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AQUA CULTURE

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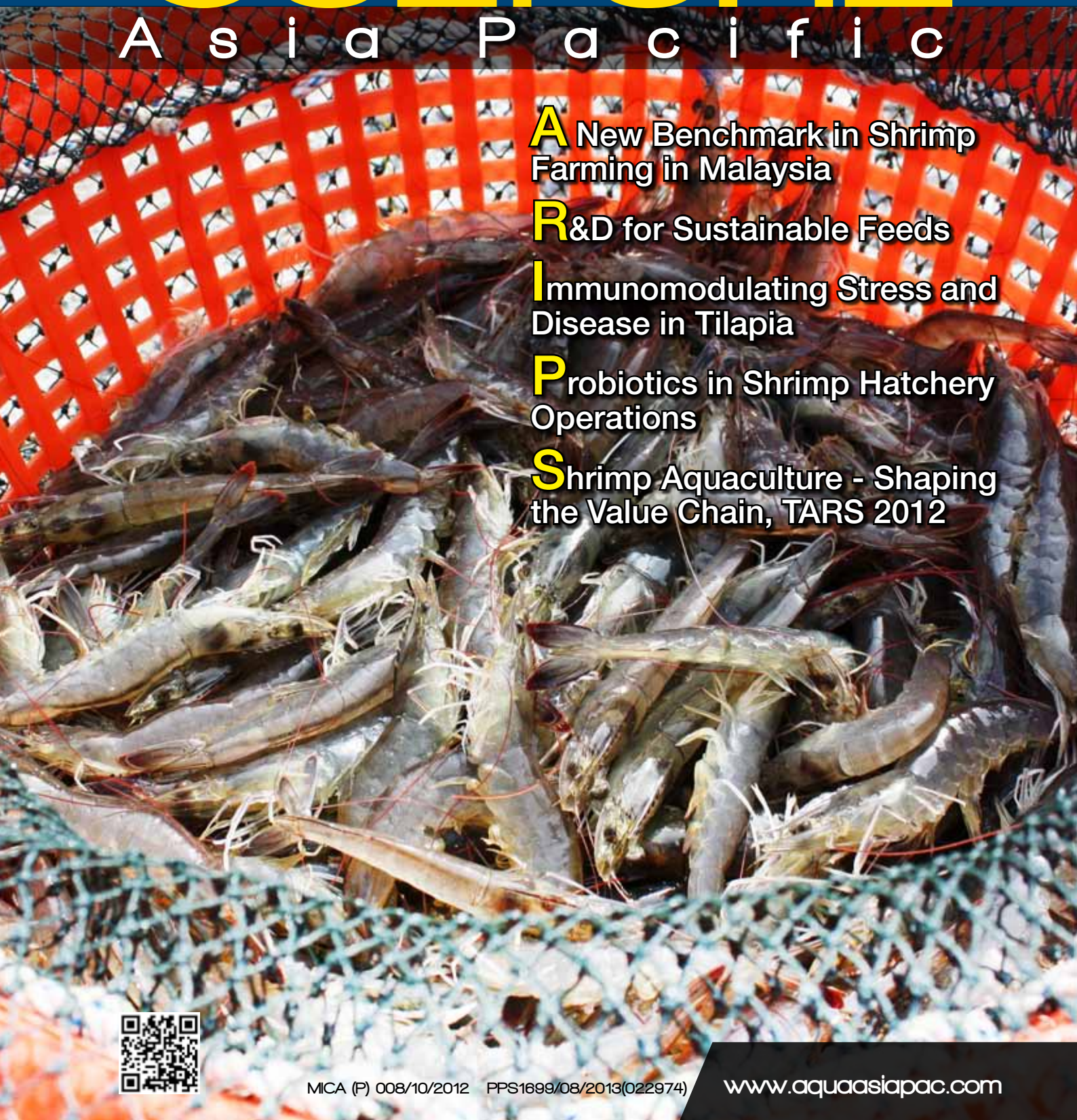

A New Benchmark in Shrimp Farming in Malaysia

R&D for Sustainable Feeds

Immunomodulating Stress and Disease in Tilapia

Probiotics in Shrimp Hatchery Operations

Shrimp Aquaculture - Shaping the Value Chain, TARS 2012

MICA (P) 008/10/2012 PPS1699/08/2013(022974)

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Contents

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Harvest of vannamei shrimp, p8

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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

Is there a Production – Market disconnect?

Fresh from TARS 2012 and its focus on "The Shrimp Industry- Shaping the Value Chain" in Phuket, one significant take away message clearly stand out. Perhaps, there is a disconnect between production and marketing in Asian aquaculture. During the roundtable brainstorming sessions, participants opted to be in one of the four industry segments namely, Breeding and Hatchery; Culture and Health; Feeds and Feeding or Marketing, Branding and Certification. What was evident was that the first 3 segments acted in a relatively seamless value chain, all pulling together in the same direction to produce more shrimp efficiently. The Marketing, Branding and Certification segment seemed to be sitting on the opposite side of the fence or the opposing team in a football match. Why is there this disconnect and what should we do?

Whichever industry we choose as a role model, automotive or personal computers, the first rule of the day is to 'listen to your customer'. Aquaculture seems to be still in the production driven phase of its life cycle. In the shrimp industry, one symptom of this is the recent rejection of Indian and Vietnam origin shrimp by Japan due to levels of ethoxyquin, the antioxidant used to stabilise fishmeal and feeds. However, this is not new as Thailand had adapted to this country requirement some time ago. Japan has now started to enforce this condition for its shrimp imports from Vietnam and India.

In the marine fish sector in Asia, retailers sell whichever species are being farmed and available from the sea catch of the day. This is clearly a characteristic of a production driven industry. Compare this with the salmon, sea bream and the European sea bass industry in Europe where these species are always available all year round at hypermarkets and fishmongers, and they never go out of fashion. Asian marine aquaculture tends to introduce new species in order to please the customer when in fact, farmers have hit a brick wall with other species in short supply due to disease problems and low survival rates. When this happens, farmers would move to another species. The best analogy I can think of is the 'slash and burn' method of primitive agriculture where nomadic populations never looked at overcoming challenges of declining nutrient levels in the soil. In the same way, the marine fish sector in Asia has not looked at overcoming these low survival rates.

In the freshwater fish sector in Asia, the more mature and successful species are single species, vertically integrated operations such as those found with tilapia and pangasius catfish. Both started out as cheaper fish for the local market but tilapia has developed via genetic selection for high growth while both species have efficient culture and post- harvest processing for the international markets. The best characteristic of their success is the consistency of supply while the other species have suffered from a production –market disconnect. This disconnect can also work in reverse such as the pangasius catfish in India which suffered low prices from overproduction in 2011 because the processing sector did not exist for such large volumes.

For any of these sectors, be it, shrimp, marine fish or freshwater fish to move to the next phase of its life cycle, it must be market led. This is the normal evolution of the product life cycle and we need to move from a fragmented industry to a seamless integrated value chain where the markets and their customers are not seen as the opposing team.

Zuridah Merican

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Industrialisation and diversification in Indonesia's aquaculture industry

Aquaculture production in Indonesia has already overtaken that of capture fisheries and next is to continue with the industrialisation of aquaculture. However, this has to work together with food safety standards.

Indonesian industry leaders at the opening of the Shrimp Club session and launch of Aqua Trobos magazine; from left: Denny D Indradjaja, Fitri Nursanti, Aqua Trobos, Dr Slamet Soebjakto, Rokhmin Dahuri, Dr Bambang Widigdo, National Shrimp Commission, and Iwan Sutanto, president Shrimp Club Indonesia

These were the opening remarks by the Minister of Fisheries and Marine Affairs, Syarif C. Sutardjo at the annual IndoAqua-Fita 2012 conference and trade show held in Makassar, Sulawesi from 8-11 June. He added, "The target will be 16.9 million tonnes of aquaculture production by 2014, an optimistic 353% increase from that achieved in 2009 at 4.8 million tonnes. This ambitious target is not impossible as in 2011, almost 7 million tonnes was produced."

This annual gathering of industry, scientists and government officials fosters interactions among all three aquaculture groups. The aim is also to bring innovations by researchers to the industry. Researchers presented their latest work in concurrent sessions on aquaculture technology, nutrition and feed technology, biotechnology, social economics, fish and shrimp diseases, brood stock and breeding. Co-organisers, the Indonesian Shrimp Club had a seminar on shrimp culture technology and the Indonesian Aquaculture Society (MAI) organised two 'talk shows' to discuss the revitalisation of shrimp farming and optimisation of aquaculture for recreational activities. There was also a 70 booth trade show (see page 52).

The food safety aspect of aquaculture was covered by **Dr Edward Landridge** who discussed the sanitary and phytosanitary requirements for the export of fish and fishery products to the European Union. He said that it is important that the regulations are not seen as overbearing or applied to be disguised as restrictions on trade but seen as essential to prevent the spread of diseases and for human health. Landridge emphasised on the need for industry to work together and that the responsibility of competent authorities is to ensure that products from Indonesia meet requirements on food safety when exported and will not need to undergo any strict checking at the destination ports.

Revitalisation of shrimp production

The marine shrimp is among the four target species for development, and industry has been credited with the success in the revitalisation of idle ponds since 2000 and in increasing production volumes. Production in Indonesia declined from 300,000 tonnes in 1995 to only 150,000 tonnes in 1996 to 1999, and in 2000, the revitalisation of 200,000 ha of idle ponds was initiated. This and the opening of new farming areas have increased production by 102,000 tonnes annually. By 2014, the revitalisation of more ponds is expected to add 210,000 tonnes to the annual production (Trobos, 2012). In 2011, total shrimp production was 226,000 tonnes with 27% comprising monodon shrimp. This was an improvement of the production in 2010, when the industry was first devastated by the infectious myonecrosis virus (IMNV).

During the talk show on the revitalisation of shrimp farming, the moderator was Anang Hermanta, director at PT Shinta Feedmill. Panel members included Director-General of Aquaculture, Ministry of Fisheries and Marine Affairs, Dr Slamet Soebiakto, Aquaculture Director-General, Dr Agung Sudaryono from MAI, M. Najib of PT Inve Indonesia and Dr Agus Somamiharja of PT Japfa Comfeed. The program is seen as an important private-public partnership. This revitalisation includes improvements in infrastructure facilities such as water channels and lining of ponds to improve culture conditions for intensive and extensive shrimp culture. Government agencies also provided excavators in certain locations for cleaning of ponds and technical centres to offer advice. The aquaculture directorate will support the demand for brood stock supply and will also allow for import permits from other suppliers of brood stock.

In 2012, the north coast of West Java will be a focus of the program with renovation works on water channels, deepening of ponds within a 20,000 ha area in Banten and West Jawa provinces. Some 5,000 ha of ponds have been designated for semi intensive shrimp culture. Ponds will be lined with low density polyethylene liners. The rehabilitation of ponds in the provinces of Central and East Java will be carried out together with the private sector.

Shrimp in 2012 and beyond

The majority of farmers operating intensive farms have been facing difficult times with the threat of IMNV as well as white spot syndrome virus (WSSV) since 2009. At the Makassar meeting, producers said that the situation is improving as they are learning to manage the culture up to time of harvesting. **Suprapto** from the Shrimp Club Indonesia (SCI) said that SCI has technical teams to assist members throughout the archipelago. They also conduct several seminars on pond and

disease management. In general, club members contribute 35% to the annual production and it is estimated that production will increase by 30% in 2012 to 300,000 tonnes.

Production has stabilised in ponds in Sumbawa, south coast of Jawa, and in Lombok, Sulawesi and Lampung. However, IMNV remains a major threat in Lampung. A total recovery will be challenging as water quality seems to be the main cause of IMNV infections and IMNV easily spreads to other ponds. Some of the measures include reduction of density from 100-125 PL/m^2 to 80 PL/m^2, reduction of feed amounts and water exchange, practice of partial harvesting, and improvement of water quality and biosecurity. However, when production stabilises, producers begin to increase stocking density. Stocking 250 PL/m^2 continues in farms such as in South Sulawesi not affected by IMNV.

Professor Rohkmin Dahuri, the former Minister of Fisheries and Marine Affairs and industry leader said, "The total potential area for shrimp farming is 1.22 million ha but only 33% or 400,000 ha have been used. Out of this, 100,000 ha are used for intensive shrimp culture, 200,000 ha for semi-intensive and 100,000 ha for extensive culture. The per ha production potential of intensive farms is yet to be achieved and when this reaches 40 tonnes/ha, and when we also include production from semi and extensive culture, the industry will become a USD 27 billion industry (calculated at USD 5/kg ex farm), surpassing palm oil and textiles which is USD12-13.7 billion/year."

"In the shrimp farming sector, the productivity level is low in Indonesian farms, and so is sustainability. We need to benchmark ourselves with our competitors and adopt technology from other countries. Aquaculture is also a supply chain business and to be successful, each stakeholder must contribute. Along the supply chain, we also need feedback. We still lag behind China, Thailand and Vietnam in terms of production volumes and so we need to look at economies of scale and an integrated management of the supply chain."

Feed and technical support

As feed is the major component of production costs, the government has approached the Association of Feed Manufacturers or GPMT to bring down feed costs. **Denny D Indradjaja**, chairman, Aquaculture Division, said, "Aqua feed prices have been fluctuating and this is inevitable as many raw material costs have been increasing. In turn we also have increases in energy and labour costs. The government is asking us to use more local raw materials, such as copra to bring down costs. The disadvantage of using copra is that it oxidises easily. Cassava is used for human consumption and so is not sustainable. Producers have this dilemma as we want to help farmers especially small scale freshwater fish farmers, but are limited by increasing costs. The demand for fish feed is increasing annually at 15%. On the other hand we have a 5% import duty for some raw materials. Our local supply of fish meal is 50,000 tonnes but this is not certified whereas buyers demand that we use fish meals from sustainable sources."

"GPMT also supports the government in its development programs such as the campaign to develop catfish farming for local consumption. Our role is to bring down feed costs for small scale producers. We also help the government by training staff on good aquaculture practices. CP Prima has been successful with its revitalisation program where we ensure that farmers receive technical assistance as they migrate to semi intensive culture practices. However, the main problem faced in other farms is the lack of funding available for feed purchases and skilled labour to manage ponds."

New fish varieties and vaccine

At this gathering, the Directorate of Aquaculture announced these developments; three new varieties of the tilapia fish, Nila Nirwana II, Nila Sultana, Nila Srikandi; domesticated torsono fish or mahseer (*Tor tambroides*) and a new vaccine against *Aeromonas septicemia*, cell suspension of *Aeromonas hydrophila* or Capriva aero-L®.

The Nirwana II is a result of work on family selection at the Freshwater Aquaculture Centre in Wanayasa. In a presentation, Eka Yudhistira said that the growth is faster (15.08%) than the Nirwana tilapia. Nila Sultana was developed since 2005 at the Sukabumi centre. In a study, Dian Hardinantho said that the new variety grows faster (4.22%) as compared with another tilapia variety in ponds. The domestication of the mahseer began 4 years ago and the success opens up the farming of the high value fish. The saline Nila Srikandi (*Oreochromis aureus* x *O. niloticus*) is the result of the domestication work at the Sukamandi centre and shows optimal growth at a salinity range of 10 to 30 ppt. It has a moderate tolerance to *Streptococcus agalactiae*.

Aquaculture is not just for food.

The other three target species are seaweed, milkfish and catfish. Rohkmin said that it is time to look at aquaculture as a supplier of raw material for biofuel, pharmaceuticals, cosmetics and human health. There are 13 species of farmed algae, four are of economic importance. In 2011, seaweed production was 4.3 million tonnes, comprising 95,200 tonnes of *Glacillaria* sp from South Sulawesi. Indonesia exported 1,827 tonnes of agar valued at USD 12.6 million. In 2012, the ministry has targeted 5.1 million tonnes of seaweeds which will make Indonesia a global leader. However, **Professor Kazuo Miyashita**, Hokkaido University Japan who presented his work on functional foods from marine products said that Indonesia mainly exports its seaweed as agar or carragenan which does not have a high value. Industry should look into using its seaweed as a functional food or feed source. His work focussed on fucoxanthin found in the lipids of brown seaweeds and its anti-obesity and anti-diabetic effects.

Industry at the talk show on the revitalisation of the shrimp industry.

Members of Shrimp Club Indonesia; Franz Anthony and Suprato (left). Suprato provides technical services on behalf of the SCI.

News in Brief

Drop in pangasius exports to the EU

Vietnam's pangasius exports to the EU dropped nearly 27% in the first half of 2012 compared with the same period in 2011. The downtrend is expected to continue in the coming months as traders face the uncertain European economy. Some European importers said that slow sales are also affecting other seafood and food products. Fish consumption may rebound in the last quarter, but only marginally as the region faces financial challenges. The Vietnam Association of Seafood Exporters and Producers (VASEP) reported that sales of fish to four European key markets, Spain, the Netherlands, Germany and Italy dipped in June. In Spain, EU's largest pangasius consuming market, imports were down by 32% in value in the same month. The largest drop was in Germany at 45% to USD 27.6 million. Meanwhile, in the first quarter of 2012, imports to the US increased by 49.2% to USD84 million. In the eighth preliminary review, the US Department of Commerce gave zero anti-dumping taxes to 18 Vietnamese pangasius exporters for the period from August 1, 2010 to July 31, 2011.

Maturation in black tiger shrimp via molecular technique

The common technique to induce ovarian maturation in the black tiger shrimp *Penaeus monodon* is by eyestalk ablation but this exhausts female brood stock quickly, increases production costs and draws criticism for animal cruelty. Dr Supattra Treerattrakool, a researcher at the Institute of Molecular Biosciences, Thailand has a strategy to induce reproductive maturation in female brood stock tiger shrimp by working at the molecular level to block the activity of the so-called gonad-inhibiting hormone (GIH) that regulates maturation. In her PhD dissertation that won a research award in agriculture and biology from the National Research Council of Thailand 2011, Supattra cloned and characterised the DNA of the GIH of the shrimp. The genetic information was then used to develop molecular substances—GIH-dsRNA and anti-GIH antibody—that were injected into female brood stock. The introduction of the substances was found to deplete GIH and neutralise its activity, and in the case of GIH-dsRNA, led to ovarian maturation and successful spawning in both domesticated and wild black tiger shrimp.

EQ and shrimp imports into Japan

Ethoxyquin (EQ) is the most cost effective antioxidant added to animal feeds either directly or indirectly as a component of an ingredient. It is used to stabilise high levels of polyunsaturated fatty acids in fish meal. The only alternative meeting requirements of the International Maritime Organisation is BHT but is 3-8 times less effective in stabilising fish meal. According to the US FDA, EQ is not allowed as an additive in foods but allowed to be added in feed ingredients at a maximum of 150 ppm in animal feeds. The European Commission also sets a limit of at 150ppm of E324, alone or in combination with other additives in animals including fish (Directive 70/524/EEC). It is sometimes used alone or in combination with the other anti-oxidants, BHA (E320, butylated hydroxyanisole) and BHT (E321, butylated hydroxytoluene) in fish feeds.

Recently, Japan imposed an MRL of 0.01 ppm for its shrimp imports from Vietnam with 30% checks. However, all-out checks began after Japan found two consecutive batches of shrimp from Vietnam containing higher levels of EQ, a week after it lifted the 30% check, said VASEP. Vietnam is now proposing to Japan an MRL of 0.05ppm, similar to that for fish based on the fact that the Japanese daily dietary intake of shrimp and fish are similar. Japan is an important importer of Vietnam seafood, so the regulation on EQ is considered as a huge obstacle for its shrimp exports to Japan.

India's shrimp exports to Japan has come under severe strain with the sudden reduction on EQ content to 0.01ppm by Japan's Ministry of Health, Labour and Welfare. Japan started detection of Indian shrimp consignments on arrival and Japan has rejected 19 shipments of black tiger shrimp from India. "We have been exporting black tiger shrimp to Japan for 40 years but this had never happened," said Leena Nair, chairman of Marine Products Export Development Authority (MPEDA). Importers have been asked not to ship shrimp until the issue is sorted out. Nearly 150 containers are lying in cold storage in West Bengal, ready to be shipped to Japan (source: www.iffo.net; www.eng.vasep.com.vn; www.business-standard.com).

Production and breeding of sleepy cod

Sino Agro Food, Inc. which develops modern commercial beef, fish and agricultural projects in China has acquired the rights for a new commercial feed and breeding technology specifically designed for the sleepy cod fish *Oxyeleotris* sp. This includes the formulation and processing for semi-floating pellets for grow-out as well as the weaning technology for fingerlings to adapt to the new pellet feed. Also included is a technique to selectively crossbreed fish to produce healthier and faster growing fish as well as enhances the breeding cycle and frequency under optimal aquaculture conditions. Solomon Lee, CEO said, "We are confident that these new technologies will greatly benefit us in the production of fish by reducing the cost of feed and labour by eliminating the processing of live bait and reducing the grow-out time. The company will also be able to produce its own fingerlings, and raise them to maturity under an enclosed environment thus lowering mortality rate when compared to grow-out in open systems."

R&D on inland production of mouse grouper

In Singapore, Apollo Aquarium has begun to run its marine research farm in Lim Chu Kang. This inland farm has a small footprint recirculation aquaculture system (RAS) to produce the high value mouse grouper *Cromileptes altivelis*. There are 12 tanks in the pilot farm. In the system, 90% of the water is recycled but the company will need to test culture parameters in the RAS. In the fully enclosed system, Apollo's COO, Eric Ng said fish are protected from the disease pathogens common in open seawaters. Ng said, "We are trying to focus on manufacturing salt water for our usage, rather than using sea water as our source. The difficult part is to understand the minerals needed in this water, the salinity content needed for the young larvae, and also for the grow-out fish." Apollo's venture into marine fish farming started with a government grant in 2009, part of a technology innovation program which provides up to 70% funding support for R&D efforts by small and medium enterprises. From its research farm, Apollo hopes to expand it into a commercial-size facility that can supply groupers to the market year-round.

