."

Actively integrating small-scale farmers in local and international supply chains also aligns with GlobalGAP's commitment to help reduce poverty and ensure food security through Good Agriculture and Aquaculture Practices.

At this year's 3-day SUMMIT 2014 in Abu Dhabi, UAE, the certification body has dedicated an entire programme session to small-scale growers, producer groups and farmers in emerging countries. Designed as a platform for producer groups around the globe to present their success models and innovative ideas, the main focus will be on mutual learning and information exchange. It will also include presentations showcasing co-operative models from around the world and highlighting the latest research findings and case studies of successful GAP activities that successfully integrate small-scale farmers in local and international supply chains.

Acquisition of functional ingredients business

AQUATIV, part of DIANA Aqua business unit within the Diana Group announced the acquisition of Diana by the German group Symrise. Within the Symrise group, Diana will operate as a new division and will be positioned as the platform for natural ingredient based solutions for taste, color, texture, health and nutrition, and food protection.

Diana Aqua has been developing for many years a marine sourcing backward integration, securing the marine functional ingredient supply to targeted markets (food, pet food and aquafeed). This marine sourcing is only based on marine co-products which fully support our customers and company sustainable development policies.

Thanks to this marine sourcing, Aquativ has been expanded worldwide to become the sole player delivering highly standardized, safe and performing functional hydrolysates to the aquafeed industry. Liquids and powders are obtained from the freshest and most sustainable marine raw materials sources one can possibly find.

Adding to its expert knowledge in the field of marine protein hydrolysis inherited from the group, Aquativ has built up a team entirely dedicated to aquaculture, including fish and shrimp nutritionists, health specialists and veterinarians. The company delivers natural ingredients bringing high functionality to the aquafeed and ultimately better productivity to the farmers.

George Marco, president of Diana Aqua said, "The key elements of this merger are the shared synergies on our global markets as well as research and innovation. In addition, our backward integration of marine resources is fully aligned with Symrise procurement strategy and markets support."

George Marco

Symrise is a global supplier of fragrances, flavourings, cosmetic active ingredients and raw materials as well as functional ingredients. Its clients include manufacturers of perfumes, cosmetics, food and beverages, the pharmaceutical industry and producers of nutritional supplements. In 2013, sales reached more than EUR 1.8 billion making it among the top four companies in the global flavours and fragrances market. Headquartered in Holzminden, Germany, the Group is represented in over 35 countries in Europe, Africa, the Middle East, Asia, the United States and Latin America.

Diana is a world leader in natural functional solutions for the food, pet food, nutraceuticals, aquaculture and cosmetics industries, and technology leader in plant cell culture, dedicated to the production of active ingredients for food, cosmetics and health. Diana is improving the sensorial and nutritional performance of its customers' products thanks to its unique biosciences expertise and helping them conquer new markets. More information: www.aquativ-diana.com; www.diana-group.com; www.symrise.com Email: gmarco@diana-aqua.com (George Marco).

First ASC certified pangasius in Hong Kong

Seafood shoppers in Hong Kong can now buy ASC certified fish in their local supermarket following Market Place by Jasons' launch of ASC labelled responsibly farmed pangasius in their stores in August. This follows the June launch of the first ASC certified pangasius in Japan by AEON and World Wide Fund for Nature (WWF) Japan. The certified fish is now available in AEON stores throughout Japan.

"I'd like to thank Market Place by Jasons for their support of ASC certified farms. By doing so they are bringing certified responsible fish to people across Hong Kong and giving them the assurance that they are making a responsible choice when they eat ASC certified fish," said Chris Ninnes, ASC's CEO.

"I am delighted with the growing support for ASC across Asia. We have seen the launch of ASC certified salmon and pangasius in Japan. The Sustainable Seafood Festival across Asia in June has helped to further raise ASC's profile in the region. With the presence of ASC labelled products in 37 counties globally, we have made strong inroads in emerging Asian markets such as South Korea and Taiwan. We are very excited that the first ASC certified salmon is also available in Australia."

The ASC labelled NBM pangasius fillets 454g is a frozen product farmed and supplied by the ASC certified An My Fish JSB farm in Vietnam. Farms certified to the ASC standard demonstrate that they use methods which minimise environmental impacts and care for their farm workers and local communities. There are currently 44 pangasius farms certified under the ASC Pangasius standard. Four more farms are under assessment.

ASC certified farms are independently assessed by certifiers accredited by ASI (Accreditation Service International). Auditors are required to undertake training and sit a mandatory exam. To ensure that certified fish is not mixed with non-certified produce, companies wishing to trade ASC certified products must pass a chain of custody audit carried out by an independent certifier. Chain of custody certification guarantees that a product can be traced throughout the entire supply chain to a responsibly managed farm.

ASC certified seafood is growing in popularity across Hong Kong and Asia. There are now six ASC labelled products on offer in Hong Kong including pangasius from Godaco Seafoods JSC and An My Fish JSC in Vietnam.

Appointments

New aquaculture member for regional team

BIOMIN has appointed **Anwar Hasan** as technical manager Aquaculture. This appointment comes at a pivotal time for the company, as its business continually expands throughout the region and the need for technical support increases in tandem, especially in the aquaculture sector. With ten years of knowledge, expertise and experience in shrimp aquaculture, Biomin is confident that Anwar will strengthen its aquaculture team in the implementation of the Solutions Concept to help customers achieve the best returns on their investments.

Despite having regional responsibilities that cover the whole of the Asia Pacific region, Anwar will be based in his home country, Indonesia, as the need for customer support and services in the local market continues to grow.

Technical support specialist

Meriden Animal Health has recently appointed **Kat Konstanti** as International Technical Support specialist. Konstanti's main focus will be to support the drive and growth of Meriden's products in the aquaculture industry through her technical knowledge and understanding of the market.

Konstanti recently graduated from the University of Stirling, Scotland with a Masters in Sustainable Aquaculture. During her studies, Konstanti investigated several aspects of aquatic animal culture and gained a solid understanding of the principles that surround the aquaculture industry. She focussed on aquatic animal health control, nutrition, food safety and practical feed production. Konstanti will also be providing additional technical support to the other species areas of the business; however her main focus will be on aqua.

She says, "Meriden has gained a solid base in the aquaculture industry since re-formulating its flagship product to create Orego-Stim Aquatract and developing Phyconomix. It is my goal to continue the development of these products within the aquaculture industry which is in dire need of effective, natural and sustainable products."

New acquisition of tooling and IP

Pentair Aquatic Eco-Systems, Inc has purchased the tooling and intellectual property of HE Group, Inc (HGI), a fiberglass design and manufacturing company, specialising in aquaculture and water treatment systems, on June 6, 2014.

"The technology and manufacturing capability acquired from HGI is a win-win for Pentair and its customers. It provides product flexibility to our customers and adds an array of commercial equipment to our recirculating aquaculture system portfolio," said Karl Frykman, president of Pentair Aquatic Systems.

Pentair Aquatic Systems provides leading edge equipment, accessories and water technology solutions to the swimming pool, aquaculture and environmental water monitoring industries. Aquatic Systems produces a broad line of products from pumps and filtration equipment to thermal products, automated controls, lights, automatic cleaners, water purification and treatment technology, UV sterilisers, electromagnetic flow meters, irrigation controls and more. Applications for Aquatic Systems products include maintenance, repair and renovation of existing in-field equipment, as well as planning and engineered solutions for new installations in North America, Europe and emerging markets such as China, Latin America and other countries.