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A new benchmark in shrimp culture in Malaysia

iSHARP Setiu walks the talk with a unique modular design, fully lined ponds and canals, the highest level of biosecurity and controlled production with biofloc technology. By Zuridah Merican

Blue Archipelago Bhd started shrimp farming in 2008 at a 420 ha farm in Kerpan, Kedah, Malaysia. Taking on this existing farm, it embarked on an extensive renovation project to bring the farm up to current industry standards. It is now an integrated operation with a hatchery, farm and processing plant. Since then it has achieved recognition as a producer of premium shrimp with high quality standards. In 2009, Blue Archipelago started construction of a new farm on a greenfield site called iSHARP in Penarik Village, Setiu in the state of Terengganu. This farm brings modern shrimp farming to the next stage, addressing the most pressing challenges of the day, with the highest level of biosecurity, vis-à-vis location and design of the farm. iSHARP stands for integrated Shrimp Aquaculture Park.

"Together, we have incorporated our past knowledge in shrimp farming and the challenges we have faced and expect to face, and have built what we see as a shrimp farm for the future. Our tagline 'quality, safety and ecology' underlines the prerequisites in shrimp production to be sustainable. Our team is committed to ethics and transparency in production and this is clearly shown in Kerpan and now in Setiu," said Christopher Lim, COO. Lim is a veteran with almost 30 years in shrimp farming, most of them in one of Indonesia's largest farms in Lampung.

Bujang Slamat (left) with Agus Mashadi

A unique design

The farm in Setiu will comprise two phases, with a total of 616 ponds. Phase 1 has 216 ponds and is nearing completion. Water for the whole complex is drawn some 1.8 km in the South China Sea to a large volume pump station. In this way, good water quality of high salinity is assured. A modular design for the ponds may seem normal in shrimp farming, but two features stand out. In the design, each module has its own delivery canal for water from its four treatment ponds. From the main supply canal which stretches for 2.5 km, water is filtered through a series of 1000 micron and 250 micron filters on entering the first treatment pond. Two modules share a discharge canal. Each module acts as a commercial unit and the design allows the module to be completely 'locked down' in case of disease.

Each module of 24 ponds, comprises 20 production and 4 treatment ponds, all 0.5 ha in size. The delivery canal is elevated. All discharge water is emptied into effluent treatment ponds. According to the regulations by the Department of Environment Malaysia, the quality should meet its effluent standards on BOD/COD, pH, etc. before discharge into the river. All the ponds and water distribution channels are fully lined with 0.65 mm HDPE liners. For biosecurity reasons, the intake system operates on a double pumping system to prevent leakages due to gravity.

Production standards

Trial production started in October 2011 with 4 modules. Now, in its first cycle, growth performance of vannamei shrimp has been good at

Pond with brown water at 84 DOC with shrimp of 16 g. The target is 90 days for harvesting. Autofeeders are used for all the ponds. These dispense 30kg of feeds 30 times/hour.

Feed tray

an average of 16 g at 100 days of culture (DOC). The yield averages 8 tonnes/pond (0.5 ha), stocking density is 100 PL/m^2 and survival rate is 95%. Feed cost in this cycle was lowered with biofloc technology. The average feed conversion ratio (FCR) was 1.4 and the best FCR was 1.2. In comparison it would be 1.6 using conventional culture technology. The average daily growth should be 0.17 g-0.18 g and at 40 DOC, shrimp should be 7 g. This will act as the standard for the farm which is capable of 2.4 crops/year.

Currently, the team at the farm comprises the farm manager, Haji Umar and two experienced production managers, Bujang Slamat and Agus Mashadi. Together, Bujang and Agus have more than 30 years of experience in intensive shrimp culture. Indonesian born Bujang and Agus worked at the then Dipasena farms in Lampung Indonesia. Bujang, who conducted the test trials at this farm is responsible for 4 modules whilst Agus will soon start production in the 5th module. Previously, Bujang was attached to the farm in Kerpan for nearly a year. They are assisted by skilled and unskilled workers from the surrounding local villages.

Blue Archipelago has a social responsibility to provide employment to the community. According to Bujang, one asset is the new 150 member staff which the team can easily train and build up camaraderie.

"When part of the ponds was completed, we started cautiously. We began with stocking at various stocking density: 40 PL/m^2, 60 PL/m^2, 80 PL/m^2, and then up to130 PL/m^2. We took the precaution as we wanted to see how our ponds and design fare during the monsoon," said Bujang.

"When we started with stocking only 40-60 PL/m^2, growth averaged 21 g in 100 DOC. Now we are confident that the 100PL/m^2 stocking density will be our standard. One advantage of these lined ponds is the cleaning process. You will see that within 2 days we can finish preparing a pond. In comparison it would have taken us 2 weeks for a soil bottom pond. This not only gives us a fast turnover but is less labour intensive for the workers."

Harvesting

Bujang holds just harvested 16 g shrimp

Overview of ponds and supply canal in phase 1

Sustainability with BFT

These lined ponds are ideal for the application of biofloc technology (BFT) which Bujang and the team are well versed in. However, he emphasised that in most ponds they are not practising the full BFT concept i.e. high stocking density and dependence on the inherent microbial population in the ponds for growth. BFT is ideal for zero exchange of water with the only water addition to compensate for evaporation. It results in less impact on the surrounding water environment and better control of disease. The main requirement for BFT is to have an adequate aeration system. The farm has a standard of 14 hp per 0.5 ha. There are 10 paddlewheels of 6 two hp units and 4 one hp units in each ponds. The pond water will start to become brown with heterotrophic bacteria by 30 DOC. Removal of sludge and siphoning are required for pond bottom management and to prevent excessively high levels of nitrite. The design of the ponds has already included this feature.

"I estimate the feeding requirements based on a survival rate of 90%. I do not use the feeding tables provided by the feed companies. In general our feed amount is about 20% less than recommended. Daily, we will tabulate the FCR and if there are any leftover feed we do not add to the feed amount but if feed is not finished, we will reduce the amount by 10-20%. The pH should be a minimum of 7.5 to a maximum of 8.0. We use molasses and grains to balance the C:N ratio in the ponds," said Bujang.

Biosecurity

The likelihood of a disease incidence has not been left to chance. At iSHARP, all production ponds have overhead bird scare nettings. Only those responsible for a module are allowed into the area. During harvesting, carried out by farm employees, only the farm lorry is allowed on the dyke. Throughout the harvest process which usually starts before dawn and lasts 4 hours, the lorry will be transporting the harvest to the harvest station. Here the shrimp is packed in ice before being sent on to the final destination, either the local market or the processing plant.

As many farms in Malaysia continue to face early mortality syndrome (EMS), Bujang has to be on alert to any potential incidence here in Setiu. The farm is quite secluded with only one other farm close by. Aside from routine monitoring of stock in ponds and of water conditions, he is also using his experience in Kerpan where from day 1 to 30 DOC, the pond water must be green to prevent EMS. He has to keep this in mind, even here in Setiu.

"With the operation of phase 1, a thorough review will be conducted and we will continue to innovate to bring the latest technology and system into phase 2. Currently, we hope iSHARP's biosecurity and environmental sustainability plus BFT will move the industry forward to a different level of shrimp farming," said Lim.

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"EZ Artemia has demonstrated higher survivals and animals having well-marked digestive tracts… we have replaced 100% *Artemia* in 2011." – *Mexico*

"We just conducted trials replacing live *Artemia* in PL transport… we intend to start using it in our larval rearing." – *Brazil*

"EZ Artemia can replace 100% *Artemia*…." – *Vietnam*

"With the use of EZ Artemia, overall survivability greatly improved, water quality is good as we observed minimal leaching. Also, molting was early. EZ Artemia performed well." – *Philippines*

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Where do we want Asian shrimp aquaculture to be tomorrow?

TARS 2012
The Aquaculture Roundtable Series
15-16 August 2012

In August, stakeholders in the shrimp sector held roundtable discussions to brainstorm on how to drive shrimp aquaculture forward.

From left, Arman Zakaria Diah, PT Central Proteinaprima, Indonesia, Kittipon Krittiyarat, DuPont, Thailand, Anutara Boonnat, Charoen Pokphand (CPF), Thailand, Saenphon Chandaeng, Wahyuni Mandira Farm, PT. Central Proteinaprima, Indonesia, Suphol Phantuma-o-phas, CPF, Thailand, Kalayanee Poon-Asawasombat, DuPont, Thailand and Sujit Kaewchum, CPF, Thailand (extreme right).

The second in the Aquaculture Roundtable Series (TARS) 2012 was held in Phuket, Thailand from 15-16 August focusing on the shrimp aquaculture value chain. There were 190 participants from 18 countries comprising the public and private sector, NGOs and academia. This event was successful in presenting a neutral forum for multiple stakeholders to share new knowledge and expertise, and provide substantial input to improve the sustainability and profitability of shrimp production in Asia.

As shrimp aquaculture crosses the threshold to become an industrial supply chain it faces numerous challenges within each of its segments as well as in the integration of all these segments. Asian producers contribute 91% of the annual global production of 3.5 million tonnes and need to be leaders shaping the future of the industry.

The objective of the first day was to determine 'where we are today'. At the plenary session, participants benefitted from updated overviews from leaders in their respective fields. Highlights from the 16 presentations from experts in Asia, Europe and the USA which addressed current challenges and emerging trends in shrimp aquaculture are given below. This formed the starting point for the break-out sessions. Led by team leaders, participants were then divided into four main groups within the shrimp aquaculture value chain segments (breeding and hatchery; culture and health management; feeds and feeding strategies and marketing, branding and certification) to discuss key challenges and formulate recommended strategies to drive the industry forward during the breakout sessions on Day 2. The responses from each group were then consolidated and deliberated in a panel discussion open to all participants to encourage cross fertilisation.

From left,Hidajat Handaja Dantjaputrat, PT Suri Tani Pemuka, Indonesia, Peter Couteau, Allen Wu, Nutriad, Taiwan, Ravi Pelluru, The Waterbase Limited, India, Srinivas Rayaprolu, Novus Animal Nutrition, India and Manoj Sharma, Mayank Aquaculture, India

Breeding and Hatchery

Traits of commercial importance

Genetics research and the development of genetically improved shrimp stocks have moved further ahead for *Litopenaeus vannamei*, which accounts for 82% of global shrimp aquaculture production. However, there are significant knowledge gaps with regard to understanding the genetics of commercially important traits in vannamei shrimp. Currently, most selective breeding efforts focus on improving growth, grow-out survival and disease resistance. However, there are other traits of commercial importance, such as reproduction and carcass traits, and little is known on the genetics of these traits, said **Dr Shaun Moss**, from the Oceanic Institute (OI), Waimanalo, Hawaii, USA.

OI is credited with developing the first Specific Pathogen Free (SPF) populations of vannamei shrimp. These populations have been very important to the global shrimp aquaculture industry, particularly in Asia, where most of the farmed stocks are descendants of OI shrimp. Currently, OI supplies a limited number of brood stock to the industry each year, conducts research related to shrimp genetics and advanced production technologies, and works with industry partners to develop new lines of selectively bred vannamei shrimp.

"We have seen the rapid expansion in vannamei shrimp since 2000. Up to 2011, production has increased 1700% to 2.7 million tonnes and in comparison, the production increase was only 24% for the monodon shrimp. This is because of the lack of healthy monodon shrimp brood stock from captive or wild stocks and their poor reproductive performance. The commercial availability of SPF vannamei shrimp since 1991 and later the availability of genetically improved strains catalysed this expansion in Asia," said Moss.

Understanding the relationships between traits is very important when defining goals for a selective breeding program. In other words, geneticist/breeders need to know how selecting for one trait will affect shrimp performance for another trait. This has been a major research focus at OI and the OI Shrimp Research Program has been able to estimate the phenotypic and genotypic correlations among several

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Dr Le Thanh Hung, Dean Faculty Fisheries, Nong Lam University, Vietnam

Dr Manoj Sharma, Director, Mayank Aquaculture, India

commercially important traits for vannamei shrimp. For example, Moss reported that there is no significant phenotypic correlation between Taura Syndrome Virus (TSV) survival and grow-out performance (growth or survival). He also reported that the genetic correlations for shrimp survival to multiple isolates of TSV are positive and of moderate magnitude. Importantly, this suggests that selection for improved survival to one TSV isolate will result in improvements (though smaller) in survival to other TSV isolates.

"An unanticipated consequence of breeding is the size of the brood stock and reproductive performance. As the shrimp is selected for growth, the 10th generation brood stock sizes have increased by 43% for the female and 33% for the male" added Moss.

Moss further stressed the importance of understanding the relationship among traits targeted for selection and how selection decisions should be focused on improving the net merit (or economic value) of a target population. He also discussed the need to not only determine whether a trait is amenable to selection (sufficient heritability and variation), but also whether it is worthy of selection (i.e. is it of economic importance).

"We should assign relative economic values of traits and understand them. However, as the industry is fragmented, we see that each stakeholder is interested in traits which will impact their particular sector. For example, a processor may want a firmer gut to facilitate ease of removal. Selective breeding targeted at the selection process cannot make all stakeholders equally happy. Along the supply chain, there will be specific traits for selection. For maturation, these are increased spawning frequency, spawn size and hatching rate, and the hatchery, nursery and grow out will want good growth and survival, while the processor will be interested in better size distribution and finally the market will want better colour, texture, taste, etc. But using the example from the poultry industry, vertically integrated companies can examine 'trade-offs' among traits that increase overall profitability."

The Ferrari analogy

This was how Moss described why farmers have yet to fully exploit the genetic potential of selectively bred shrimp stocks. To reach its maximum performance it should not be limited by poor culture conditions. A Ferrari capable of 250 kph in an autobahn can only achieve a speed of only 25kph when forced to travel on a dirt road. "The future is selective breeding with biotechnology and controlled production environments."

Taming the tigers: the need of the hour

Ravi Kumar Yellanki, Vaisakhi Bio-Marine (P) Ltd, India is sure that the niche segment of bigger size shrimp could be achieved with monodon shrimp which grows quickly to 50-60 g. But the ultimate weapon for its farming is large scale domestication. This is the need of the hour: domesticated stocks with a reliable history of being free of pathogens of concern which can help mitigate risks from persistent outbreaks of diseases.

"India's national production of the monodon shrimp for 2011-2012 is estimated at 135,778 tonnes. This is the highest ever monodon shrimp production to meet market demand despite the introduction of the vannamei shrimp. In Bangladesh, monodon shrimp is farmed using the traditional method. Despite recurring disease out breaks, the annual production is above 60,000 tonnes but it has the potential to produce 150,000 tonnes annually. In India, about 30,000 tonnes are produced annually through traditional culture whereas the potential is almost 100,000 tonnes. The introduction of vannamei shrimp is ruled out in both countries as the tide-dependent traditional farms are closely connected with the natural environment. There is a chance for the vannamei shrimp to escape into the wild and affect the biodiversity".

Ravi showed that it is still possible to have good production from wild brood stock. He compared the higher productivity of 2.47 tonnes/ha/yr in Gujarat with the rest of India, where average production was only 1.15 tonnes/ha/year. Here all the farmers stock post larvae from a few selected hatcheries which screen the brood stock for pathogens of concern before and after spawning.

There are already several companies involved in the domestication and breeding of monodon shrimp: Moana Technologies in Hawaii, Aqualma in Madagascar, Charoen Pokphand in Thailand, CSIRO in Australia and the Marine Products Export and Development Authority (MPEDA) in India. However, Ravi said, "These breeding programs need to get a grip on commercial mass scale reproduction. They need to scale up to cater to the critical mass of the farming community and I

Dan Fegan

Leading Culture and Health Management groups, Francisco Gomes and Pornlerd Chanratchakool (right).

Hervé Lucien-Brun (left) and Panisuan Jamnarnwej at the panel discussion on Marketing, Branding and Certification

believe that successful breeding programs need to set up multiplication centers in shrimp growing countries.

"Monodon shrimp is more suitable for traditional farms. The farming of the vannamei shrimp which requires new infrastructure and high operational costs is not an option for small farmers. In view of the large groups of small, marginal and traditional farmers facing increasing incidences of WSSV infections in the wild brood stock, it is up to the governments of shrimp growing countries with a large base of small, marginal and traditional farmers to work on breeding programs for the monodon shrimp as soon as possible."

"However, looking at the success in Gujarat, in the meantime, there are alternatives to domestication such as the consortium nauplii centers with stand-alone quarantines, maturation and improved egg/nauplii washing protocols, better diagnostic tools and sampling procedures for testing brood stock subjected to unfavourable conditions such as reduced water temperature or any other stress conditions," said Ravi.

New trends in hatchery protocols

According to **Dr Olivier Decamp**, INVE aquaculture, these tend to be in four areas; upgrading of biosecurity in the hatchery, some replacement of live food, feed and health boosters and improved water management by the application of probiotics.

"It has been shown that most bacteria live in colonies, i.e. in aggregates in the water or in biofilms on surface. The persistence and survival of *V. harveyi* in shrimp hatcheries is attributed to its ability to form biofilms with resistance to disinfectants and antibiotics. Thus, the recommended protocol is to use new types of biocide with increased activity against bacterial biofilms," said Decamp.

Shrimp brood stock is usually fed with fresh feeds such as polychaetes, oysters and mussels. The drawback is the biosecurity issue in addition to supply and nutritional quality. Decamp suggests the increased use of performing formulated feeds. With conventional dry diets no more than 50% of the fresh food can be replaced in brood stock rations. New generation, semi-moist pellets replace up to 70% without affecting reproduction performance and nauplius quality.

"The uncertain availability and pricing of *Artemia* cysts from the Great Salt Lake are triggering the industry towards the development of *Artemia* replacement protocols. Different commercial feeds are now being positioned as total *Artemia* replacement diets. However, reported results appear still variable and there is room for improvement. Best results occur with partial *Artemia* substitution using a balanced combination of live food and formulated larval diets. Work in Brazil, Ecuador and Mexico demonstrates that production cost reductions of 25-30% are obtained when increasing the *Artemia* replacement from 65 to 85%.

Decamp added that in a monitoring of the nursery grow-out performance of 60 million post larvae (PL) it was shown that survival increased by 30% when quality hatchery feeds were used to feed the PL.

In Brazil, the application of probiotics in zero exchange aerobic heterotrophic culture system led to improved survival and growth rate. In Mexico, a combination of live food, selected water and feed probiotics, health booster and feed resulted in a minimum harvest weight of 200mg after a 30-day nursery cycle at a stocking density of 15 PL15/L.

From left, Tim Flegel, Pornlerd Chanratchakool and Pedro Encarnação

Nyan Taw (left) and Soe Tun, chairman, Myanmar Shrimp Association

Ravi Kumar Yellanki (left) with Carlos Massad, Groupe Grimaud, Vietnam

"The current challenge in Asian shrimp farming is early mortality syndrome and this is an opportunity to reconsider biosecurity measures, culture system management and the relationship between hatchery and on-growing stages."

Culture and Health Management

Progress on managing EMS

In his presentation on the current diseases in shrimp, **Dr Tim Flegel**, Shrimp Biotechnology Business Unit, Centex Shrimp, Thailand said that the two top threats to the industry are White Spot Syndrome Virus (WSSV) and followed by Early Mortality Syndrome (EMS). There is no doubt that shrimp farmers have been facing challenging times with diseases and in particular, EMS or Acute Hepatopancreatic Necrosis Syndrome (AHPNS) which remains a threat in China since 2009 and Vietnam, Malaysia and Thailand since 2011.

"EMS is the name used for the unusually heavy shrimp mortality approximately within the first 35 days of culture. This very imprecise case definition has led to confusion in diagnosis. This has become clearer with a case definition presented by Dr Donald Lightner, University of Arizona, at a meeting on the EMS in NACA from 8-9 August, 2012. The case definition is a major breakthrough for groups seeking answers on EMS and is a very important progress as we can now look at the same type of specimens.

"EMS, in short is the acute progressive degeneration of the hepatopancreas which is dedicated for various functions and its degeneration will stop all the functions. E-cells no longer divide and cells in the centre of the organ no longer work. At the terminal stage, there will be secondary bacteria but when diagnosis is done at this stage, there could be several causes."

With a series of slides, Flegel showed that these can only be seen through histopathology. He added," I propose that, although there may some disagreement, that EMS is the sloughing of hepatopancreatic cells and this situation might end up with septicaemia. Lightner confirms that the problem is not caused by IMNV or a microsporidian. The new and presumptive field diagnosis is given in in the NACA website and diagnosis should be confirmed by histological examination."

There are ways to assess the causes for AHPNS. It could be biotic and abiotic toxins in pond water and water supply, soils and sediments, feed and feed ingredients, probiotics, and in old and recently used agricultural pesticides, etc. Nobody has isolated the bacteria. Flegel cautioned that, "it is important that the dissection for sampling is done well to avoid stomach and midgut bacteria contamination."

Flegel's message is that we need to look at this in totality.

"At Centex Shrimp, we have started to investigate a possible new bacteria and checking for the possible phage-bacterium partnership which could result in a toxic bacteria. We have identified bacteria present at a high level in the affected ponds. We are now working on a probe for this."

Key points to avoid mortality and disease

Dr Pornlerd Chanratchakool, Novozymes Biologicals, Aquaculture explained how the balance between basic pond management and biosecurity set up can reduce losses in a shrimp farm. In any farm, the bottom line is to reduce diseases and this is achieved with a clean environment, healthy stock and less pathogens. Recent research in Thailand pointed to effects of temperature and dissolved oxygen on feed consumption causing poor water and soil conditions which in turn trigger disease outbreaks and also affect growth and survival.

"Some important measures include adjustments to feed amounts as per the recommendation of Dr Chalor Limsuwan. When temperatures go down to 24-26°C, the feed amount should be reduced by 40-60%. Feeding behaviour is an important indicator of the health of shrimp. In a poor pond environment, feeding will start to either slow down or stagnate after 60-80 days. This is a sign that the shrimp is under stress, which affects the feeding behaviour and thereby the weight gain. In a good pond environment, no external factors stress the shrimp, and it continues to feed and grow until harvest."

Some management guidelines presented include the following;

- Based on a stocking density of <120 post larvae/m^2 of the vannamei shrimp, the biomass is < 1.3-1.5 kg/m^2 in a standard pond without partial harvest and < 0.6-0.8 kg/m^2 for monodon shrimp.

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From left, Li Huitao, Shandong Liuhe, Mingyan Huai, Alltech China, Hu Liang, Novus International, Peng Zhi Dong, Guangzhou Hinter Biotechnology, Yan Yuan, Ningbo Tech-bank and Dong Qiufen, Guangzhou Hinter Biotechnology.

Olivier Decamp (centre) leading the Breeding and Hatchery Management Roundtable, together with Jeff Prochaska, Global Gen, Indonesia (right) and Christopher Co, Oversea Feeds Corporation, Philippines

- The feed tray should be checked earlier at 20-25 days (instead of 30-35 days) after stocking to determine growth. Feeds should be adjusted based on actual growth in each pond. The daily feed increment should be monitored and adjusted accordingly (for example; not more than 500g/100,000 shrimp per day) and no feeding should take place if weather fluctuates or if there is leftover feed on the tray.
- Dissolved oxygen levels should be maintained at > 3 ppm near the edge of sludge.
- Partially harvest/ or direct harvest if production close to maximum capacity.

His message was that although there are basic pond and feed management and biosecurity practices to achieve optimal soil and water conditions, there will be a need to consider individual pond management and appropriate decisions based on specific pond data and shrimp. In the future, farmers will need to include in their operational procedures, the unpredictable weather conditions.

Probiotics- why are there still doubts?

Probiotics have been used in shrimp farming for decades and yet the question 'does it work' persists. According to **Dr Pedro Encarnação**, Biomin, Singapore, the doubts are on their efficacy and strains. Then there are also questions on their application in terms of dosage and when to apply. Most importantly, the economic return and cost effectiveness must be demonstrated.

"In the case of aquaculture, we need to specify the different applications. There are feed probiotics which improve the intestinal microbial balance in the gut and those for water application. The latter are for bioremediation which is to change the microbial community in the rearing environment, to degrade organic waste products and to eliminate toxic substances and organic odours. There should be different strains for different applications since they have different modes of action (competitive inhibition, nitrification, denitrification, enzyme production), different requirements (pH, O_2, nutrients) and occupy different niches in the ecosystem (shrimp gut, water column, soil).

"A healthy gut is important and is the major vehicle for entry of pathogenic bacteria. The gut is rich in nutrients which supports pathogenic bacteria. In the gut it is essential to minimise negative or potential pathogenic bacterial strains. Gut probiotics work by competing with pathogenic bacteria for space and nutrients and they lower pH through an increased production of volatile fatty acids (VFA) and lactic acid. Gut probiotics produce antimicrobial substances (lactoferrin, lysozyme, bacteriocins deemed as natural antibiotics) and can also stimulate intestinal immune responce."

"There are proven benefits in the use of probiotics in shrimp culture but we can understand the doubts because sometimes the effects are not significant and not clearly identified. Usually the benefits do not compensate for the increase in investment and there is confusion with the number of strains. Some probiotics work well in some conditions, for example *Lactobacillus* can work well in the gut but not for bioremediation. Some have poor bacterial stability or the concentration is too low at less than 10^8 CFU/g. A study in Thailand showed that several probiotics in the market do not live up to the claims on the label. Unfortunately, there are claims that artisanal probiotics work against viral diseases such as WSSV.

"Generally, probiotics work in aquaculture operations but need to be managed. Given the concerns in the industry, there is a need to regulate probiotics in the market. We also need to learn to evaluate the potential probiotics well."

Culture models

Biofloc technology

With emerging viral problems and rising costs for energy, biofloc technology appears to be the answer for sustainable production not only in Asia but throughout the world, said **Dr Nyan Taw**, Blue Archipelago, Malaysia.

Biofloc technology is a system that has a self-nitrification process within the culture pond water with zero water exchange. The technology has now been applied widely, from shrimp brood-stock production, hatcheries and farms including super-intensive raceway systems. Commercial interest in biofloc technology is threefold, for it provides high productivity, low FCR and a stable culture environment, which lead to better economic viability.

"There are some basic requirements for a successful application of biofloc in vannamei shrimp farming such as high aeration (28 to 32 HP/ha of paddlewheel aerators) and the positioning of the aerators is critical. The floc density is controlled at <15 ml/L and the accumulated sludge requires siphoning. Ideally ponds should be HDPE or concrete lined. For sustainable commercial production, with a stocking density of 130-150 PL10/m^2, a production of 20–25 tonnes/ha/crop with 18-20 g shrimp can be expected. At the R&D level, we have used biofloc technology for stocking density of 250-300 PL/m^2 either direct or partial harvest to produce up to 50 tonnes/ha/crop. Feed costs can be reduced with supplements of grain pellets and molasses are required to maintain the C:N ratio. With the focus on sustainable production methods, this is surely one of them."

Nyan detailed the technology in his presentation and compared this with a conventional culture system. "The economics of biofloc can be explained in terms of higher daily growth rates; 0.16-0.21 g and better FCR at 1.1-1.2 as compared to 0.13- 0.16 g and 1.5 - 1.7 with the conventional systems. This translates to 3-4% savings in feed costs for every 0.1 change in FCR. Other savings are in days of culture and energy costs with zero exchange of water."

A glimpse of the future

The vision of **Dr Addison Lawrence**, Texas A& M is shrimp production in raceways inside buildings or greenhouses with complete biosecurity with increased predictability and the potential for the production of 'organic shrimp'.

"Our vannamei shrimp are already selected for higher growth at 4-6 g per week and can show linear growth to large sizes of 35-40 g. The future will need more predictability requiring complete biosecurity. Recently a

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completely new innovative technology has been developed using stacked raceways with a unique bottom design using average water depths of 15 to 20 cm with production levels between 600 and 1,200 tonnes/ha of footprint water per year and growth rates between 2.5 and 3.2 g/week."

Lawrence outlined the features of the shallow water stacked raceway technology (SST) which requires a small footprint. It can be used for the nursery phase to produce 19 to 33 day old post larvae from PL5. The SST technology is a cost effective way with complete biosecurity to increase production and crop predictability. It can act as a nursery system adjacent to existing traditional ponds or deep water raceways. In hatcheries, it is value adding as it can produce PL19-33 from PL5.

"What are the advantages? The management quality is better, there is a quarantine phase and stocking of larger PL with no expression of WSSV in ponds. Furthermore, there will be an accurate account of PLs stocked and a shorter time to commercial size in the grow-out system."

Production planning

Dr Francisco Saraiva Gomes, Novus International, Inc said, "More often than not, success in large aquaculture operations leads managers and owners to develop integration plans across the supply chain. The most common example is when grow-out operations integrate with hatcheries and nurseries. Successful farms may integrate further and bring to their operations either upstream feed mills, either downstream processing plants, or both."

The two typical drivers for integration are short term and long-term profitability. He added that in the first, there is a need to bring in-house gross margins that are otherwise paid to a supplier (upward integration of farms with feed mills) and/or captured by a customer (downward integration of farms with processing plants). The perception is that by integrating the adjacent segment in the supply chain there is an immediate increase in margins due to either cost reduction either to higher net selling price. Long-term profitability pertains to control of the supply chain within a certain defined context of anticipated market trends. Control-led integrations tend to be longer term strategic decisions. They imply that in the near-future, the lack of control of a new part of the supply chain, will result in increase of costs and or in loss of production capacity and or in decrease of sales price.

Marketing, branding and certification

Shrimp from Thailand

With more than 30 year's history, Thailand has been successful not only in farming up to 550,000 tonnes but also in exporting almost 380,000 tonnes annually. "These numbers easily place Thailand as the world's number one in farmed shrimp aquaculture production", said **Dr Panisuan Jamnarnwej** from the Thai Frozen Foods Association. TFFA is a private non-profit organization with 210 members, 98 of them in the shrimp business. The distinctive elements of the Thai shrimp industry are farms operations, the supply chain structure and business practices coupled with government support.

"Shrimp is now the leading product, with two third of our members' income from marketing shrimp. Thailand's shrimp exports have seen a steady growth up to 2011. In 2012, there has been a decline in tonnage by 3% but prices were relatively higher. But generally, shrimp prices have been steady all these years, at USD 6.50 to 7.00/kg. In 2010, there was a big swing up to more than USD 9.00/kg which made it difficult for us to cope. The US is our largest market and here our shrimp prices are high but this is because there is more value adding. The highest share of this market that we have achieved was 45%, but it now hovers around 32 to 35%.

"Although our shrimp trade centre is still the Mahachai market, many processors now buy direct from farms and the Movement Documents for both fry and harvested shrimp assure traceability. Control on food safety assures quality. Today, some companies are using the radio frequency identification (RFID) technology to facilitate an accurate tracing system.

"For exporters, the transition to the vannamei shrimp has greatly facilitated the traceability requirements. Imagine when we were marketing the monodon shrimp, for one 17-tonne container we would need shrimp from more than 130 ponds to get the acceptable size uniformity. With the vannamei shrimp, we can do the same with only 24-30 ponds. Our shrimp production will continue and growth in terms of volumes for 2012 is estimated at 3%. The industry is not worried on sales since the production is stable while demand continues to grow. However, a general concern is the rising costs of labour, expected to be over 10% of total cost within a year or so."

Joe Kearns

Dr Addison Lawrence

Shrimp for the EU market

The European Union (EU) is the largest shrimp market in the world and imported 610,300 tonnes in 2011. A 1.2% slight decline of imports in 2011 reflected a marginal impact of the actual crisis in the shrimp market, said **Hervé Lucien-Brun**, consultant, France in his presentation. "Although it is a large market for seafood, it is a very diverse one with consumption as high as 56kg/capita in Portugal to less than 4kg/capita. Spain and France are the largest markets at 12 and 7% of the world market, respectively."

"We can see some historical links on where shrimp is imported from but quality and prices also play an important role. India is the main supplier to the UK market, displacing Thailand in 2011 and is getting stronger as quality is improving. It is now the second largest supplier to France after Ecuador. Bangladesh is a major supplier to Germany but only provides large black tiger shrimp. In Germany, price overrides quality as discount outlets are becoming more important than supermarkets in the distribution of frozen shrimp.

"The impacts of the economic crisis differ in each market. The shrimp market in France fell from 114,600 tonnes in 2010 to about 109,800 tonnes in 2011. Madagascar is losing its market, falling from 9,600 tonnes in 2006 to 7,600 tonnes in 2011, due to the very high prices for its large black tiger shrimp and to the improvements of the Indian competition. After 4 years of strong growth the German imports have slightly decreased. In all the European countries, the market for certified shrimp is growing." (For more details, see article on the European shrimp market, Volume 8 Issue 4, July/August 2012, pp 46-47).

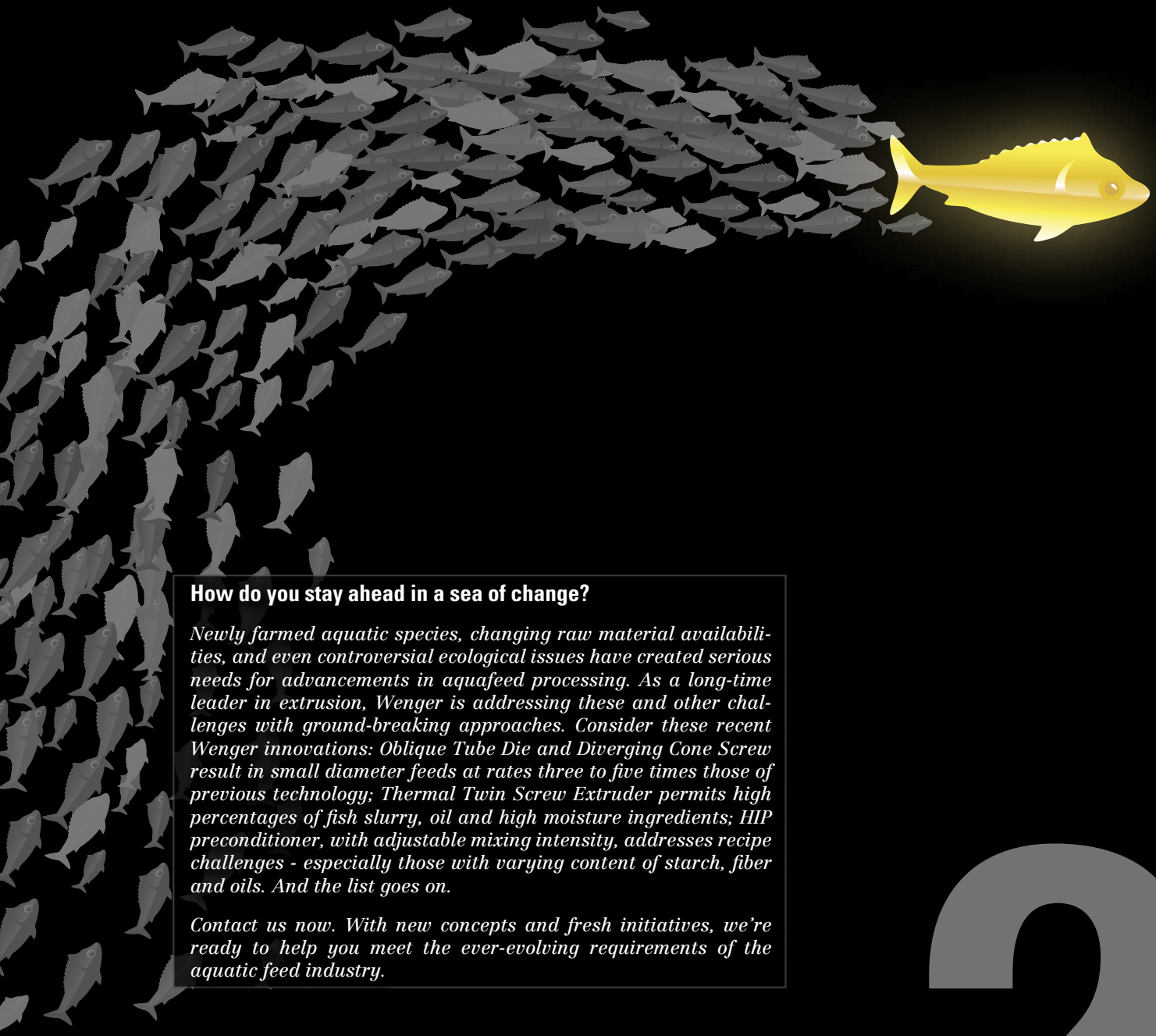
Shrimp farm certification

"There are many reasons for certification. We have environmental issues around shrimp farming and NGO pressure on importers and retailers. Through certification, major retail chains use their Corporate Social Responsibility (CSR) and reputation to reassure consumers that the shrimp they supply are safe and farmed in a responsible and/or sustainable manner.The differentiation of products comes with better prices and economic incentives. There is increasing attention on traceability in the supply chain," said **Dan Fegan**, Cargill Siam Ltd in his presentation on 'Where are we now and where do we go from here?

Fegan discussed the role of national certification schemes such as ThaiGAP, VietGAP and IndoGAP which is to raise standards across the board and promote local standards internationally to maintain competitiveness. The credibility of these programs depends on capacity although governments say that they have the sovereign rights to have them. There are many third party certification schemes such as GlobalGAP, Aquaculture Stewardship Council Shrimp Standards (ASC)

INNOVATION DISTINGUISHES BETWEEN A LEADER AND A FOLLOWER.

—Steve Jobs



How do you stay ahead in a sea of change?

Newly farmed aquatic species, changing raw material availabilities, and even controversial ecological issues have created serious needs for advancements in aquafeed processing. As a long-time leader in extrusion, Wenger is addressing these and other challenges with ground-breaking approaches. Consider these recent Wenger innovations: Oblique Tube Die and Diverging Cone Screw result in small diameter feeds at rates three to five times those of previous technology; Thermal Twin Screw Extruder permits high percentages of fish slurry, oil and high moisture ingredients; HIP preconditioner, with adjustable mixing intensity, addresses recipe challenges - especially those with varying content of starch, fiber and oils. And the list goes on.

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and Aquaculture Certification Council BAP program.

"These aimed at differentiating and rewarding best performers. It is also to raise the bar such as with the objective with the ASC shrimp standards to get others to replicate the best 20% in industry. Instead, the question is whether the top 20% will leave the rest behind. In Asia, we need to be aware of the importance of certification or else we spend our time trying to play catch-up when inputs come from industry in other regions and used for a competitive advantage against shrimp from Asia."

Fegan also raised some issues when such farm certification schemes include elements outside of the direct control of the farmer such as brood stock/fry source and treatment, feed formulation and ingredient sourcing and requirements to source from certified suppliers.

"BAP's Star system of certification is aimed to benefit the end user. However, the difficulty is that certification is dependent on supplier being certified too. The BAP and ASC farm certification is dependent on the feed supplier being certified and which in turn requires certification of its respective suppliers. For GlobalGAP certification, the feedmill should be GlobalGAP certified too."

Other issues with certification is the complexity in dealing with non-integrated operations such as farmer groups and contract farming systems who do not keep records, confusion over the role of third party and government certification schemes, multiple certifications for different customers and the heavy burden of documentation and effectiveness of the audit process. A bone of contention among governments in Asia is the lack of recognition of their certification programs by international retailers. A major issue is also the costs of certification.

"The burden of costs is not only the registration and audit costs but the difficulty and costs of compliance by the farmer. The costs of improvements and requirements such as that for an environmental impact assessment (EIA) or social impact assessment (SIA) can be quite high. Some producers question the benefits of certification to their business. We need to see impacts at various levels within the industry, and provide some suggestions on where certification may lead in future," said Fegan.

The take home message is "Asian producers should be more engaged and involved to have a larger influence in standard setting. As these dialogues include retailers and NGOs and with an active participation, we hope that they will be able to understand better the challenges of the producers".

Feeds and Feeding

Where are we today

The gap analysis by Dr Jacques Gabaudan, DSM Aquaculture Center Asia Pacific, Bangkok, Thailand explained how much we do know on shrimp nutrition and what should be the target for improvements in productivity. The best information available for the public is contained in the NRC 2011. The model to explain targeted nutrition is the change in productivity for the salmon where since 2007, it takes only 14 months to achieve marketable size fish as opposed to 18 months in 1980. The shorter production cycle reduced costs of production from USD11 to USD 2.97 and the relative feed cost to produce a kg of salmon

went down from USD 3.59/kg to only USD 1.48/kg. In Thailand, the work by McIntosh showed that productivity increased when time to harvest of 25g vannamei shrimp changed from 128 days in 2004 to only 72 days in 2010 and FCR and survival was better.

The presentation also covered the numerous technical advances required to lower feed costs for shrimp. These include information on nutrient requirements for all life stages, different temperatures, salinities, stocking densities, for optimum water quality and resistance to adverse conditions, alternative ingredients, formulations based on nutrient digestibility, functional feed additives enhancing survival/growth and feed management. Available information for the two species of shrimp, *Penaeus monodon* and *P. vannamei* is still not comprehensive. When these are available, comparison between species is difficult because of the different methods used.

The future will require specialised formulations which give benefits beyond classical nutrition to help shrimp exposed to adverse conditions from temperature change, water quality to bacterial, viral and parasitic infections. Learning from the salmon feed industry where there are functional feeds to meet the needs of the various stages of culture, the shrimp industry can look at single or multi components to develop functional feeds enhancing resistance to diseases. At the same time, there a push towards less use of fish meal and replacing with alternative shrimp feeds containing poultry meal, distillers' grains or pea meal.

Rising ingredient costs

Dr Jorge Arias, Alltech USA Inc, in presenting 'feeding shrimp for health, performance and profit', agreed that nutrition has not kept pace with advances in productivity. He added that the constraints nowadays are that when we try to use alternative raw materials, cost is also a factor. However, cheaper raw materials will inevitably increase the risk of mycotoxins leading to hepatopancreatic damage.

"Alternatives to fish meal are functional nutrients from yeast which contain 45% crude protein and 5-7% nucleotides to improve immunity and are rich in glutamic acid, amino acids and inositol. There is also a field of enzymes in the market which industry can use in feeds. A study by Cruz Suarez uses an enzyme to improve digestibility of plant meals but the logistics of inclusion is an issue. Dietary selenium, nucleotides and antioxidants showed improvement in shrimp immunity and disease resistance in a recent trial in Malaysia. The way ahead may be through algae which contains high levels of docosahexaenoic acid and is a non GMO (genetically modified organism). The ingredient can match required functions such as pigmentation, attractability and immune modulation," said Arias

"Perhaps the main challenge is to make sure that nutrition concepts and technology are applied to shrimp nutrition. Raw material supply is almost reaching crisis levels, and certainly prices; but there are opportunities to replace fish fishmeal and fish oil with sustainable protein sources. There are technologies available to improve utilisation of plant proteins and to use low cost ingredients without losing shrimp performance."

Beyond nutrition

"There is a need to think out of the box when we look at aquafeed formulation. So far shrimp nutritionists are mostly focused on obtaining acceptable levels of 40+ essential nutrients for maximising shrimp growth and survival. Under pressure of increasing ingredient prices, the formulator is focusing on standard ingredients providing the known essential nutrients. However, there are extra-nutritional or functional feed additives that have benefits beyond their nutritional role and which can affect drastically cost-efficiency at the farm and the feed qualities. The inclusion of functional feed additives can promote nutrient utilisation and thus improve FCR, growth, reduction in visceral waste, improvement in fillet yield, and reduction in environmental impact through less pond waste. They also promote health by reducing impact of bacterial/viral diseases and parasitic infestations on farm productivity," said **Dr Peter Coutteau**, Nutriad International, Belgium.