Pentair plc delivers industry-leading products, services and solutions for its customers' diverse needs in water and other fluids, thermal management and equipment protection. With 2013 revenues of USD7.5 billion, Pentair employs approximately 30,000 people worldwide. More information: www.pentair.com

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New fish vaccine against most prevalent disease affecting tilapia

Norman Lim (third from left) and the MSD team at the launch

In August, MSD Animal Health (known as Merck Animal Health in the USA and Canada) introduced a new fish vaccine as a promising measure to help protect tilapia and other fish against the biotype 1 strain of *Streptococcus agalactiae*, which is the biotype specific to Thailand and other key tilapia-producing regions in Asia, including Malaysia.

"We are pleased to introduce a new fish vaccine to help producers protect their fish from one of the most costly diseases affecting the species," said Norman Lim, Regional Technical manager for aquaculture in Asia, MSD Animal Health. "The vaccine is backed by MSD Animal Health's 'Strep Control: Your Tilapia Health' program, which provides producers with the support they need to implement an effective vaccination and control program."

MSD Animal Health conducted extensive sampling of farms in the world's most important tilapia-producing regions and found that *Streptococcus* accounted for 70% of all pathogens collected, making it the most prevalent disease affecting tilapia. Of the two *Streptococcus* strains that have been identified, *S. agalactiae* is the most economically damaging, causing widespread mortality and morbidity in larger fish.

In a laboratory test, fish experienced full onset of immunity one week after vaccination with this vaccine and protection was demonstrated to last for at least 12 weeks. In a large scale field trial in an environment challenged by *S. agalactiae* biotype 1, the fish vaccine increased survival by 17%, increased biomass by 11.2%, and improved feed conversion efficiency by 9%. Protection was demonstrated for the entire grow-out period. The fish vaccine provides specific protection against the biotype 1 strain of *S. agalactiae*, the main cause of *Streptococcosis* in tilapia in Thailand. Fish vaccinated with the vaccine are safe for human consumption.

As part of the 'Strep Control: Your Tilapia Health' program, MSD Animal Health help producers confirm the strain and biotype present on their farm, implement a surveillance and vaccination program, and train staff on appropriate control strategies. Producers can consult their MSD Animal Health representative or a fish health professional to learn about MSD Animal Health's 'Strep Control: Your Tilapia Health' program and the new fish vaccine. More information: www.msd-animal-health.com

World Nutrition Forum: Exploring Sustain:ability and Limits to Growth

Professor Jorgen Randers, one of the authors of the famed Club of Rome publication 'Limits to Growth' and '2052-A global forecast for the next forty years' will be the keynote speaker at BIOMIN World Nutrition Forum 2014. Randers will present his forecast and highlight the consequences for the global industry in general, with a focus on agriculture and food production.

This year's forum from 15 to 18 October will be held in Munich where the unique theme "sustain:ability" is expected to guide and provoke much discussion and exchange on the future of animal nutrition. In Malthusian-like fashion, Randers, along with the authors of the 1972 'Limits to Growth' publication, had portrayed rampant economic growth and development as being potential triggers leading to the eventual demise of the earth's resources and its human population.

While critics have resolutely denounced these findings, the crux of the message in 'Limits to Growth' remains keenly pertinent today and into the future—that is, the urgent need for responsible stewardship of our earth's finite resources. Theories from the book have remained influential in discourses on the dichotomy between ecology and the economy, a theme explored once again in the latest book '2052-A global forecast for the next forty years'.

A professor of climate strategy at the Norwegian Business School, Randers has extensive expertise in climate and energy issues, scenario analysis and system dynamics. He estimates that slower growth towards 2052 will affect efforts to avert a climate crisis, albeit with resource use kept within the earth's carrying capacity. He will also share his rationale behind predictions of continuing poverty, stagnating growth in mature economies and more efficient energy use, among other issues, and the socio-economic trends that are continually being shaped and that will define the next 38 years of the life of our planet and its people. More information:**www.worldnutritionforum.info**

Technology for Novel Fish Feeds

26 October - 29 October 2014

Olhão, Algarve, Portugal

This technology for novel fish feeds course will give an update on the theoretical and practical aspects of fish feed manufacturing process. It will cover the wide knowledge basis gathered in the ARRAINA consortium, and using SPAROS pilot-scale feed technology platform. It is organised by Wageningen Academy.