Although it is widely accepted that supra-nutritional levels of certain nutrients such as vitamin E, vitamin C, carotenoids, nucleotides,

Group on Culture and Health management.

essential fatty acids, are important for disease prevention in fish and shrimp, the role of extra-nutritional or functional feed additives is far less documented. In shrimp, disease prevention measures can include the application of specific additives to boost energy reserves in the hepatopancreas via the enhancement of lipid vacuolisation. Promising results in disease prevention are obtained with phytogenic feed additives, used as alternatives to antibiotic growth promoters and capable of modulating gut health in fish and shrimp. A wide range of functional feed additives are being explored in aqua feeds such as enzymes, herbal extracts and phytobotanical compounds, organic acids and feed emulsifiers.

Extruded shrimp feeds

The progress on extrusion technology for shrimp feed production was discussed by **Joe Kearns**, Wenger, USA. There are advantages of extrusion such as flexibility in formulation of recipes, higher starch gelatinization, less fines in feed and increased water stability. Extruded product sizes down to 0.8 mm or less lends well to the current situation where automatic feeders are used in shrimp farming in many parts of Asia. "If we study the salmon industry and how it evolved over the years, their industry went from hand feeding to automatic feeders. Besides lowering manpower costs of feeding this change also had an effect on extrusion machinery manufacturers. Why? We did not design the auto feeders but we were expected to make feeds which survived the feeders without pellet destruction or fines development. Studies of pellet hardness and how to achieve the required pellet specifications resulted in equipment design changes and operation changes in order to achieve the cell structure required. Salmon feed formulations are not as ever changing as seen in shrimp feeds so this will be a special challenge for this industry.

"Feed processing costs for extrusion are higher, typically USD 20-25/ton higher than for pelleting. But increased extrusion rates with smaller extruders can reduce costs. Under development is the technology to produce shrimp feeds and sinking products less than 3mm at high capacity with 3x open area and 5 times the capacity. Research may show the capacity can be doubled to 6-10 tons per hour. Increasing extrusion rates with smaller extruder size can greatly reduce operating costs.

"We know that feed management can be improved with extrusion technology as there are potential costs savings in the recipe costs. There are better effects on feed performance. The final product density correlated with float/sink properties show that for fast sinking pellets in 3 ppt salinity have 640g/l bulk density," said Kearns.

TARS 2013 will focus on Finfish Aquaculture- Industrialisation and Sustainability. It will be held from 21-22 August in Singapore.

Application of beneficial bacteria improves shrimp survival from hatchery to grow-out

By Elisabeth Mayer and Gonçalo Santos

Maintaining balanced water quality is a major challenge yet fundamental to both the health and growth of shrimp from larval to grow-out stages.

With the rapid developments in aquaculture and high densities in intensive shrimp farming operations, disease represents the biggest problem in the future of shrimp farming. Members of the genus *Vibrio*, including *V. parahaemolyticus* and *V. harveyi*, are among the most common pathogenic species of bacteria in shrimp that cause serious economic losses in the hatchery and grow-out phases throughout the world.

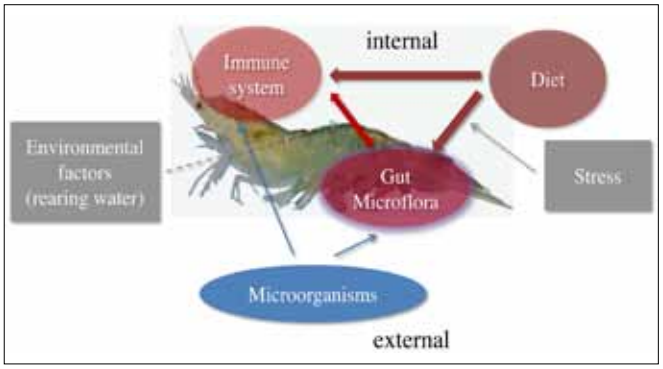
A sustainable method for preventing and controlling disease is to improve the health of cultured organisms by balancing aquatic environmental conditions through the prophylactic use of beneficial bacteria (probiotics). Many studies have described the various modes of action of common (feed) probiotics, including their antagonism towards pathogens (competitive exclusion), attachment to intestinal mucosae and production of beneficial compounds. In aquaculture, however, live bacteria are not only applied in feed but also via water to maintain or re-establish good tank/pond equilibrium.

Beneficial bacteria are used as bioremediation agents to improve water and soil quality, which are related to algae overgrowth, *Vibrio* load and thus greatly impact aquatic productivity. The effects of biodegrading strains (*Bacillus* sp., *Paracoccus* sp., *Thiobacillus* sp., *Nitrobacter* sp., *Nitrosomonas* sp., etc.) involve the modification of microorganisms in ponds, enhanced mineralisation of organic matter, degradation of undesirable waste compounds (ammonia, nitrite, hydrogen sulphide, etc.), reduced sludge accumulation and decreased anaerobic conditions in pond bottoms.

Interactions within the microbial environments

It is important to understand interactions between the microbial environment, gut flora and immune system of the shrimp, as well as factors that determine the persistence of microbial species in the internal and external microbial ecosystems (Figure 1). While natural environments are balanced, the farming environment favours the growth of microorganisms as it is rich in nutrients and feed wastes. With hosts and microorganisms sharing the same ecosystem, shrimp are constantly exposed to and challenged by microorganisms in the surrounding environment, causing a natural interaction between the microbiota of the ambient environment and the gut. When the bacterial challenge exceeds a certain level, the health of the shrimp is in danger, as the animal alone cannot defend itself sufficiently.

Figure 1. Interactions within the microbial environments.



Thus, beneficial bacteria are added to the water during larvae production as well as during shrimp grow-out to directly or indirectly alter the composition of the microbial community in the rearing environment and in the larvae gut, improving animal health and performance.

Shrimp hatchery

In contrast to terrestrial animals, shrimp larvae do not have inherent colonising bacteria from their mother as they are spawned as axenic eggs. The young shrimp larvae do not have developed guts or microflora, which means that the gut, gills and skin are free from bacteria. However, the bacteria from the ambient environment colonise the surface of eggs and thus, the properties of the bacteria in the ambient environment are of utmost importance.

As there is a close relationship between water quality and aquatic productivity, the ambient environment plays an important role in hatchery production. The high density of larvae in hatchery tanks offers ideal conditions for culturing bacteria and spreading pathogens. Instead of accidental colonisation, the composition of the microbial community in hatchery production can be manipulated by beneficial bacteria applied via live feed or freeze-dried in water.

Several bacteria have been tested and applied to the water in the larval culture of shrimp. Suyawanish (2011) investigated the effects of *Bacillus* sp., *Lactobacillus* sp., *Enterococcus* sp. and *Pediococcus* sp. (2.5g/1000L AquaStar® Hatchery, 3 x 10^9CFU/g, Biomin GmbH) on larval survival, stress resistance and the *Vibrio* spp. count of water cultured from the hatchery tanks of *Litopenaeus vannamei* larvae. Apparently, higher survival rates were achieved with the probiotic from nauplii 6 to post parvae (PL) 15 stage when compared with the control group (no probiotic inclusion). A significantly higher survival rate of PL15 was also observed in an ammonia stress test (addition of ammonium chloride) after 24 and 48 hours (Table 1).

Table 1. Effect of ammonia stress test on larval survival (%).

Time (hour)	Control	AquaStar® Hatchery
0	100 ± 0.00	100 ± 0.00
24	47.58 ± 3.89^b	53.73 ± 2.34^a
48	30.07 ± 4.62^b	38.73 ± 4.20^a

^{a,b} means within a row with different superscripts differ significantly ($P < 0.05$)

Furthermore, it was observed that the surviving larvae in the control group were not as active and healthy as the larvae in the probiotic group. Garriques and Wyban (1993) also found that *L. vannamei* larvae raised with probiotics were larger and more active and no luminous bacteria were observed. In the previous study by Suyawanish, water from the probiotic group had lower numbers of *Vibrio* spp. than in the control group, with a significant reduction of 2 logs, from PL2 until PL 15 stage (8.55 x 10^3 CFU/mL vs. 3.03 x 10^5 CFU/mL). The results can be seen in Figure 2.

Shrimp grow-out

Aquaculture operations generally involve stocking and feeding of shrimp in open or semi-closed water systems. Semi-closed pond systems have

Figure 2. *Vibrio* spp. counts in water under post larvae culture system (CFU/mL)

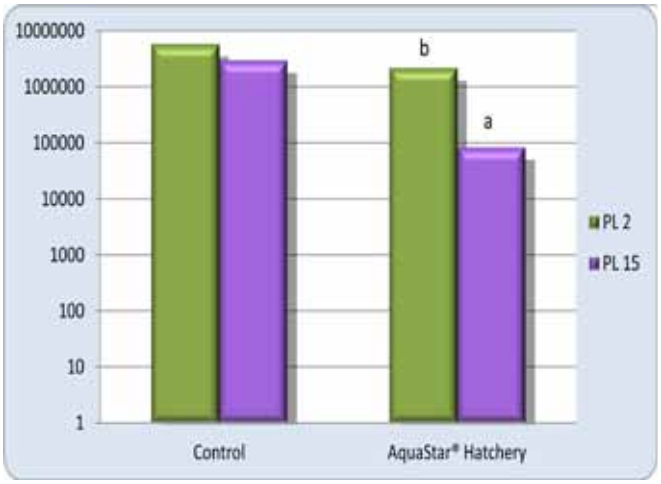
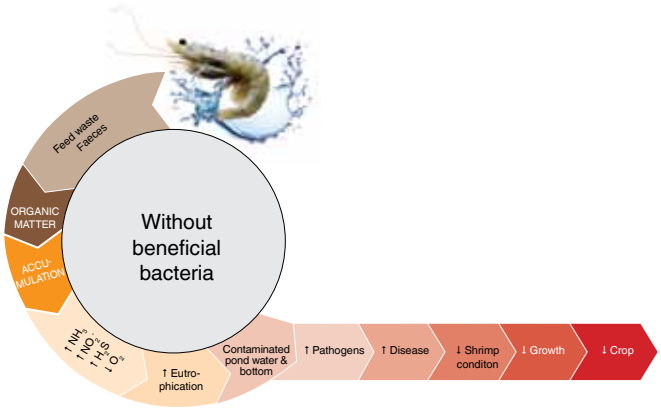


Figure 3. Pond interactions without the addition of beneficial bacteria.

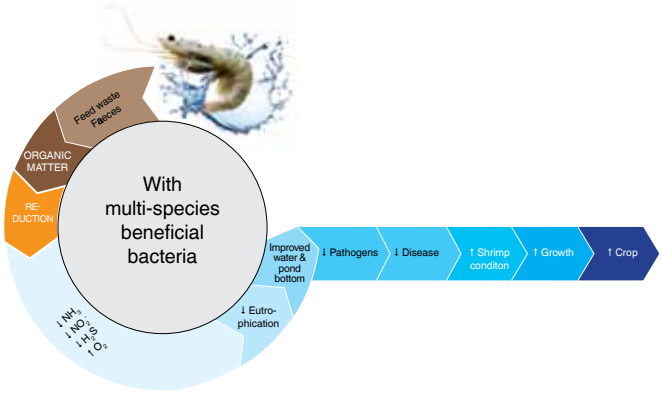


a low water turnover and can accumulate gases, nutrients, metabolites etc., which can deteriorate water quality and water chemistry. Thus, good pond management is crucial for high production and a healthy crop. Since water quality plays an important role, it is important to understand various interactions taking place within the ponds. These are quite complex and depend directly on the pond environment, stocked biomass, input of nutrients and pond management.

As can be seen in Figure 3, the accumulation and degradation of organic waste in the pond will result in an increased consumption of oxygen (O_2) and production of waste compounds such as ammonia (NH_3), nitrites (NO_2^-) and hydrogen sulphide (H_2S), which can lead to a phytoplankton bloom. Massive growth of phytoplankton can deplete oxygen during the night and contribute to a phytoplankton bloom crash. All these factors contribute to the contamination of water and soil, creating favourable conditions for pathogens to grow and affecting the condition of the shrimp. Under these poor conditions, the shrimp faces higher levels of stress and is more susceptible to disease, which could result in poor growth or a failed crop through disease outbreaks.

With the inclusion of beneficial bacteria (Figure 4), organic matter is utilised as a source of nutrients, which reduces the amount of waste accumulating in the pond. Additionally, specific nitrifying and denitrifying bacteria will convert NH_3 and NO_2^- into nitrogen gas,

Figure 4. Pond interactions with the addition of beneficial bacteria.



reducing the level of such toxic compounds. Some beneficial bacteria can also degrade toxic H_2S, improving water quality and odour. Also, by utilising organic matter and nutrients present in the pond, these beneficial bacteria can control the growth of phytoplankton, avoiding massive blooms and bloom crash. At the same time, other specific probiotic bacteria compete with pathogens for nutrients, reducing their numbers. These probiotics also produce substances (e.g. bactericides etc.) that are able to inhibit the growth of several pathogenic bacteria. The combination of all these factors will improve water quality and the condition of the pond bottom, resulting in a better environment for shrimp with better growth and health status.

Studies with bioremediation products were conducted to investigate the effects of beneficial bacteria on shrimp performance parameters and water and pond soil quality. In a field study in China in 2010, it was observed that the average daily weight gain of shrimp in the group treated with a mixture of *Bacillus* sp., lactic acid, nitrifying and denitrifying bacteria as well as enzymes increased by 36% and feed conversion ratio improved by 9% in the probiotic treatment group compared with the control group (no probiotic inclusion). Furthermore, soil from the probiotic test ponds showed a distinct yellow colour which is regarded as the best bottom type (Photo 1), while soil from the control ponds exhibited a dark, blackish color which is an indication of accumulated dead organic matter (Photo 2).

During a field study in Indonesia in 2009, it was observed that ponds treated with AquaStar® Pond (2 x 10^9 CFU/g) had a reduced

Photo 2. Samples of pond bottom soil from the control group.

Photo 1. Samples of pond bottom soil from the probiotic group.

Vibrio load which was already detectable after 24 days in all ponds. The *Vibrio* count decreased up to 4 logs and stayed at these low levels in all of the three contaminated ponds.

Based on these results, it was concluded that in the search for more effective and environmentally-friendly treatments, beneficial bacteria have emerged as a viable alternative. Such bacteria positively affect the survival and health parameters of shrimp, enabling more efficient production in optimal hatchery and grow-out conditions.

Elisabeth Mayer is technical manager for Biomin, Austria, and responsible for the probiotic product line. Elisabeth has an extensive background in probiotics and nutrition. Email: elisabeth.mayer@biomin.net

Gonçalo Santos is technical manager for aquaculture in Biomin, Austria since 2010. Prior to this, he worked for 6 years as a researcher at Wageningen University in fish physiology and immunology. He has an MSc in aquaculture from the same university in 2004. Email: goncalo.santos@biomin.net

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Strategic R&D to deliver sustainable feeds

Dr Alex Obach says that replacement of fish meal is possible with supplementation of micro ingredients but it will still take some time for fish meal free diets in the salmonids.

Originally from Barcelona, Spain, Alex Obach is a veterinarian with a Master in Aquaculture from the University of Girona, Spain and a PhD in fish pathology and immunology from the University of West Brittany, France.

He started working at Skretting Aquaculture Research Centre (ARC) in 1993 as a researcher, initially in fish health, then as a nutritionist and most recently held the position of manager of Skretting ARC's Fish Health Department. During 1993 to 1995, he was also a lecturer at the University of Barcelona, and worked for two years as manager of the Marine Harvest Technical Centre.

Research and development (R&D) is a recognised asset of Skretting, the global fish feed producer. Today there are thirty researchers at the Skretting Aquaculture Research Centre (ARC), based in Stavanger, Norway, with facilities both in Norway, Italy, Japan and China. **Dr Alex Obach** is the managing director since 2007 and at the recent Australasian Aquaculture Conference and Trade Show in Melbourne, he gave some insights into the strategic R&D of the company and which in the future will deliver sustainable feeds.

The global feed company has an annual production of 1.5 million tonnes of fish and shrimp feed. It has production facilities in 14 countries with 24 factories producing feeds for more than 50 different species, from salmon, trout, sea bass, sea bream and turbot in Europe to yellowtail, red sea bream, barramundi and shrimp in Asia and Australia. It is the leading fish feed producer in Europe, with 11 factories in Norway and the UK in the north and France, Italy, Spain and Turkey in the Mediterranean. Elsewhere, there are factories in Canada, USA, Chile, Brazil and Tasmania, Australia. In Asia, it has a factory in Japan and has been marketing marine fish and starter feeds, mainly to Indonesian and Malaysian fish farms. Expansion in Asia is part of the new policy to grow in Asia and in 2010-2011, the company acquired two shrimp/fish feed factories, each in Zhuhai, China and Ho Chi Minh City, Vietnam.

"I really believe that R&D is absolutely necessary in aquaculture. Although, we have achieved a lot in terms of progress in fish feeds, there are still many things that we do not know in fish and shrimp

nutrition. We need to compare what is known about poultry and pig nutrition! Then we think of the number of nutritionists working on aqua feeds and compare with the number working on pig and poultry in each country. Aquaculture is an old farming practice but a young industry. R&D in aqua feeds has been a priority but we still have lots to do. So far it has been easy, fish will grow on a diet from a mixture of fish meal, fish oil and a binder. But global fish meal supply is limited at 5 million tonnes and fish oil at 1 million tonnes and aquaculture is already using 60-80% of supplies. If aquaculture is to double its output by 2020 year, we need to reduce our dependency on fish meal and fish oil."

Replacement of fish meal and fish oil

At ARC, the approach in fish meal and fish oil substitution has been very clear. "When we started in 1989, we already knew that we were not on the same level as the poultry nutritionist, who can prepare feeds based on specific nutrients from the first week of culture."

Scientists at ARC spent the first ten years in understanding the nutritional requirements of fish. The R&D focussed on nutrients in fish meal and alternate raw materials. Some 500 raw materials would be tested. For example, they tested more than 20 sources of soybean meals to understand the ingredient and analyse the crop, its nutritional value and digestibility coefficients. In 1996, through a better understanding of amino acid nutrition they created the Amino Balance™ concept. In this breakthrough, balanced amino acids increase the value and uses of protein for its real purpose- muscle growth.

"These are some of the investments we have put into R&D. It is to have the knowledge available and to be able to utilise this knowledge: For example, we have invested in the study of anti-nutritional factors (ANF) and whether keeping below a certain level will help and how do you include an ingredient whilst keeping the ANF at a low level.

"Fish meal is a complex raw material. It can come from anchovy in Peru, capelin in Norway or herring from Iceland and other local species in other areas. The composition changes in terms of amino acids as well as fatty acids and so it is important to really understand this ingredient well. We see that protein digestibility can range from 60 to 90%. Again, for poultry, all the information on the nutritional value of the ingredients and digestibility coefficients are available. The same cannot be said for fish and shrimp.

Fish meal is extremely variable in quality and composition, and methods to determine quality is essential. It contains micro ingredients and by understanding these, ARC researchers have made significant advances in replacing fish meal in salmon feeds. For many years, salmon diets contain at least 25% of fish meal. In 2009, we succeeded to reduce fish meal to 15% and diets with MicroBalance™ were launched in 2010. Today we know how to formulate diets for salmonids with fish meal levels as low as 5-10%."

Towards independence of fish meal?

How far are we from this?

"We know that in aqua nutrition, we still refer to raw materials when actually they do not require raw materials but nutrients. If you see the way we were formulating diets, it was how much protein and how much energy. In the 1990s, we focussed on digestible protein and digestible energy, and came up with digestible amino acids, the AminoBalance ™.

"Then in 2000, we focussed on fish oils and fatty acid profiles and used a combination of fatty acids in LipoBalance™ when we started replacing fish oil with alternative sources. Fish are flexible in that they require fatty acids for membrane structure and energy and they retain the fatty acids that they need. If we give an excess of long chain

polyunsaturated fatty acids (PUFAs), they will burn them for energy. Imagine that we take fish out of the sea, feed to fish again and they burn this for energy! This leads us to think that we should give them less of the PUFAs and more of the monosaturates for energy."

The MicroBalance concept which allows for ultra low levels of fish meal in diets was initially developed for the salmonids. The information has now been transferred to the seabass and seabream where the diets contain as low as 10% fish meal. Skretting is now working to transfer this information to other species.

"In our R&D approach, we have gained so much experience on the salmon that it will be much faster to transfer all the information to other species. We have done this for the omnivorous sea bream and carnivorous sea bass in the Mediterranean and can move on to the carnivorous barramundi."

Part of the information for this work is available for the public as ARC researchers collaborate with more than 40 universities and annually publish several scientific articles.

Approaching aqua nutrition research

"In Asia, there is no doubt that all governments are supporting research but unlike in the EU where research institutions come together for some common goals in research, this to my knowledge is not happening in Asia, despite the region being a major aquaculture producer and that many countries share the same species for culture. Ultimately, the situation arises where large multinational feed companies conduct in house R&D and the output remains the property of the company. Working on small budgets, research progress may be slow within public institutions. There are examples of European Union funded projects where scientific groups from selected institutions and private companies in the various countries, look at components of a project. As many countries share common species, this optimises scientific networking, pool expertise, management, co-ordination, monitoring and exchange of information.

"It makes sense to have a community working together for a common aim. Repetition of what is already being done should be avoided. Some issues such as health are so important that it requires research with critical mass input to achieve results. Avoiding duplication in Europe, we have groups in Norway, Scotland and Ireland putting together resources and working together on the sea lice in salmonids. In Asia, many countries share the same species. A prime example is early mortality syndrome (EMS) affecting shrimp where groups seeking solutions are working independently without coordination.

"Within Skretting, the work in China is just starting but the plan will be to build research resources as we have at ARC in Norway. In Japan, we are already collaborating with Kagoshima University."

The Next Ten Years

"In fish, we will still be probably looking into the full understanding of the physiology and metabolism of the fish. In shrimp, today there may be nothing wrong with formulating on a crude protein basis, but if we are expected to lower fish meal usage to 20-25% only, we do need to move away from this. Fish and shrimp do not need raw materials such as fish meal, shrimp liver meal or squid meal; they require nutrients above specific levels to maximise performance and optimise health. The premise is that if we decide to follow the example with the sea bass and sea bream, we can move faster."

Nile tilapia beat stress and disease with immunomodulating β-1,3/1,6-glucan

By Felipe De Conti Horta and Fabiana Pilaski

Supporting the immune system through dietary addition of an immunomodulating β-1,3/1,6- glucan is a valuable way of helping fish battle the stress of intensive production. High growth performance is maintained, even when faced with a potentially deadly pathogen challenge.

Intensive production systems usually expose fish continuously to a number of stress factors. Fluctuations in water quality and management practices including excessive handling, transportation and high density stocking induce stress responses, with detrimental consequences to performance, immune responses and pathogen resistance (Wendelaar Bonga, 1997; Barton, 2000). In such situations, nutrition has an important role in maintaining the expected growth and health in aquatic organisms.

Immune modulators are biologically active substances that are able to influence and enhance the efficacy of specific and non-specific mechanisms of immune defense in animals (Verlhac et al., 1998; Vainikka et al., 2005; Chagas et al., 2009). The use of these substances in the diet can have a positive influence on the resistance of these animals to infections and diseases (Erdal et al., 1991; Verlhac et al., 1998; Sakai, 1999; Raa, 2000; Amar et al., 2001; Vainikka et al., 2005). The improvement in immune condition through feed can be considered an alternative to drug administration in aquaculture (Verschuere et al., 2000). This strategy is of particular interest when a farm is faced with a disease, stressful culture conditions or where antibiotic use is increasingly under question and vaccination is not be available for a particular disease.

Strategic feeding for immunity and performance

In order to maintain the health of fish in intensive production systems, an interesting strategy consists of the inclusion of immunomodulators in the feed to stimulate non-specific mechanisms of defense in the fish (Sakai, 1999). The adoption of immunostimulation protocols for fish will allow us to maximize protection in stress situations, and prevent diseases becoming established. This contributes to an improvement in performance and fish survival and consequently can reduce economic losses in the production cycle (Pilarski, 2011).

In recent years, beta-glucans have emerged as a promising nutritional tool in aquaculture, protecting aquaculture species from the challenges they face from stress and disease in intensive production systems. Extensive research has elucidated the modes of action of a specific, purified beta-glucan on the immune system,

Tilapia from the experiment, from left, healthy to those infected with streptococcosis

inflammatory response and mucosal composition in fish (Fretheim, 2012). Importantly, the structure of the beta-glucan is critical to its mode of action and consistency of effects (Goodridge et al, 2011).

To evaluate the specific effects of the purified β-1,3/1,6-glucan, MacroGard (Biorigin, Brazil) in enhancing health status, performance and prepare tilapia to combat environmental aggressors, a trial was conducted at the Aquaculture Research Center of São Paulo State University in Brazil.

For the experiment, 84 Nile tilapia juveniles were used, with an initial body weight (BW) of 174.6 ± 20.38g, distributed randomly between four 500L experimental tanks (2 treatments and 2 replicates, 21 fish per tank). Fish in treatment group 1 were fed a basic commercial diet plus 0.1% MacroGard. Treatment 2 consisted of the basic commercial diet and served as a control. The treatment period lasted for 30 days. During this time, fish were fed twice a day until apparent satiation. Performance and survival parameters were evaluated. Blood samples were taken at 7, 15 and 30 days of treatment to evaluate the "respiratory burst" potential, one of the main mechanisms used by fish to destroy pathogens. After the initial 30 days of treatment and observation, fish were challenged with *Streptococcus agalactiae*, administrated by intra-peritoneal injection. Fish were fed the two different treatment diets and observed for a further two weeks, to evaluate the responses of the fish to the challenge as a result of the two different treatments.

Figure 1. Daily weight gain of Nile tilapia fed with diets with or without β-1,3/1,6-glucan for 30 days. Different letters show statistical differences between groups (P<0.05).

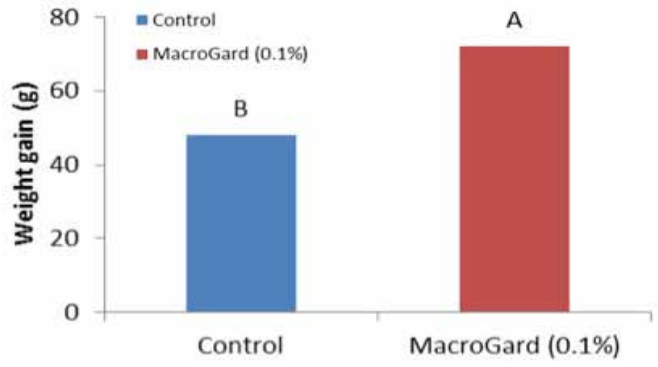
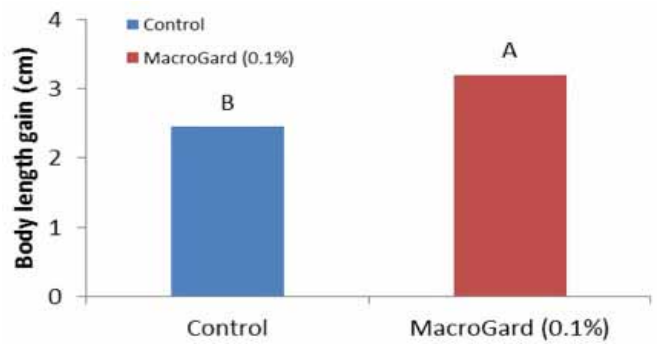


Figure 2. Body length gain of Nile tilapia fed diets with and without β-1,3/1,6-glucan for 30 days. Different letters shows statistical differences between groups (P<0,05).



Immune system rises to the challenge

The following results show the performance of the fish during the 30 days of treatment before the challenge; and their survival after the challenge. Figures 1 and 2 show that, before the *Streptococcus* challenge, tilapia receiving the β-1,3/1,6-glucan treatment already had significantly increased weight gain and body length compared to controls. This finding has been reported elsewhere in various fish species and is attributed to a low-level non-specific improvement in immunity as well as modulating the inflammatory response and supporting a healthy biochemical composition of glycoproteins in the mucosal layers of the skin, gills and in the gut. Fish are generally in better condition to combat the normal stresses of intensive production and can use more of their valuable nutrient resources for growth.

Health and disease resistance parameters

Leucocyte respiratory activity (burst) is one of the main mechanisms used by fish to destroy pathogens. During a bacterial infection, these immune cells rapidly release reactive oxygen species to kill the invading pathogen. High leucocyte respiratory activity values correspond to a higher potential for pathogen destruction during an infection. Fish fed the β-1,3/1,6-glucan thus demonstrated an enhanced capacity to fight pathogenic microorganisms, as shown in Figure 3.

Challenge with *Streptococcus*

Following the challenge with *S. agalactiae*, mortality began in the control group at around 24 hours after the application of the bacteria onto the fish. In these fish, it was also possible to observe typical signs of streptoccocosis, including blackening of the body, abdominal distension by ascites and erratic swimming. In the β-1,3/1,6-glucan fed fish, however, clinical signs only began 5 days after the inoculation, with mild intensity. Mortality in the control group began to increase immediately, reaching 30% of all control fish within 4 days (Figure 4). In contrast, fish treated the β-1,3/1,6-glucan had notably reduced mortality, which reached only 3% by day six and did not rise higher than this by the end of the trial.

Protecting and performing with beta-glucans

Streptococcosis is a major challenge to successful tilapia farming. This bacterial disease can devastate fish farms and has been reported to be

Figure 3. Leucocyte respiratory activity of Nile tilapia fed β-1,3/1,6-glucan or a control diet. Capital letters indicate differences between treatments at the same time and small letters between different times with the same treatment. AC represents the results after the pathogen challenge.

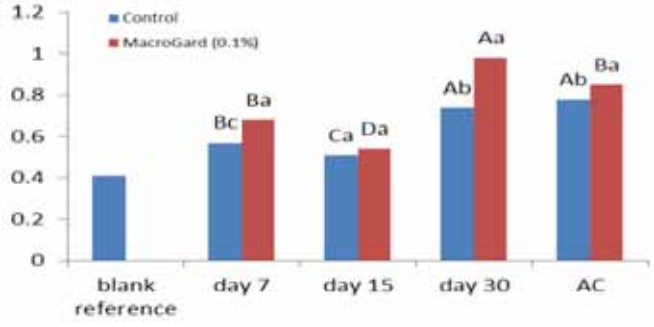
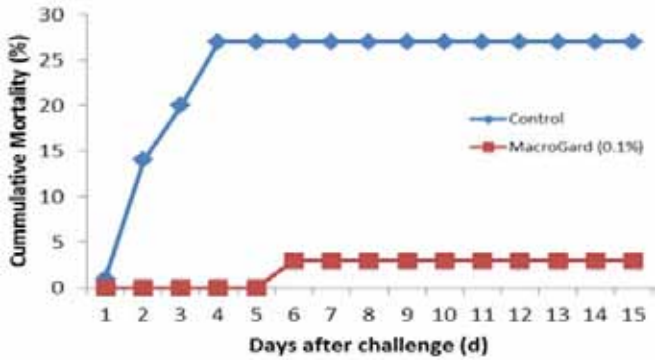


Figure 4. Mortality (%) of Nile tilapia fed with diets with and without β-1,3/1,6-glucan for 30 days and challenged with *S. agalactiae* on day 0.



a particular threat to aquaculture. *S. agalactiae* is the most commonly found species in outbreaks of streptococcosis in hot climates and is associated with diseases in many different fresh water, marine and estuary fish species (Evans et al., 2002). This pathogen is responsible for much of the mortality in tilapia culture in Thailand in recent years (Tan et al., 2007). Streptoccocosis is more common in larger fish, above 100g in weight. Any disease during this growth stage of the production cycle can have serious detrimental effects on growth, as well as increasing mortality. Protecting growing fish in intensive aquaculture is therefore essential in any commercial farming. Antibiotic treatment is available against streptococcus infection, but to be effective, this must be administered during the early stages of infection. In addition, considerable thought must be given before embarking on a course of antibiotic treatment for any production species. Vaccination is under development, though many might question the suitability of this strategy in terms of the extra labour costs involved as well as the high levels of handling stress (Clark et al., 2009).

Based on the observed results we can conclude that the treatment with MacroGard (0.1%) in diets for 30 days improves growth performance of Nile tilapia. It provides non-specific resistance mechanisms of defense and protection against a *S. agalactiae* infection. In general, this is a powerful preventive tool to be included in any health program for tilapia production.

References are available on request

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Tilapia: Overview on genetic strains and hatchery technology

By Eric Roderick

Production now at 3.23 million tonnes is growing, from a diversity of stocks but dependent on sex reversal techniques for an all-male production.

With tilapia being such a diverse group of over 100 species, surprisingly only a handful of species are cultured commercially and only one species, the Nile tilapia, *Oreochromis niloticus* accounts for 95% of global production. Culture systems range from small backyard operations producing a few fish to sustain a small family, to huge agro-industrial units producing over 20,000 tonnes annually. With the rapid growth of the global tilapia industry over the past 25 years, genetic improvement programmes enable a more profitable industry to benefit from the increased popularity of tilapia as a global food commodity. From humble beginnings being farmed for the Pharaohs in ancient Egypt 4000 years ago, the 'aquatic chicken' is now a very important globally traded commodity with production worldwide of 3.23 million tonnes in 2011 and still growing.

All male production

Most commercial farms only grow male tilapia, which grow much larger and faster than females and this was initially achieved through manual hand-sexing of the fingerlings and discarding the females, which was labour intensive, inconsistent, and wasteful. It was then found that certain hybrids between different tilapia species (*O.niloticus* and *O.aureus*) gave very high % male progeny. The downside with this technique was that it required hatcheries to hold two separate stocks of tilapia species, and as the purity of tilapia stocks deteriorated, the technique became unviable.

Researchers then discovered that tilapia fry, when fed male sex hormones for the first month after hatching, were able to change sex, from 50:50 male to female ratio, to ratios of almost 100% male fry. This is a highly variable technique due to hormone purity and operator experience. One of the major challenges facing the industry is that use of methyl testosterone will be phased out. This is overcome by the latest technology to effectively provide all male fry - the YY Male Technology developed by Fishgen. After many years of research in the UK and in the Philippines, Fishgen produced supermale tilapia which had two Y chromosomes instead of the usual Y and X chromosome. Females have two X chromosomes. These supermales produce only male fry addressing the problems of a future ban on hormonal sex reversal.

Commercial stocks

Deciding on which commercial strain of tilapia to use in a new tilapia project can be daunting, and there are many commercial stocks available globally. The farm's location can have a deciding influence as there are restrictions on importation of some strains from some countries, to minimise disease and biodiversity issues particularly in Africa where there are many unique endemic strains of tilapia, requiring protection from contamination by the careless introduction of new genetic lines, where escapees could interbreed or outcompete with the pure endemic species.

GIFT

There are currently 4 main genetically improved commercial lines that are globally distributed and proven to be fast growing. The largest genetic improvement programme was the GIFT project (Genetically Improved Farmed tilapia) and the current stock was originally produced from 8 strains of the Nile Tilapia collected from Africa in the 1980's, and after extensive selective breeding programmes carried out in the Philippines between 1988 and 1997 by ICLARM (Now WorldFish Centre) in collaboration with AKVAFORSK (The Institute of Aquaculture Research in Norway) a new strain was produced and distributed globally. World Fish Center is now located in Penang, Malaysia and the breeding programme is still carried on scientifically and commercially in both Malaysia and the Philippines.

Gift Foundation hatchery staff inspecting hatching trays.

The commercial rights to a recent GIFT genetic line was sold to Genomar (a Norwegian venture capital genetic improvement company) a few years ago and is now marketed globally as Genomar Supreme tilapia (GST) and the processed fish as Trapia (traceable tilapia) ensuring full genetic traceability of their products to the food industry. Trapia is produced in Genomar's cage farms in a large lake in Malaysia. The farmed fish is mainly exported to the USA. Since the sale of the GIFT latest genetic lines to Genomar, the Philippines have carried on with their own genetic improvements of the GIFT line and market the GIFT Excel line now. These lines are all based on the original genetic stocks collected in Africa in the 1980's.

Chitrilada

Another well-known stock is the Chitrilada strain, farmed extensively in Thailand, and originated as a gift to the King of Thailand by the Emperor of Japan in 1965, and was maintained as a pure line in the Royal Jitralada Palace in Bangkok for many years before being distributed throughout Thailand by the Thai Department of Fisheries in 1967. Since then it has been improved by selective breeding programmes and is now widely farmed in South and Central America, particularly Mexico and Brazil. This stock also originated from Egypt.

YY Supermale

The only other tilapia genetic line commercially used extensively around the world is the YY Supermale strain, developed by Fishgen in the UK. This stock is also based on the Nile tilapia from Egypt, but the main difference between this line and all the others available, is that no hormones are required to sex reverse the fry for grow-out, as the YY supermale has been specifically bred to sire only male offspring.

Hatchery technology

Tilapia hatchery systems are diverse with cost of construction and production of tilapia fry varying enormously, from basic pond hatcheries in tropical countries costing almost nothing, to expensive high-tech bio-secure indoor recirculation systems. The low cost breeding systems utilise simple earth broodstock ponds, with a shallow area around the edge where the fry once released from the female's mouth, tend to congregate in tight shoals and are collected with large dip nets or small seine nets, on a daily basis. Larger hatcheries use lined ponds in poly-tunnels which give better temperature control, biosecurity and predator protection and the fry are incubated by the female which is less efficient than removing the fertilised eggs from the female's mouth and using artificial incubators to hatch the fry.

Many of the world's largest tilapia hatcheries are in Asia, where 75% of global tilapia production takes place, and they utilise hapa-based production systems, where the brood stock are bred in long hapas (net pens) and the eggs are harvested from the female's mouth every 5 days. This is done by opening the buccal cavity of the female and gently rinsing the eggs out of the mouth into a bucket.

With global tilapia production still growing steadily, hatcheries are also expanding to provide fry for the grow-out farms and some of the biggest hatcheries now have the capability to produce 1 million fry per day. At present the main tilapia producing countries are China, Egypt, Thailand, Indonesia, Philippines, Costa Rica, Ecuador, Mexico

Hatching trays at the GIFT Foundation hatchery

The author at Genomar's breeding nucleus facility at Freshwater Aquaculture Center (FAC) with Mayet de Vera who runs the facility. Mayet has been involved for many years with the initial GIFT breeding programme, before transferring to Genomar

Hapas at the Fishgen's facilities in the Philippines

Professor Terry Abella (pictured with FAC staff) is the overall director of the Freshwater Aquaculture Center, which houses 3 large tilapia breeding programmes, an ornamental fish breeding programme (shown here) disease challenge facilities, vermiculture research for organic aquaculture, and a large Macrobrachium research facility

and Honduras. There are large hatcheries in all these countries but the biggest farms are vertically integrated units which produce their own fry to minimise biosecurity issues and ensure supply of fry. Regal Springs is one of the world's largest tilapia businesses producing over 70,000 tonnes in 2010 in several countries around the world. ACI in Costa Rica is one of the largest individual farms. Both companies export all their production as fresh fillets to the USA. Biomar is just completing its brand new high tech feed mill very close to the ACI farm to meet the growing demand for tilapia feed in Central America.

Expansion and markets

With the tilapia market firmly established and growing in the USA and globally, future challenges for tilapia producers will be to find new markets and to overcome stiff competition from the Pangasius catfish, imported from Vietnam, especially in European markets which is still seen as a new high value market for tilapia producers around the world. Spain is importing 20% of the EU total and Poland 33% but these are mainly frozen tilapia from China with demand fuelled by the low prices reflecting the current economic downturn throughout the EU.

Rapidly expanding importers of tilapia are Russia and the Middle East, but as China becomes far wealthier, consuming more of its own tilapia domestically, price increases and possible shortages of tilapia as an export commodity are possible. Many countries are ramping up production to fill this perceived new demand. These are Vietnam, Bangladesh, Brazil, Egypt and Malaysia, where government support is helping to drive this new wave of expansions. The main growth areas are in value added products particularly in the producing countries so increasing profitability, and filling new and growing markets. Tilapia's future is rosy.

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Seafood cuisine in Malaysia: more choices

Presentation of exotic freshwater fish and the soft shell crab, all locally farmed, mainly in recirculated aquaculture systems.

Liaw Boo Lai (right) with from left, Adam Omar, Global Good Way farming marine fish and shrimp, Khoo Eng Wah, Sepang Today Aquaculture Centre and Goh Cheng Liang, Goh Siong Tee Marine Products

Producers from Selangor led by Ting Kwong Chung, JW Aquaculture farming marine shrimp (second right).

In Malaysia, as in Singapore and Hong Kong, seafood restaurants tempt the palate of diners by introducing either a new recipe or a new species of fish. The aquaculture industry is always on the lookout for new species to culture to meet this demand. In June, at its annual lunch banquet, the Malaysia Aquaculture Development Association (MADA) promoted several species farmed locally.

The venue was the Unique Seafood Restaurant in Subang, close to Kuala Lumpur. The restaurant is part of the Unique Seafood group, a leader in the dining concept where guests select live seafood from aquariums and chefs prepare dishes according to preference. The cuisine is mainly Cantonese. The group imports live seafood from all over the world including snow crab and lobsters from Australia, geoduck from Mexico, Canada and California, turbot from France, sturgeon from Russia and clams from Scotland.

In his introduction of the five species in the menu, MADA president, Liaw Boo Lai, said "Local producers have worked hard to develop culture systems for some of these or have adapted the farming to local conditions. These maybe relatively expensive at the moment but as their culture progresses, we can expect the fish to be more available and at much cheaper prices. Today, the menu is prepared by the master chef at Unique Seafood Restaurant with fish sponsored by seafood retailers, fish farmers and wholesalers. We have these fish species; paddle fish, American red channel cat fish, jade perch, US bass as well as the Malaysian soft shell crab and our giant grouper."

New arrivals

The American paddlefish *Polydon spatula* is farmed at the indoor farm of Baolai International Sdn Bhd in Tanjung Malim, Perak. Ricky Oh, director said that his farm has just recently started supplying the cold water paddlefish to restaurants. "The average market size is 2 kg and thus the head of the fish was used to prepare the dish, 'double boiled paddle fish bone with Chinese herbs' and we use the flesh for 'stir fried paddle fish with ginger and spring onions. The cartilaginous bones can also be fried."

The US bass *Micropterus salmoides* is farmed by SMI Indoor farming. Adam Leong, managing director said that he brought over the ecological recirculation system developed by Hi-Q in Taiwan. This proprietary technology allows him to culture fish with high survival rates. The technology is patented in Taiwan, USA, Japan and Germany. The bass is gaining popularity in local restaurants and ex-farm prices range from MYR 50-80/kg (USD 16-26/kg). He imports the fry from Taiwan and grows them up to 500 g to 1 kg fish in 6-10 months. Leong who started aquaculture 6 years ago, also farms the jade perch, white sultan fish *Leptobarbus hoevenii* and the empurau *Tor tambroides* at this farm in Selangor. The bass was served deep fried with orange sauce.