The course will comprise the following: Theoretical modules on fish nutritional requirements, formulation and feed processing steps (size-reduction and mixing, extrusion, pelleting, microencapsulation, vacuum coating, drying and storage), alternative fish feed formulations, novel feed ingredients and global challenges for a sustainable supply, functional aquafeeds, interaction of ingredients and processing conditions on the nutritional utilisation and physical quality of feeds, new tools for assessing nutritional condition in fish.

A practical component with hands-on exercises on feed formulation, extrusion (twin-screw extruder), microencapsulation (spray-drying) and vacuum coating of fat and heat-labile additives. All equipment are available at the SPAROS pilot-plant.

The course is aimed at (young) professionals from the industry and research institutions (e.g., PhD students) across the enlarged European Union and the candidate countries. After the course the participants would have acquired an in-depth perception on the state-of-the art and future challenges in formulation and production of novel, sustainable and cost-effective fish feeds, with a focus on the interaction of current formulation trends (plant-rich, alternative feedstuffs, functional additives) and some feed processing constraints. Topics will be introduced by different experts from INRA, Univ.Porto, NMBU-FôrTeck, CCMAR, FEFAC, SORGAL, CLEXTRAL, BIOMAR and SPAROS. More information: Programme manager Malou Gosselink (malou.gosselink@wur.nl)

What to look forward to in Aqua Culture Asia Pacific in 2015

Our editorial calendar reflects the new and existing issues in aquaculture in Asia Pacific which we see as most relevant to the industry. We will continue to present trends and update you with technologies to help the aquaculture industry in Asia Pacific move to the next level.

Volume 11 2015						
Number	1 – **January/February**	2 – **March/April**	3 – **May/June**	4 – **July/August**	5 – **September/ October**	6 – **November/ December**
Issue focus *Recent developments and challenges for the next step*	Automation & Energy efficiency	Nursery Technology	R&D & Genetic Selection	Industrialisation & Aquaculture Insurance	Health Monitoring & Disease Management	Biofloc Technology
Industry Review *Trends and outlook, demand & supply*	Marine Shrimp	Tilapia	Aqua Feed Production	Catfish	Marine fish	Freshwater Fish/Prawn
Feeds & Processing Technology *Technical contributions from feed industry*	Functional Feeds Hatchery/Nursery Feeds	Fishmeal & Fish Oil Replacements & Novel Feed Ingredients	Extrusion & Processing Technology	Feed Enzymes, Additives & Probiotics	Feed Safety & Hygiene Processing & Environment	Nutrition & Formulation
Production Technology *Technical information and ideas*	Blue Revolution/ New Culture Technologies	Disease Biotechnology	Recirculation Aquaculture Systems	Sustainable & Responsible Aquaculture	Genetics in Fish/ Shrimp	Aeration Technology & Waste Removal
Aqua business Feature articles	Experiences from industry and opinion article covering role models, benchmarking, health management, SOPs, social investments, CSR, ancillary services etc					
Markets	Developments in markets (live fish, product development, market access, certifications, branding, food safety etc)					
Company/Product news	News from industry including local and regional trade shows					
Deadlines for Technical articles	**November 10, 2014**	**January 26**	**March 30**	**June 1**	**July 27**	**September 28**
Deadlines Advert bookings	**November 17, 2014**	**February 2**	**April 6**	**June 8**	**August 3**	**October 5**
Show Issue & Distribution at these events as well as local and regional meetings ****Show preview***	**Aquaculture America 2015** February 19-22 New Orleans, USA	***Aquatic Asia/VIV Asia** March 11-13 Bangkok, Thailand **Global Seafood Expo 2015** April 21-23 Brussels, Belgium	***World Aquaculture 2015** May 26-30 Jeju, Korea	**The Aquaculture RoundTable Series (TARS 2015)** August 19-20 **Vietfish 2015** August 24-26 Ho Chi Minh City, Vietnam	**20th China Seafood & Fisheries Exposition 2015** November China (TBA) **10th Philshrimp Congress,** General Santos (TBA)	