Making a mark

In Malaysia, local farming of the omega-3-rich jade perch started in 2008, mainly in indoor farms using recirculation systems and with

Steam jade perch with spicy nyonya sauce

Fried soft shell crab coated with salted egg

The giant grouper was steamed with tofu

The paddlefish fillet fried covered with ginger and spring onions.

Steamed catfish

imported fry from Australia, where the fish is known as the silver perch *Scortum barcoo*. However, the Australia jade perch sponsored by KGC Eco Resort Sdn Bhd is farmed in ponds with a high rate of water exchange using fry from China and Taiwan. The culture period is 8 months for a market size of 500 g. Harvests are mainly sold live to local seafood restaurants and the current price is MYR 45/kg (USD 15/kg). Liaw, a mechanical engineer entered the aquaculture business with the farming of the freshwater prawn in 2000. He has now diversified and also farms the jade perch, black sultan fish and red tilapia. He has predicted that in 2 years, it will be possible for local hatcheries to produce fry and juveniles of the jade perch for grow-out and expand its farming. At this lunch, the jade perch was steamed 'nyonya' style, in a thick spicy gravy to bring out the sweetness of the flesh.

The soft shell crab has already made its mark in local restaurants. Restaurants usually depend on imports, mainly from Thailand and Myanmar where the crab is farmed in open cages. Local production in closed systems is a recent development in Malaysia. Mac K.L Ho of Dyna Tree, now produces soft shell mangrove crab, *Scylla serrata* using a seawater recirculation aquaculture system. Ho said, "The technology for this farming in a closed system was developed four years ago. Now we have perfected and patented this system. We keep the crabs in single enclosures and simulate moulting in unison. We then collect the crabs by hand."

Originally, soft shell crabs were served fried in appetizer menus in seafood restaurants but it has now made its way into main dishes as well as in sushi rolls, and demand is high. At this banquet, the dish was fried soft shell crab coated with salted egg.

Evergreen grouper

Several species of groupers farmed in Malaysia is already a standard feature in most dining menus. At this function, there is the giant grouper *Epinephelus lanceolatus* which was steamed with tofu. The fish was sponsored by Dragon Taste Seafood Wholesale and Retail Sdn Bhd. The Unique Seafood restaurant also displays farmed and wild caught green grouper *E. coioides*, the former being 30% less expensive. An extremely high value grouper species is the spotted grouper. Seafood restaurants in Malaysia are also the main markets for live groupers farmed in floating cages, in addition to the export markets in Singapore, Hong Kong and China.

Gold Coin Specialities Sdn Bhd and **Gold Coin Biotechnologies Sdn Bhd** have announced the relocation from Johor Bahru to a new factory in Selangor with effect from 1 September 2012.

The new address and contact details are:

No 19 Jalan Perigi Nenas 7/2, KS 11
Kawasan Perindustrian Pulau Indah
42920 Pulau Indah, Selangor Darul Ehsan, Malaysia
Tel: +603 3102 3070, +603 3102 3071 and +603 3102 3072
Fax: +603 3102 3090 (sales) and +603 3102 3091 (admin and accounts)
Email: sp.koh@goldcoin-my.com (Koh Song Par, General Manager, Gold Coin Specialities Sdn Bhd)
Web: www.goldcoin-group.com

Vietfish 2012: Responding to market changes

A difficult year with a global economic downturn in major markets, lack of local raw material, in particular shrimp and pangasius catfish but industry urged to prepare for the future.

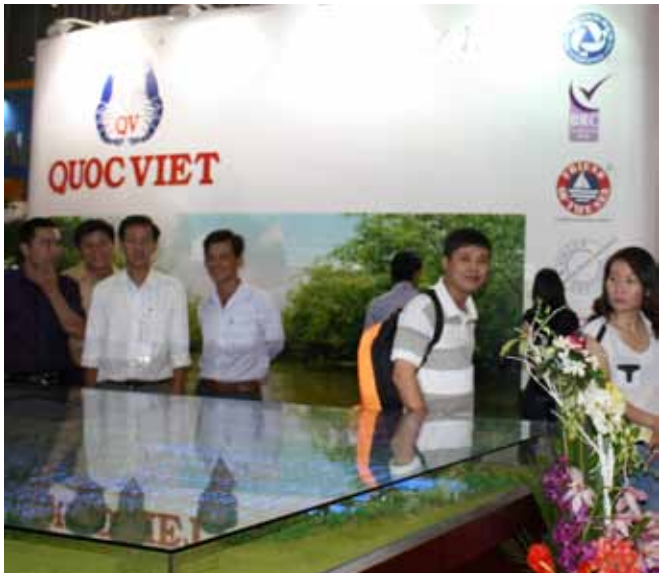
Since 1999, Vietfish is the platform for trade in Vietnam's large seafood production and processing sector. This year, organiser, the Vietnam Association of Seafood Exporters and Producers (VASEP) has the support of Camimex, Dai Thanh Seafoods, Minh Phu, Quoc Viet and CL Panga Fish as platinum sponsors and as gold sponsors, Phu Cuong Group, Godaco Seafood, Caseamex, Nam Viet Corp, CL Fish Corp and Bien Dong Seafood Corp. VASEP also reported a significant increase in the number of international exhibitors such as the Chilean trade mission and Bangladesh Frozen Foods Exporter Association. Korea and China had national pavilions. Among the 270 booths, foreign participation totalled 76 booths.

In the first quarter of 2012, pangasius catfish exports increased by 13% as compared to the same quarter in 2011. Sales are rapidly increasing in many markets with the exception of the European Union, where imports are lower because of the debt crisis. Imports to the US increased by 50% (Vietfish, 2012). However, despite this demand from markets, pangasius farming is facing problems. It was reported that 90% of businesses faced capital shortage and were running at 50-70% of capacity. Between March and April, ex-farm prices decreased to VND 23,000/kg and then further to below cost of production by end of June. It was VND18,000-19,000/kg in mid-July but has since rebounded to VND 22,000-22,500/kg. The cost of production is VND 20,500/kg with feed cost accounting for 87% of total cost. Cost of feeds range from VND 9800-10,500/kg and with an FCR of 1.7, cost of feeding is as high as VND 17,850/kg. The current exchange rate is VND 20,825 to USD 1.

Higher prices will push farmers to restart operations and improve supply of raw materials for the processing industry. In his editorial in Vietfish International (May/June 2012), Dr Nguyen Huu Dung, VASEP vice president, advised enterprises to expand the business coverage to the entire value chain to help them stay flexible and responsive to market changes, and to avoid bottlenecks and conflicts arising at the different stages in the value chain. Some recent investments include Godaco Seafood Joint Stock Company (Godaco) which has invested more than VND 500 billion in building up its pangasius farming area of 120 ha which will supply 25,000 tonnes per year of fish, meeting over 90% of the processing demand of the factory. Anvifish will increase its farming area and build a new farm in Long Xuyen.

Low supplies of shrimp

Shrimp production in Vietnam is facing challenging times with diseases affecting several areas in the Mekong Delta.These include 10,000 ha of ponds in Bac Lieu, 13,000 ha in Soc Trang and 10,000 ha in Tra Vinh, all in the Mekong Delta. In Soc Trang, this represented 40% of the total area. In 2011, the Ministry of Agriculture and Rural Development (MARD) reported the damage from disease was 80,000 ha in the Mekong Delta valued at VND 5 trillion (USD 240 million). The unknown disease affects the shrimp hepatopancreas which Dr Nguyen Van Hao, head of



Pham Cong Thanh, technical service and marketing manager at the Pharmaq booth. The company has a vaccine ALPHA JECT panga 1 for the pangasius industry.

the Aquatic Research Institute No. 2 said could be due to toxic residues present in the mud layer at the bottom of the ponds. FAO has provided USD 0.5 million to help farmers affected by the disease with post larvae procurement and to fund research to establish the causes of the disease.

In August, there are reports that prices for monodon shrimp have decreased by 30-40%. It was VND 190,000/kg for 20/kg size and VND 107,000-115,000/kg for the smaller 30- 40/kg size. Production costs have been increasing by an estimated 30%. This is from increasing costs for water treatment and feeds. In Vietnam Net, Vo Hong Ngoan, a farmer in the Mekong Delta, said the production cost has climbed to VND 90,000-110,000/kg for 30-40/kg size shrimp. Domestic seafood processors have refused to buy local shrimp, deemed too expensive. According to VASEP, monodon shrimp prices in Bac Lieu, Ca Mau and Soc Trang province are higher by 15-30%, equivalent to USD 1/kg higher that in Thailand, India or China. Thailand is exporting shrimp to Vietnam as processing plants need to meet export orders.

First time exhibitor at Vietfish. Jeffrey Liu (right) of Hai Yu Enterprises Co Ltd, Taiwan

Food safety at Vietfish 2012

US FDA

The Food and Drug Administration (FDA) will require the renewal of food facility registrations during the period from October 1, 2012 to December 31, 2012. Seafood exporters from Vietnam will soon need to address the new US Food Safety Modernization Act (FSMA) when exporting seafood to the US. This comprises several existing regulations and also adds a series of new requirements for seafood exporters.

In a seminar to inform local importers of the regulations on exports to the US, Chitra Ananda, Regulatory Advisor for Singapore, Malaysia and Indonesia, Registrar Corp said that exporters will need to be aware of these changes to avoid the potential suspension of their registrations and possible detention of their shipments. There are 200,000 foreign facilities that will likely be looking for a new US agent during the required FDA registration renewal period in October 2012 and Registrar Corp has an expert team of regulatory specialists in the United States and 19 international offices. It has an office in Ho Chi Minh City.

"The jurisdiction of the centre for Food Safety and Applied Nutrition, under the FDA encompasses most food products including seafood. The review for the entry of products will include a look at records, i.e. the history of the manufacturer, importer and even the country. It becomes an issue in the case of rogue importers. It also looks at the risk levels for the product, in seafood, it conducts tests for *Salmonella, Vibrio* etc. There is a score system which provides an analysis of the shipment. The FDA used to check only 2% of imports but the level has been increased recently.

"For compliance with the FDA regulations, a US agent is required for foreign companies. FDA also requires prior notice to be filed. With this, the FDA knows what imports are arriving as the prior notice is filed before the shipment is in the US. It is important to note that prior notice is not an 'approval' as the FDA could still inspect shipments," added Chitra.

Better access to Japan's seafood market

Japan is the third largest market for Vietnam's seafood. It is leading importer for shrimp which was valued USD 161 million and comprises 26.9% of total exports. However, recently, some processors face difficulties entering the Japanese market as Japan has implemented stricter measures on residues of trifluralin, enrofloxacin and ethoxyquin. In May, it was reported that 30% of shrimp shipments from Vietnam must undergo quality tests on arrival. Japan said that it would raise the mandatory testing percentage for Vietnam's shrimp from 30% to 50% and then to 100% if more consignments are reported to contain ethoxyquin (Vietfish International, May/June 2012).

During Vietfish 2012, the ASEAN - Japan Centre (AJC) and the Vietnam Trade Promotion Agency (VIETRADE) organised a seminar to inform producers and exporters the regulations and access requirements. This was conducted in Vietnamese and Japanese. Hiroaki Harushima, former executive director of Japan Frozen Foods Inspection Corporation and current advisor of the Corporation was invited by AJC to discuss the seafood import situation, procedures and regulations in Japan; food safety laws for seafood imports into Japan; legislative requirements related to traceability, seafood irradiation; technical barriers to trade and Japan's market access.

He stressed that the Japanese consumers place particular attention to heath and therefore they are very strict on food quality and safety. The advice given to Vietnamese seafood companies interested in exporting seafood products to Japan was that they should have a solid knowledge of Japanese laws and regulations relating to food safety, especially for seafood imports. Seafood imported into Japan must not have antibiotic residue, additives forbidden in Japan and must have files tracing product origin (source: http://www.vietrade.gov.vn).

At Vietfish 2012

Marketing the cobia and pompano

A change in focus to meet local and regional market demands for the fresh and frozen cobia.

Whole pompano on display at Vietfish 2012

Cobia fillet. From right, trim A with the collar, trim B and trim C.

Marine Farms Vietnam is the leading producer of the cobia *Rachycentron canadum* in Vietnam since 2006. The fish is farmed in offshore cages in the pristine waters off Hon Lon Island in Van Phong Bay, off Nha Trang in central Vietnam. Cobia is now farmed together with the pompano *Trachinotus blochii*, a new addition to its portfolio. There are 8 locations which the company uses for its four farms on a rotational basis. In two sites, circular cages hold pompano and in two other sites, the 2011 generation and 2012 generation of cobia, respectively. In addition, separate sites are used for trials with feeds, and for holding two generations of brood stock of the cobia and pompano. This is kept for a local hatchery under a strategic agreement.

The global production of the cobia is decreasing. According to Jorge Alarcon, general manager for Marine farms Vietnam and Belize, the estimated global production of the cobia was 30,000 tonnes in 2006-2007. However, production was less than 3,000 tonnes in 2011. The current annual production of Marine Farms is 400 tonnes of cobia and 400 tonnes of the pompano.

Changing markets

Previously in 2011, AAP reported that the target market for the cobia from Marine Farms in Vietnam was value added markets in the US and Europe. This followed tests in these markets for sashimi grade fish. This has now changed with an emerging local market in Vietnam absorbing most of its production. The remaining is processed chilled vacuum packed fillet for other markets such as Japan, Korea, Taiwan and Australia.

"We already have 1.4 million pompano in the cages and 120,000 cobia juveniles. These will be ready for harvest in October. The pompano harvest size will be 450g each. Pompano is a relatively new species for us. Most of our past production was sold in fillet form, mainly to Europe, some to Japan, with a very small percentage of whole-round fish being sold locally. There are no fillet products for the local market. With pompano we are still exploring other formats and markets, so it would be hard to say where the 2012-generation will end up," said Sandro Rezzio Jil, technical production manager. Jil was with Alarcon at their booth during Vietfish 2012. Jil has worked in Salmon Chile prior to joining Marine Farms Vietnam.

"Our average harvest size for the cobia will be 4kg and the local market has been taking about 80% of our cobia production. They will require the whole fish, gills and all. This is new trend which is working well for us but it is hard to know what will happen in the future. Next, we want to focus on production and exploit nearby markets such as China which is already keen on quality fish."

Marine Farms supplies several product forms. For the cobia, there is WR (whole round), GG (gilled and gutted), HGT (head, gutted and tail off) and portions for the cobia. There are three types of fillet, trim A with the collar, trim B and trim C depending on the specifications of the buyer. Pompano are sold as whole round or fillet, fresh and frozen.

"Our export market is mainly skin-on fillet for markets in Asia such as for Korea, Japan and Taiwan. The US markets buys skinless fillets," said Alarcon.

Solving issues

Jill added that Marine Farms is working closely with a local hatchery in the supply of both juveniles for the cobia and pompano. Feeds used are from a local supplier, Ocialis and they also run field trials for the pompano feeds from two other producers, Skretting and Uni President.

The production of the cobia is unique in that feed conversion ratio can rise from 2 to more than 2.5 as the fish grows from 2kg onwards. Thus the decision on the size to harvest will rest on this. In addition fish shows a large size variation with 10% within the 2.8-3.5kg range, 80% in the 3.5 to 5.5kg range and another 10% in the more than 5.5kg range. Some 90% of the problems are feed related and as major producers, they will need to work to solve these issues.

More information: www.marinefarms.vn; email: sales@marinefarms.vn

At Viefish 2012, from left; Jorge Alarcon, Sandro Rezzo Jil and Tran Gia An.

Sea cucumber in the Maldives

By Charles M. James

An initial commercial farming of an exotic species has started but the future is in the breeding and farming techniques for the local species.

Brood stock from grow-out lagoon

Juveniles for stocking in grow-out

Sun drying of eviscerated sea cucumber

The sea cucumber, popularly known as 'trepang' or '*beche-de-mer*' is a delicacy in several countries. In the Chinese medicine, sea cucumber is considered as a tonic and a traditional medicine for centuries from the Ming Dynasty to the Qing Dynasty. It is said to nourish the blood and vital essence (jing), to treat disorders of the kidney (qi) and to moisten dryness. Traditionally, sea cucumbers are eaten more for their tonic value than for their seafood taste. Hence, the popular Chinese name for sea cucumber is 'haishen', which means 'ginseng' of the sea.

Tropical sea cucumbers processed into '*beche-de-mer*' are a valuable source of income for many coastal communities in the Indo-Pacific region. The sea cucumbers *Holothuria scabra* (sandfish) and *H. lessoni* (golden sandfish) fetch high prices in the Asian market compared to other tropical sea cucumbers. Increasing demand and high prices, combined with inadequate management of the wild stocks, has resulted in over fishing and depletion of the natural stock of sea cucumbers in several countries. The attractive price for processed sea cucumbers and the declining wild stocks has led to considerable interest in developing alternative methods of producing *beche-de-mer*, especially through aquaculture (Giraspy and Ivy 2005, 2010).

Although Japanese researchers produced juveniles of the sea cucumber *Stichopus japonicas* as early as during 1950, commercial production has been achieved only in recent years (Battaglene 1999a). Mass production of sea cucumber in commercial hatcheries has been restricted due to high mortality rates in larval settlement and early juvenile stages. This problem has been resolved in recent years due to improvements made in hatchery feeds and effective tank management practices. This decade has seen significant interest focused on the culture of *H. scabra* and *H. lessoni*. Both these species are best suited for commercial farming because of its hatchery viability for mass production. However, the commercial farming of sandfish has been carried out only in a few countries such as Australia, Maldives and Madagascar (Giraspy and Ivy 2005; Eeckhaut et al., 2008).

Aquaculture in the Maldives

The Republic of Maldives located in the Indian Ocean is an archipelago of 1196 coral islands. In the fisheries sector, there is a dependence on capture fisheries, especially tuna and grouper. Netting or trawling is not allowed in Maldives due to the presence of corals. Therefore, the nation is importing all of its supply of shrimp and fish for the tourism industry as well as for local consumption. Natural distribution of the high valued mud crab *Scylla serrata* is available in several islands. However, they are not commercially exploited due to limited wild stock as well as lack of land-based culture systems for farming mud crabs.

Although capture based holding of groupers and other reef fish species in sea cages is practised for the live fish market, the industry is not doing well in recent years due to the depletion of wild stocks, especially the groupers. The coral atolls with its lagoons and pristine seawater provide ideal conditions for floating sea cages in protected waters for grouper as well as other marine fish farming. There have been several aquaculture project proposals for commercial marine fish, shrimp, sea cucumber farming as well as other aquaculture ventures.

Currently, commercial aquaculture in Maldives is limited to the hatchery and farming of sea cucumber at Shavayani Atoll in Kendhikulhudhoo lagoon. Other entrepreneurs are interested in initiating sea cucumber farming in the neighboring islands and lagoons. Maldives is blessed with all the natural resources such as protected pristine waters, fish meal plants, tuna and poultry wastes and other resources for developing sustainable aquaculture. Marine fish farming integrated with sea cucumber farming would complement to each other.

Source of brood stock and breeding

The initial commercial hatchery and farming of the sea cucumber used brood stock of the sandfish *H. scabra* from India, brought over a decade ago by Dr. Beni Geraspy, a consultant for the project. Along with consultants for the project, Dombe from Maldives dedicated himself with trial and error studies to adapt the technology to suit local conditions. The hatchery breeding technology was refined over the years through trial and error and the juveniles were seeded in a protected lagoon for grow-out. Currently the required brood stock for hatchery breeding is collected from the grow-out lagoons. They are brought to the hatchery and placed up to 5 individuals per m^2 in a flow through system with aeration to maintain dissolved oxygen above 5 mg/l with good feeding. Spawning is induced by thermal shock, a temperature increase of 3-5°C. Males spawn first followed by females. Fertilized eggs hatch into auricularia larvae after 48 hours at a water temperature of 25-27°C.

Hatchery larval rearing

Larval rearing is carried out at seawater salinity and at temperatures from 25 to 27°C. From early to late auricularia stage, they are fed with microalgae. Larval diets consist of mixed species of diatoms and other microalgal species. Cultures of *Chaetoceros* sp., *Isochrysis* and other micro-algal species are mass produced. However, they are mixed in different proportions as per the developmental stage of the larvae and the microalgal density also gradually increases from 10,000 cells/mL to 35,000 cells/mL. The auricularia larvae develop into doliolaria and pentacula stages before they metamorphose into juveniles. During this stage, their behaviour changes from swimming to attaching. Therefore, the doliolaria larvae are transferred to tanks with settlement cues, such as corrugated plates to facilitate pentacula attachment and juvenile growth.

Hatchery larval tanks

Nursery

The nursery phase takes three to four months for the growth of the juveniles before stocking in the grow out culture facilities. Several kinds of feeds are used in the nursery stage. This includes powdered seaweeds to formulated feeds. These feeds are prepared at the culture facility itself. Juveniles that reach about 5-7 cm size are used for stocking in the shallow lagoons at nearby islands. At present the hatchery has the capacity to produce six million seeds annually at a survival rate of 5% from the eggs.

Grow out

Grow out of sea cucumber is carried out in protected lagoons within the Atoll. Most of these are shallow lagoons with about 1-4m deep. Seeding is carried out in batches to reach an average stocking density of 5-6/ m^2. Each lagoon covers about 8-10 ha area. Very large size lagoons are also available for seeding. However, grow out area is restricted at the moment to permitted lagoons alone due to the alien origin of the species concerned. The local seaweed *Helimeda* sp., is harvested, dried, powdered and used to feed the sea cucumbers in the lagoons since the water is not productive and the coralline soil is with minimum organic detritus to sustain the sea cucumber in the grow out operation. After seeding the lagoon, it takes 18 to 24 months to reach the marketable size ranging from 300-500g individual wet weight. Harvesting is carried out by hand by observing the size of sea cucumbers in the lagoon since seeding is carried out in different batches. At the moment, about 500 individuals per day are harvested.

Processing for export

Harvested sea cucumbers are sliced for thorough evisceration before boiling for one to two hours until the animals shrink to half of their length. The boiled sea cucumbers are buried in damp sand for 12-18 hours. After this process they are cleaned to remove the external chalky coat and boiled again for about 20-30 minutes and sun dried. The drying racks are made up of wooden frames with velon screen mesh. It takes about 7-8 days for curing and processing the sea cucumber before they are packed for export. Processed sea cucumber is graded into large 20-30 pc/kg, medium 40-50 pc/kg and small 60 pc/kg. Usually the large size constitutes about 25-30%, medium 30-35% and small 40-45%. According to size the current market price ranges from USD 120-200 depending on the festive seasons in SE Asia.

Sea cucumber farming is a very lucrative business with a high internal rate of return (IRR) for the investor. Grow-out cost is minimized due to the use of lagoons and with almost no feed cost involved. With a total investment of about USD 2 million which includes developing a hatchery and farming (capital and recurring cost), the anticipated annual net income exceeds USD 1.5 million. Cost benefit analysis ratio exceeds over 8:1 showing the high profitability of sea cucumber farming in the Maldives.

Newly settled juveniles

Future prospects

The exotic species *H. scabra*, grows slowly in 18-24 months, instead of 12 months. Survival rate is low. Furthermore, there are concerns on its impact on the local species and the environment. Therefore, the future of sea cucumber farming in Maldives depends on developing techniques for breeding the local species *H. nobilis* or *H. fuscogilva*. It is anticipated that the survival of *H. nobilis* in the grow-out stage could be about 35% compared to the survival of less than 15% for *H. scabra* in the Maldives. However, in the international market *H. scabra* fetches a higher price (up to USD 200/kg) compared to that of *H. nobilis* (USD 110-120/kg).

Several entrepreneurs have shown interest in farming the sea cucumber in the Maldives because of the presence of natural protected waters. Considering the non-fertile coralline soil in the lagoons, it is recommended to integrate sea cucumber farming along with sea-cage fish farming since the sea cucumber can act as a bio-remediator to clean up the environment and pave the way for a sustainable aquaculture venture in Maldives.

References are available on request.

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Growing in India's shrimp feed market

The management and sales team was present at Aqua India in March 2012. From left, Rajan and Baskara Doss, both technical officers, Tamil Nadu; Iyyappan from the laboratory in Tamil Nadu; Mars Fang, managing director;, Kumaresan, director; Baskaran, regional manager; Andhra Pradesh and Suresh, technical officer Kerala, Karnataka and Goa.

Since April, 2010, Vietnam's leading shrimp feed producer is making a mark in India's shrimp feed market, setting up local company and warehouse facilities. It is now the largest supplier of imported feeds.

In the 1990s, Uni-President Enterprises looked at India as the potential market for its shrimp feeds, in particular for the monodon shrimp, the main shrimp species cultured at that time. It imported shrimp feed from Taiwan through groups of importers and distributors. This move into the Indian market was interrupted when feed demand dropped as the mainly monodon shrimp industry suffered from diseases. In the middle of 2009, the industry regained momentum with the introduction of vannamei shrimp culture. Uni President Vietnam then set up a local company, UPEC (India) Foods PVT Ltd and warehouse facilities in Chennai. UPEC is headed by managing director, Mars Fang and the Director, A. Kumaresan.

The shrimp feed market in India picked up in 2011 at 190,000 tonnes, comprising 75,000 tonnes of vannamei and 115,000 tonnes of monodon shrimp feeds. In 2012, feed demand is expected to increase to 300,000 tonnes with some 60% comprising feeds for the vannamei shrimp. Industry expects a production of 150,000 tonnes of vannamei shrimp and 80,000 tonnes of monodon shrimp feeds. There are five major players, led by Charoen Pokphand, Avanti Feeds, Godrej, Grobest and Waterbase, all producing shrimp feeds in mills located mainly on the east coast of India.

Good headway

"In 2010, we imported 5,000 tonnes and since then, this has increased to 10,000 tonnes in 2011. We expect a larger volume of imports up to 20,000 tonnes in 2012, comprising 8,000 tonnes of monodon and 12,000 tonnes of vannamei shrimp feeds. We have good distribution channels in all the states. Some of them have been with us since the early days when Uni President first came to India. In each region, we have a regional manager, assistant manager and senior technical manager overseeing trained technical staff. In general we have one person to service every 500 tonnes of feed sales. We train staff for 3 months locally and in Vietnam, before we put them out in the field," said Fang.

There are three brands of feeds for the monodon shrimp in the Indian market; 'UP', 'La One' and 'Hi Aqua' and two brands, 'Uni One' and 'Uni Vanna' for the vannamei shrimp. The differences are with the crude protein level and formulation. In addition, astaxanthin and an immunostimulant are added to LaOne and Hi Aqua feeds. Currently, retail prices range from INR 59/kg (USD 1.06/kg) for UP to INR 61/kg (USD1.11/kg) for La One.

"Our main challenge as an importer is that shrimp feed imports into India have import taxes of 5%. Recently, feed prices increased in line with the depreciation of the rupee from INR 45 in 2011 to INR 55-56 against the US dollar in March 2012. Sales are mainly to farms in Andhra Pradesh for vannamei shrimp feeds and to farms in West Bengal, Orissa and Tamil Nadu for monodon shrimp feeds," added Fang.

"In general our feeds are priced higher than the top brand of shrimp feeds in India. We would like to see some exclusivity for our

feeds. Usually, when farmers use our feeds, the shrimp reach the target size with shorter days of culture (DOC) with lower feed conversion ratio (FCR), higher survival rate and higher production than other feeds. So, when you calculate the cost of production it is always less than other feeds. On average, with our feed, the monodon shrimp is 50 g by 160 DOC when stocked at 10-15 PL/m^2. This will give an output of 6 tonnes/ha and there will be two crops a year. For the vannamei shrimp, the aim is 20 g in 90 days shrimp stocked at 60 PL/m^2," said Kumaresan.

Uni President has designed and produces an autofeeder called the 'feeding robot.' Currently it is conducting demonstrations in several farms in different states to demonstrate changes in feed efficiency when using this autofeeder. According to Kumaresan, the results show that shrimp fed using the autofeeder grew faster in comparison with those fed manually.

"Within the same DOC, production was higher in ponds with the 'feeding robot' by as much as 400 kg and shrimp were more than 2g in size and the FCR was less by 0.2. Our idea is to show that our vannamei feeds give the best result if fed using the 'feeding robot' by lowering FCR, avoiding feed wastage and therefore preventing water pollution. Labour cost is also reduced."

Adaptation and collaboration

UPEC has a technical collaboration with four hatcheries which supply post larvae to farmers with first preference to its feed clients. Uni-President Vietnam also helps with the training of technicians in vannamei shrimp hatchery operations at its two hatcheries in Vietnam. The selling price for vannamei PL10 currently ranges from 35 to 40 Indian paise each (USD 6.25 – 7.14 /1000 PL).

There are two demonstration farms which UPEC uses to try out new feeds as well as to demonstrate feed efficacy to farmers. With Aqualife System in Ongole, Andhra Pradesh, they test out feeds for monodon shrimp. There are two sites of 100 acres (40 ha). The stocking density used is 10 PL/m^2 and the feed conversion ratio (FCR) is 1.6 over 160 DOC. The harvest in 2010 was sold to BMI processing plant at INR 540/kg for 20 pcs/kg shrimp.

"In Bharathi Aqua, owned by Messrs Vijaya Kumar and Abilash and located in Chinnaganjam, Andhra Pradesh, we conducted trials with vannamei shrimp. The stocking density was 60 PL/m^2 and FCR was 1.3 after 130 DOC. At the all–out harvest in June 2011, the output was 59 tonnes from 4 ponds which total 3.8ha with 27 pcs/kg shrimp sold to a processing plant at INR 330/kg (USD 5.8/kg). With partial harvesting, shrimp sizes usually averaged 16g for the first harvest and 30g for the second and final harvest," said Kumaresan.

"Our sales personnel are also technically qualified; they provide essential advice for a successful culture. Customers have access to free analyses at the water quality laboratory in Pattukottai in Tamil Nadu. They are encouraged to have weekly analyses of water quality at the laboratory. The laboratory also provides customers with microbiological analyses, histological examination of diseased shrimp samples brought in either dead or alive for disease diagnostics."

Organic growth

In Vietnam, Uni President also produces feeds for the sea bass, grouper, cobia, catfish and tilapia. It would also like to bring these feeds into India. However, Fang said, "Commercial farming of these species is yet to take off although there are already efforts by the Ragiv Gandhi Centre for Aquaculture to initiate culture of fish in offshore cages. They also need to prove the economics of marine fish farming before the farmers will be interested and when they do, we will be able to provide our sea bass and grouper feeds. For the freshwater fish, we also import feeds for the catfish and tilapia.

"At the moment, we will focus on the shrimp feed business and grow this business. We want to have the confidence of our clients with our feed and that we are here in India, to stay."

Launch of two operations and strategic alliances to offer a new range of marine hydrolysates

AQUATIV, the leading producer of functional hydrolysates for aquafeed, just started new operations in Costa Rica and Ecuador. These will produce both liquid and spray dried powder respectively from farmed tilapia and shrimp. In parallel, the company signed a strategic alliance with a Norwegian company to produce krill functional hydrolysates.

George Marco, Aquativ director, said, "AQUATIV has already fine-tuned the hydrolysis process for tuna, sardine, squid, currently produced respectively in its plants in Thailand, Brazil, Mexico and Argentina. These new operations will bring to the market a wider range of functional hydrolysates from both aquaculture and marine origin, to best match with each market and species needs for optimum feed performance. Our raw material sourcing is secured through the partnership with the raw material supplier which guarantees a consistent supply and price stability to our customers. In addition, our factories always meet DIANA Group standards in terms of quality and traceability.

"What is interesting with this new product is that we are using aquaculture raw materials which means that the concern with fish-in fish-out or FIFO, will be addressed", added Marco

For the krill hydrolysate, Aquativ has formed a strategic alliance with Olympic Seafood AS, a Norwegian seafood company owned by Olympic Group, located on the West Coast of Norway. The group has one of the four licences for the harvesting of krill in the Antarctic and is Friend of the Sea (FOS) certified.

"Olympic Seafood is the sole krill processing player offering an on-board hydrolysis technology. Therefore, it was a natural move to approach Olympic and form this strategic alliance where we bring our scientific and marketing resources to produce and sell functional hydrolysate from krill for the feed market. Rather than just a protein concentrate, we have now developed together a functional product in a concentrate form with bioactive components"

Functional hydrolysate is a new generation of ingredients produced through the hydrolysis of fresh marine raw materials. They are currently used at 2-10% in diets, depending on the feed segment.

They have been shown to be relatively new nutritional tools in health management of fish and marine shrimp due to the bioactive compounds generated by the enzymatic hydrolysis. In addition to the bioactivity, these have properties such as better digestibility and palatability. With the higher levels of peptides and free amino acids, hydrolysates are categorised as functional feed ingredients. Ideally, these have added value for feeds by improving the fish and shrimp health, therefore lowering mortality. The enzymatic digestion of the raw material improves the nutrients digestibility and peptide availability increasing feed assimilation and attractiveness.

"The message that we have conveyed at World Aquaculture 2012 conference and trade show, is that besides developing a wide range of functional hydrolysates, we are today the sole company in this industry demonstrating our product bioactivity with regard to feed performance and farming productivity".

In a paper presented at the conference, R&D director Dr Vincent Fournier detailed trials conducted with hydrolysates from krill, tilapia and shrimp focusing on bioactivity benefits. These have been used in feeds where the effects include reduction in stress and mortality rates.

More information: www.aquativ-diana.com

George Marco (right) with Dr Vincent Fournier (middle) and Thomas Levallois, director of Sales at their booth during the recent World Aquaculture 2012 in Prague, Czech Republic

Intestinal health in aquaculture

Lallemand Animal Nutrition hosted its first aquaculture technical event for South East Asia and dedicated this to intestinal health in fish and shrimp.

In June, the company gathered more than 200 participants from South East Asia, Central Asia and Middle East in Bangkok, Thailand for this mainly technical event. Over two days, 13 speakers and experts gave more than 15 scientific and technical presentations in the areas of microbiology, immunity, nutrition and fish and shrimp health. Particular attention was paid to highlight the recent advances and knowledge on intestinal health in aquatic species and the importance of gut management when developing innovative and sustainable solutions to optimize the performance of aquaculture systems.

Invited academic speakers and Lallemand's product manager also delivered the state of the science relating to the mechanisms of action and benefits of the unique, scientific based and field supported probiotic strain *Pediococcus acidilactici* MA18/5M (BACTOCELL®). Key industrial companies, farmers, scientists and nutritionists attended this event and expressed it as "a unique event at the crossroads of science and industry".

"These two days met our expectations and willingness to make this seminar a purely scientific and technical event, providing the audience high level and up-to-date scientific information. We thank once again all the renowned speakers who have agreed to participate and to deliver their message in a clear and committed manner.

"We would like also to thank all the participants for the interest they expressed and all the positive feedback we received. We trust the audience has well received the key message we wanted to deliver: in the current challenging context of aquaculture, intestinal health has a critical role to play to optimise the performance of our aquaculture systems. Even though a more focus and dedicated approach is absolutely necessary at the academic and R&D level, specifically in the shrimp sector, sustainable and consistent solutions are already being developed and applied. This is what Lallemand is aiming at with its consistent and efficient microbial based solutions", said Dr Mathieu Castex, Product manager at Lallemand.

This seminar was the occasion for the company to reinforce its commitment in providing strong technical services and high technical solutions to its customers and to show its willingness to become a significant player in the Central Asia and South East Asia aquaculture markets.

Speakers covered a range of topics; Dr Sadasivam J. Kaushik, INRA, France looked at the main challenges in fish nutrition in the global context of feed ingredients demands whilst Dr Jaime Romero,

Mathieu Castex

Universidad de Chile, Santiago, Chile discussed the central role of gut microbiota in fish gut health and formulation strategies in terms of feed ingredients and gut health was covered by Professor Åshild Krogdahl, Norwegian School of Veterinary Science, Norway. Dr Daniel Merrifield, University of Plymouth, UK discussed gut health management for improved health and performance of farmed fish.

In fish and shrimp nutrition, Dr Dominique P. Bureau, University of Guelph, Canada gave a critical review of experimental design in feed additives research and current challenges in shrimp nutrition and Henrik Aarestrup, BIOMAR AS, Denmark gave an industrial perspective on functional feeds. In disease management, Professor Tim Flegel, Centex Shrimp, Mahidol University, Thailand discussed challenges in shrimp health management and Assistant Professor Sirirat Rengpipat, Chulalongkorn University, Thailand on gut microflora of crustaceans. In the immunity of fish and shrimp, Dr Jumroensri Thawonsuwan, Coastal Aquatic Animal Health Research Institute, Thailand looked at valuable biomarkers in shrimp and Professor Viswanath Kiron, University of Nordland, Norway discussed uptake and local immune response of shrimp to WSSV and mucosal immunity in fish. Some perspectives presented included brood stock and antioxidant status by Dr Liet Chim, IFREMER, New Caledonia and a farmer perspective on probiotics in shrimp farming was given by Dr Manoj Sharma, Mayank Aquaculture Pvt Ltd, India. More information: www.lallemandanimalnutrition.com

From left to right:Jaime Romero, Viswanath Kiron, Jumroensri Thawonsuwan, Åshild Krogdahl, Mathieu Castex, Manoj Sharma, Dominique P. Bureau, Sirirat Rengpipat, Liet Chim, Daniel Merrifield, Sadasivam J.Kaushik, Tim Flegel and Henrik Aarestrup

10th AFAF 2013 Yeosu and CAA4

10th Asian Fisheries and Aquaculture Forum
4th International Symposium on Cage Aquaculture in Asia

April 30 (Tue) – May 4 (Sat) 2013
The Ocean Resort Hotel, Yeosu, Korea

Sessions

10th AFAF

(1) Aquatic Animal Nutrition, Feed & Feeding
(2) Aquaculture, Producton System
(3) Fisheries Processing
(4) Fisheries & Asia Pacific Fish Watch
(5) Fisheries Policy, Economics, Marketing
(6) Fish for Human Nutrition & Health
(7) Environment Impact, Pollution & Ecotoxicology
(8) Biodiversity, Genetics, Biotechnology, Breeding & Conservation
(9) Fishing Gear & Technology
(10) Fisheries Assessment & Aquatic Resource Management
(11) Aquatic Animal Health & Management
(12) Shrimp & Other Crustacean Aquaculture
Special1 : Higher Education of Fisheries Science
Special2 : 4th Global Symposium on Gender in Aquaculture and Fisheries

CAA4

(1) Marine and Freshwater Cage Culture
(2) Environment, Pollution and Ecotoxicology
(3) Disease Prevention and Health Management
(4) Seed Production and Hatchery Management

The Korean Society of Fisheries and Aquatic Science
10AFAF /CAA4 Home Office
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New headquarters

Diamond V dedicated its new 1,700m^2 high-tech global headquarters in August at its 77-acre (31 ha) campus in Cedar Rapids, Iowa. The The company, industry leader in microbial-based fermentation research and technology innovation, manufactures all-natural products in Cedar Rapids that it markets to livestock producers worldwide.

Its new, green headquarters relies on geo-thermal heat for even climate control. Windows in each work area provides natural lighting and an inviting work environment. Expanded space for training and meetings sits next to the second-floor boardroom.

The new global headquarters sits adjacent to the state-of-the-art South Manufacturing Facility. Dedicated just three years ago, this facility is now undergoing an expansion to accommodate growing demand globally.

"Our mission at Diamond V is to leverage technology and science to deliver nutritional solutions for the world," said John Bloomhall, president and CEO, Diamond V.

"With the world population expected to reach nine billion within 40 years, an increase of two billion individuals, food production will need to double. Some 70% of that increase is expected to result from efficiencies gained through improving technology. Diamond V is a key player in answering the world demand for quality feed ingredients to optimize animal nutrition and health."

The company received recognition and congratulations from the American Feed Industry Association president Joel Neuman, the Governor of Iowa Terry Branstad, the Lieutenant Governor of Iowa Kim Reynolds, Mayor of Cedar Rapids Ron Corbett, U.S. Senators Chuck Grassley and Tom Harken, and U.S. Representative David Loebsack. Senator Grassley presented a certificate of recognition.

Participating in the ribbon cutting ceremony are red-jacketed ambassadors from the Cedar Rapids Chamber of Commerce, (from left) Cedar Rapids Mayor Ron Corbett, Iowa Lt. Governor Kim Reynolds, Iowa Governor Terry Branstad, and Diamond V President and CEO John Bloomhall.

"Diamond V Original XPC and XP fully fermented yeast culture introduced the industry to the full benefits realized by optimizing digestive function and performance 70 years ago," says Bloomhall. "The proprietary anaerobic fermentation technology known only to Diamond V leads the livestock industry thanks to research insights gained through first-hand experience and hundreds of objective, in-depth and unmatched scientific, peer-reviewed research trials." More information: www.diamondv.com.

First approval for new *Streptococcus* vaccine in Asia-Pacific

MSD Animal Health (known as Merck Animal Health in the US and Canada) has obtained approval from Indonesian authorities to begin marketing AQUAVAC® Strep Sa, an inactivated vaccine that aids in the protection against *Streptococcus agalactiae* infections in tilapia and other susceptible fish. Indonesia, the world's third largest producer of farmed tilapia, now has a new tool available for managing streptococcosis, a highly prevalent bacterial disease that can cause high levels of mortality and sharp decreases in fish performance.

AQUAVAC Strep Sa, the world's first oil-adjuvanted vaccine for tilapia, is administered intraperitonealy as a single-injection dose to fish weighing no less than 15g. Vaccinated fish develop protection within 3 weeks of injection and laboratory challenge studies have demonstrated that this protection lasts for at least 30 weeks.

"AQUAVAC Strep Sa represents a major breakthrough that will help Indonesia's tilapia producers reduce losses from this disease while helping to improve the long-term sustainability of Indonesia's fish farms," said Neil Wendover, technical director for warmwater aquatic species at MSD Animal Health. He noted that the vaccine, the first of its kind in the industry, was registered successfully in Brazil in late 2011 and subsequently in several Central American countries.

"The tilapia industry is quickly adopting vaccination as a disease management tool because it fits with its strategy to produce healthy, profitable, high-quality fish for local and export markets," Wendover added, noting that vaccinated fish often show significant performance improvements when compared to unvaccinated controls. MSD Animal Health is pursuing registrations for AQUAVAC Strep Sa in other major tilapia markets.

Significant losses

S. agalactiae is a bacterial disease that strikes tilapia at all stages of the production cycle, but disease outbreaks late in the grow-out period are the most economically significant because, at that point, tilapia farms have already made considerable investments in feed, energy and other production inputs.

According to Wendover, *streptococcus* thrives at temperatures from 28-32°C. Fish stressors such as rapid increase in temperatures, fluctuating water quality and high competition and stocking densities have made fish more susceptible to the disease. Streptococcosis typically causes bulging eyes and a swollen belly. Infected fish swim in an erratic circular motion and often experience high mortality. "If left uncontrolled, *S. agalactiae* Biotype II infection could cause mortality rates of up to 90 % in pre-market age fish," Wendover said. "The disease also results in significant declines in feed conversion and growth in tilapia. Surviving infected fish may also be damaged and produce lower quality and lower yielding fillets."