Introduction to Aquaculture Short Course

October 6-7, Singapore

LMC Training has partnered with Venture Farms to deliver an Introduction to Aquaculture short course on the 6th-7th of October in Singapore. The two day course is planned for individuals interested in entering the aquaculture industry or for existing aquaculture workers, researchers and educators looking to refresh or fine tune their knowledge and skills. The course will encompass information on current trends in global, regional and local aquaculture production while allowing the participant to gain a strong understanding of the various culture techniques of a multitude of species. The course will also highlight contemporary water quality and general aquatic animal husbandry techniques including disease identification and control.

Recirculated Aquaculture Systems Short Course

October 8-9, Singapore

LMC Training has also partnered with Venture Farms to deliver a Recirculated Aquaculture Systems (RAS) short course on the 8-9 October in Singapore. The two day course is for individuals interested in gaining more RAS knowledge, investors, existing staff, business owners, researchers and educators. This short course has a strong commercial focus and will enable attendees to gain a strong understanding of the current trends in RAS system development, including the use of RAS in a wide range of species and at various life stages. The course highlights best practice RAS system management which involves having competence in both engineering and RAS system aquatic animal husbandry. The emergence of RAS as real culture alternatives to combat the huge contemporary biosecurity challenges commercial facilities are experiencing will also be explored. The course will conclude with highlighting the economics of RAS in 2014.

Upon successful completion of each course participants will receive a Statement of Attainment from LMC Training, Australia's premier warm water aquaculture training college. Both courses are sponsored by the Institution of Aquaculture Singapore and the Institute of Engineering Technologists Singapore. The venue is at the ASTA School of Business and Technology, Singapore.

Applications are on a first come basis. More information for both courses: Mark Oliver, (admin@lmctraining.com), Jimmy Lim (venturefarms@hotmail.sg); Web: www.lmctraining.com

2014 - 2015

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

September 21-22
Aquatic China 2014/VIV China 2014 Management
Beijing, China
Web: www.vivchina.nl/en/Bezoeker/Special-Themes/International-China-Summit/Aquatic-China.aspx

September 21-26
21st Annual Practical Short Course on Aquaculture Feed Extrusion, Nutrition and Feed Management
Texas A&M, USA
Email: mnriaz@tamu.edu (Dr. Mian N. Riaz)
Web: http://foodprotein.tamu.edu/extrusion

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

October 7-10
GOAL 2014
Ho Chi Minh City, Vietnam
www.gaalliance.org/GOAL2014/

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

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

November 4-7
Latin American & Caribbean Aquaculture 2014,
Guadalajara, Mexico
Email: mario@marevent.com (Mario Stael for trade show)
Web: www.was.org

November 5-7
China Fisheries and Seafood Expo
Qingdao, China
Email: jennie8888@seafare.com (Jennie Fu)
Web: www. chinaseafoodexpo.com

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

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

February 20-22
Aqua Aquaria India 2015
Vijayawada, India
Email: mpeda@mpeda.nic.in
Web: www.aquaaquaria.com

February 20-22
Shrimp 2015
Vijayawada, India
Email: info@infofish.org
Web: www.infofish.org

February 19-22
Aquaculture America
New Orleans, USA
Email: mario@marevent.com (Mario Stael for trade show)
Web: www.was.org

March 11-13
VIV Asia 2015/Aquatic Asia
Bangkok, Thailand
Web: www.vivasia.nl

April 2-4
Tilapia 2015
Kuala Lumpur, Malaysia
Email: info@infofish.org
Web: www.infofish.org

April 21-23
Seafood Expo Global
Brussels, Belgium
Web:www.seafoodexpo.com/global

May 26-30
World Aquaculture 2015
Jeju Island, Korea
Email: mario@marevent.com (Mario Stael for trade show)
Web: www.was.org

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