Most prevalent isolate

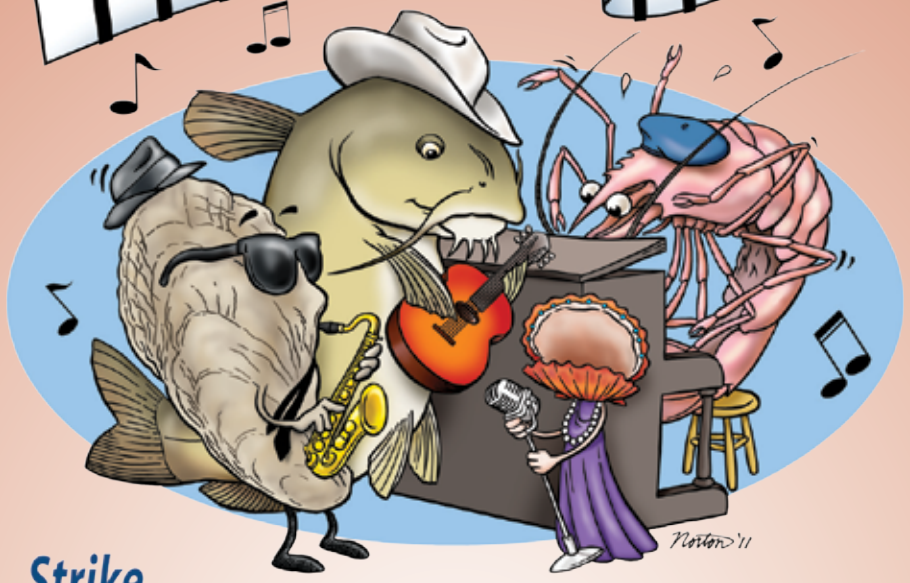
Epidemiological surveys conducted by MSD Animal Health in major tilapia-producing markets have collected over 1,000 bacterial isolates from tilapia reared at 74 sites in 14 countries.

"Streptococcal species were the dominant bacterial pathogens, accounting for more than half of all bacteria identified. *S. agalactiae* was more prevalent than *S. iniae*," reported Siow Foong Chang, site manager at MSD Animal Health's aquaculture research facility in Singapore. Of the *S. agalactiae* isolates collected globally, Biotype II accounted for 56% compared to 26% for Biotype I. "These data showed an unexpected geographical segregation of the biotypes, with *S. agalactiae* Biotype II being the only strain isolated from Indonesia and Latin America," he added.

MSD Animal health offers customers a strain identification service to ensure they are choosing the correct vaccine. AQUAVAC Strep Sa has been shown both by the strain survey and cross-protection studies to be the vaccine to use in Indonesia and Latin America.

For more information: www.aqua@merck.com or the local MSD Animal Health representative.

AQUACULTURE 2013



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Email: worldaqua@aol.com • www.was.org

IndoAqua and FITA 2012: Towards industrialisation

Anang Hermanta, PT Sinta Prima Feedmill

At the PT Grobest Booth. Mujianto, sales manager (left)

The IndoAqua and FITA 2012 conference had a 70 booth trade show with participation from regional and local suppliers of feeds, equipment (including those for health diagnostics) and probiotics. Displays at the booths of the provincial offices and aquaculture research and development (R&D) centres of the Ministry of Fisheries and Marine Affairs showed the newest developments in their regions and in R&D, including new species developed for aquaculture. Support also came from the major feed companies PT Matahari Sakti, PT Suri Tani Pemuka, PT Central Proteinaprima, PT Cargill Indonesia, PT Sinta Prima Feedmill and PT Grobest Indomakmur.

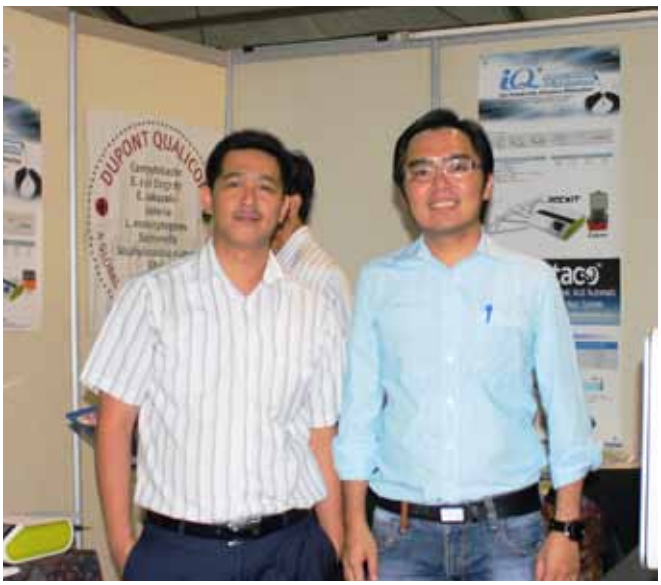
The Situbondo Brackishwater Aquaculture Centre (www.bbapsitubondo.com) supplies *Gracilaria* and *Eucheuma* seaweed, milkfish, humpback and tiger groupers and vannamei shrimp for production. Recent work on the hybridisation of the groupers have resulted in several hybrids: the Kustang hybrid from the female mouse grouper *Cromileptes altivelis* and male giant grouper *Epinephelus lanceolatus*; the Cantang, a hybrid of a female tiger grouper *E. fuscogutattus* and giant grouper male; and the Tiktang hybrid from the female *E. microdon* (locally called batik grouper) and male giant grouper.

The centre also produces brood stock and nauplii of the locally developed strain of vannamei shrimp (Vaname Nusantara I, VN-1). Other activities include surveillance of diseases in shrimp and fish farms in East Java, Bali and West Nusa Tenggara, assurance of antibiotic free production in East Java and on certification based on Indonesia's good aquaculture practices program (CBIB). Research covers studies on the culture of fish, seaweed, molluscs and live feeds, nutrition, fish diseases and genetics of vannamei shrimp, molluscs and marine fish. The aquaculture centre in Batam promoted the breeding, from larval rearing to juveniles of the pompano *Trachinotus blochii*. In the breeding of the abalone *Haliotis asinina*, the centre advises on the selection of brood stock from the wild as well as breeding and larviculture.

PT Cargill Indonesia is one of the leading producers of aqua and animal feeds in Indonesia. It was established in Indonesia in 1974 with a small feed plant in Bogor. It now has six plants for aquafeed production. It has both sinking and extruded floating feeds for: common carp, tilapia, Clarias and pangasius catfish, *Colossoma*, milkfish, giant gourami, sea bass and groupers. PT Grobest Indomakmur is part of a multinational chain present in China, Taiwan, Vietnam Philippines, India and Malaysia. In Indonesia, it produces feeds for shrimp, tilapia, gourami, Clarias catfish and milkfish. It also supplies feed micro-ingredients and additives such as enzymes.

PT Sinta Prima Feedmill is now the leading producer of fish feeds. The company now has three feed mills and has 50% of the market share for freshwater fish feeds in several locations in Indonesia. The products range from floating and sinking feeds for carp, *Clarias* catfish, tilapia, gourami, pangasius catfish, pompano and milkfish in brackish water culture. At the booth, Anang Hermanta, director of marketing, said,

"Our latest development is the GMP+B1 certification which is a European standard for feed safety assurance that was awarded early this year. This is the first certification in Indonesia and it allows us to expand production and open new markets outside Indonesia. We are also working in partnership with Skretting where we manufacture floating and sinking marine fish feeds at our factory, with sales and marketing handled by Skretting. PT Sinta celebrated its 30th anniversary in Jakarta in May."



Dennis Teoh (right) with Suhendra Se, president director, PT Kinglab Indonesia

Luqman Raya, product manager, PT Sambe (centre) and his team

Rudy Utomo, PT Tequisa Indonesia (left) and a shrimp buyer.

Feed additives and probiotics

As shrimp farmers have continuously faced threats from Infectious Myonecrosis Virus (IMNV) over the last few years, Shrimp Club Indonesia conducted regular sessions on how to overcome diseases and improve yields. Some members reported better yields and consistent production cycles when they use a combination of probiotics, minerals and vitamin C supplements in feeds or a complete mineral supplement. These are provided by companies such as Blue Aqua International, Thailand (www.blueaquaint.com) and PT Sanbe Farma (www.sambe-farma.com). The latter has a range of products for maintaining good water quality (such as $SanO_2$® to increase dissolved oxygen, probiotics, multivitamins and disinfectants) other products for the health of shrimp and fish such as vitamins and minerals, immunostimulants and vitamin C. It also distributes live bacterial preparations and soil water conditioners to be added into ponds from Poseidon Biotechnology, India. PT Caprifarmindo Labs (www.vet.caprifarmindo.com) produces a probiotic, Probiobac Aquatic which contains *Bacillus subtilis* and *Bacillus licheniformis*. Both bacteria work in synergy to remediate soil and water in ponds.

Health diagnostics

PT Kinglab Indonesia (www.kingladindonesia.com) is a leading distributor of laboratory and scientific equipment to the aquaculture community in Indonesia. The equipment on display was the Kyratec PCR-Live, the forefront in real time PCR (Polymerase Chain Reaction) analysis. In disease diagnostics, this is an advancement over the conventional and currently popularly used PCRs which requires almost 4-6 hours from sample preparation to obtaining a qualitative measurement. Along with air cycling, Real time PCR outperforms block PCR cyclers in optical performance in terms of uniformity and speed. Dennis Teoh, business development manager for Lab-Ind Resources Sdn Bhd, Malaysia (www.mylabind.com) explained that the uniqueness of real time machines and real time reagents is the quantitative readings for the major diseases. The real time reagents are from GeneReach Biotechnology, Taiwan.

"All of the government centres in Indonesia are now upgrading from the conventional PCR to real time PCR platforms and we are introducing this to them. The machines are marginally more expensive but the advantage is that measurements are quantitative, providing a higher level of accuracy. As the name implies, results are immediate. Here up to 40x0.2 mL tubes are held in a carousel spinning at high speed in a heated air chamber. Each tube is subjected to the same thermal environment and passes through the optical detection. The data points are collected immediately, collated and an average reading is presented.

"In addition to lab base real-time PCRs, we have launched the next generation portable 'point of care' real-time PCR system. The POCKIT platform is affordable and accessible to industry and regulatory agencies. This expands capability and builds capacity to monitor and manage shrimp and fish viruses along the production chain by stake holders. The system is designed for field applications. It is an affordable option for small laboratories, and operates with minimum infrastructural requirement. Important OIE shrimp and fish virus kits for POCKIT are also available," said Teoh.

"In Indonesia IMNV is still a serious threat, although the industry is managing well with strategies such as lining of ponds. The virus is contained in the soil and pond liners create a barrier. Both in Malaysia and Indonesia, the industry practice involves regular testing for White Spot Syndrome virus (WSSV), Taura Syndrome (TSV), IMNV, Yellow Head virus (YHV) and Infectious Hypodermal and Hematopoietic Necrosis virus (IHHNV). In the case of the freshwater and marine fish, tests are for koi herpes virus (KHV), Iridovirus, Viral Nervous Necrosis (VNN) and Spring Viraemia of carp (SVC)."

Vietfish 2012

Trade in aqua products

Apollo Aquaculture provides biofiltration, water treatment and recirculation water systems. The ARS system is a modern recirculating aqua system to compliment good aquaculture practice and better management in aquaculture. Its participation at Vietfish 2012 was to seek local cooperation in their integrated system and promote the full ARS for intensive shrimp production. The aim is to provide consistency in production and the production cycle can be controlled to supply the market year round. The hatchery, nursery and grow out systems can be integrated under one roof to ensure quality shrimp production for the market. It is critical to exercise control over the early stages of the value chain so that seafood and traceability issues can be effectively addressed.

Camau Frozen Seafood Processing Import Export Corporation (CAMIMEX) presented three products: organic shrimp, whiteleg shrimp and value-added shrimp products. Since 2002, the company is the only processor in Vietnam with Naturland certification for organic black tiger shrimp. The shrimp is farmed in Camau in the Mekong Delta where out of 1,200 farms, 800 are certified for organic shrimp production. The main requirements are stocking at 2-3 PL/m^2, without the use of antibotics,and with natural productivity as feed source. Camimex exported 250 tonnes of the shrimp in 2004-2006. In the medium and long term, Camimex plans to upgrade processing to value-added shrimp products in Camau province and develop industrial shrimp farming area in Kien Giang province. It is investing in modern technologies in its shrimp hatchery in Nam Can district and plans to get good brood stock of black tiger and whiteleg shrimp for the production of high quality post larvae.

The team from Scotland based Xyrex has developed Prawnfresh, a safe and easy-to-use non-residual product to control the onset of melanosis in wild-caught and farmed shrimp. This results in shrimp that have a much longer shelf life, which in turn increases their market value. According to John Davis, director, Prawnfresh works by inhibiting the enzyme present in the shrimp that results in melanotic blackening. It is much safer to use and more effective than sodium metabisulphite. Shrimp also appears more natural looking in terms of colouration (www.xyrex.com).

Some of the new exhibitors in aquaculture included two local feed producers, Domyfeed and Ewos. Domyfeed is the feed producing arm of Docifish Corporation which farms and markets pangasius, shrimp and tilapia in an area of 100 ha. It produces 8,000 tonnes of pangasius feeds annually. In Vietnamseafoodnews, the company said that its two

At the Ewos stand, from left; Thang Huynh Hoang, Tran Duy Hai, Nguyen Trong Hung and Tran Nguyen Diem.

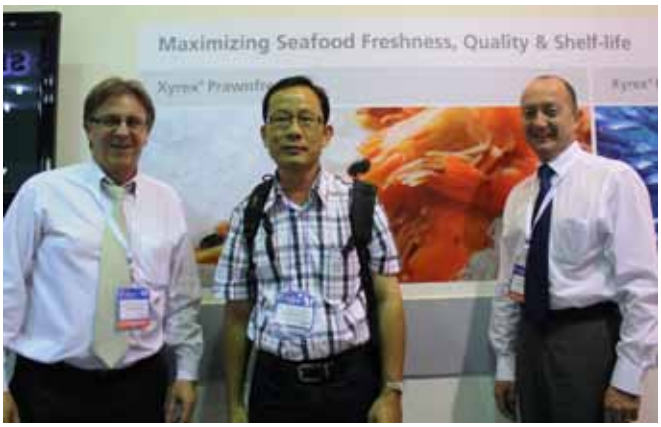
pangasius farms of 20 ha producing 6,000 tonnes of fish are expected to be certified by the Aquaculture Stewardship Council (ASC) in 2012. This is equivalent to 2,000 tonnes of finished products with the ASC label. It has GlobalGAP certificate for its five ponds with a total area of 5 ha which supplies 1,500 tonnes of fish. The company plans to have all its farming area certified to meet the requirements by its traditional partners (www.docifish.com.vn)

The team at the Ewos booth introduced a range of functional feeds which contain natural ingredients with anti-stress properties. The three products, Ruby, Diamond and Sapphire are feeds for the fingerling stage, 2-3 month old and marketable size fish respectively. The formulation for the Diamond feed brand will help with stressful pond conditions and prevent diseases whilst that of the Sapphire feed is formulated for white fillet.

At the show, Hai Yu Enterprises Co Ltd, Taiwan, had products for shrimp aquaculture such as hatchery and grow-out feeds as well as water treatment systems. The latter includes the neg-ion nozzle series. Also on display were feeds for the giant grouper, from the initial feeding stage to grow-out. These have been produced using a unique trans-micron technology (www.haiyu.com.tw).

Vietfish 2013 will be held from June 25-27 in Ho Chi Minh City.

Visitors from the show, from left, Dong Qiufen, Guangzhou Hinter Biotechnology Co.Ltd, Nguyen Thi Minh Huong, aquaculture manager and Mai Anh Tuan, Benh Meyer Vietnam



At the DKSH booth, Gerry McQuire (left) and John Davis (right) of Xyrex and visitor , Lee Chee King, Blue Archipelago, Malaysia.

Strategic research alliance in salmon business

Global animal health and nutrition company Alltech and the Norwegian Institute of Food, Fisheries and Aquaculture Research (Nofima) have entered a strategic research alliance to focus on optimising nutrition and management practices in the salmon industry. This three year public-private partnership creates value and facilitates growth in global aquaculture. The research from this partnership will be conducted in six of Nofima's research centres situated in Tromsø, Bergen, Stavanger, Ås, Sunndalsøra and Averøy.

The aim of the research alliance is to further contribute to the understanding of microalgae in modern feed formulations and their role in health, performance and flesh quality. Alltech Algae in Winchester, Kentucky, USA, is exploring the applications of algae in animal nutrition and aquaculture. Dr Karl Dawson, Alltech vice president and chief scientific officer said, "The salmon industry faces challenges that require a progressive partnership with research institutions that are focused on finding long-term answers. This agreement provides us with the structure to work openly and in collaboration on challenges, such as alternative feeding solutions for the salmon industry."

"This alliance helps achieve a common goal shared by Alltech and Nofima: advancing science while stimulating business creation in aquaculture," said, Dr Øyvind Fylling-Jensen, president and CEO of Nofima. "Nofima covers the whole aquaculture value chain, which is vital to a business that has the eyes of the environmental movement set on its operations. We need not only to know what works and what pays off, but also what is sustainable. Exploring the solutions provided by algae, together with a global business leader like Alltech, creates fantastic future prospects for research for the aquaculture industry and for the environment. " More information: www.altech.com

What can you expect from AQUA Culture Asia Pacific in 2013

In 2013, we can expect more developments as aquaculture plays its role as the leading source of seafood for the global market. Aquaculture in Asia will need to become an industry with an integrated supply chain. In order to be sustainable, we must learn how to control diseases in shrimp and marine fish while reducing costs of production through optimization of feed ingredients and feed management. AQUA Culture Asia Pacific can be a vital tool for your marketing needs. During this 9th year of our publication, we invite you to join us to look at opportunities and how we can help market your products and services.

Volume 9 2013						
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*	Aqua feed Production	Health Management	Hatchery & Breeding Technology	Food Safety & Traceability	Sustainable & Responsible Aquaculture	Culture Technology
Industry Review *Trends and outlook, demand & supply*	Marine Shrimp	Tilapia	Marine Fish	Catfish	Marine Fish	Freshwater Fish/ Prawn
Feeds & Processing Technology *Technical contributions influencing the final value of aqua feeds*	Feed Additives Processing technology	Novel Feed Ingredients Extrusion	Fish Meal /Oil Replacement Feed Management	Feed Enzymes Product Quality	Feed Probiotics Good Manufacturing Practices	Nutrition & Formulation
Production Technology *Technical information and ideas*	Culture Management & Biosecurity	Genetic Improvement	Recirculation Aquaculture Systems	Hatchery Technology	Certification and Regulations	Hygiene & Food Safety
Aqua business *Feature articles*	Experiences from industry, including role models, benchmarking and opinion articles in shrimp/fish culture					
Markets	Market trends, product development and promotions at local and regional trade shows					
Show Issue *Distribution at these events as well as local and regional meetings* **Show preview*	**Aquaculture 2013** February 21-25 Nashville, Tennessee, USA **VIV-Aquatic Asia 2013** March 13-15, Bangkok, Thailand*	**ESE 2013** April 23-25, Brussels, Belgium **10th Asian Fisheries & Aquaculture Forum** April 30 - May 4 Yeosu, Korea	**Vietfish 2013** June 26-28 Ho Chi Minh City, Vietnam	**The Aquaculture RoundTable Series (TARS 2013)**-Finfish Aquaculture August 21-22, Singapore	**18th China Seafood & Fisheries Exposition 2013** November China*	**Asian Pacific Aquaculture 2013** December 10-13 Ho Chi Minh City, Vietnam*
Deadlines Articles	**November 14 2012**	**February 1**	**April 2**	**June 1**	**August 1**	**October 1**
Deadlines Advert bookings	**December 3 2012**	**February 8**	**April 9**	**June 7**	**August 7**	**October 8**

International Fisheries Symposium-IFS2012

Can Tho City, Vietnam, 6-8 December 2012

Sharing knowledge for sustainable aquaculture and fisheries in South-East Asia

This is the second time, seven universities, Universitas Airlangga (Indonesia), Can Tho University (Vietnam), Kasetsart University (Thailand), Nong Lam University (Viet Nam), Universiti Malaysia Terengganu (Malaysia), Prince of Songkla University (Thailand), and Rajamangala University of Technology Srivijaya (Thailand), are jointly organising the International Fisheries Symposium. In line with its objectives, the theme of this annual symposium is 'Sharing knowledge for sustainable aquaculture and fisheries in South-East Asia'.

This will be an opportunity for scientists, technicians, entrepreneurs, farmers and managers from the South- East Asian countries and from the rest of the world to come together to share knowledge and information on aquaculture and fisheries science and technology. Students are encouraged to attend the symposium.

This annual symposium will be organised at Can Tho University, Viet Nam. The country is the third largest aquaculture producer. This will provide a chance for participants to explore the aquaculture and fisheries industry in this country. The symposium program will include a plenary session, country reports and scientific sessions on seed production and aquaculture systems, aquatic animal nutrition and physiology, disease management, genetics and biodiversity, aquatic resources and environment, seafood processing technology and food safety, capture fisheries and fisheries economics and management.

There will also be a special round table discussion amongst producers, processors, marketers and researchers and showcase of products of service providers. There will be a field trip to aquaculture farms and seafood processing factories in the Mekong Delta.

The organisers said, "We strongly believe that this symposium is not only an opportunity to share knowledge, but also a great chance to promote international collaboration in research, education, technical transfer and other business activities."

The symposium will include invited and submitted papers. Submitted papers should be in English and the deadline for submission of abstracts is **October 1, 2012**. The early bird registration ends on October 1 2012. More information: Nguyen Thi Ngoc Lien (secretary CAF), Can Tho University, Viet Nam Fax: 84710 830323 Email: ntnlien@ctu.edu.vn or caf@ctu.edu.vn

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

2012

September 15-17
The7th Strait (Fuzhou) Fishery Expo
Fuzhou, China
Web: http://www.fishexpo.cn
Email zhaozd11@163.com (Zhao Zhidan)

September 23-28
19th Annual Practical Short Course on Aquaculture Feed Extrusion, Nutrition and Feed Management
Texas, USA
Email: mnriaz@tamu.edu
Web: www.tamu.edu/extrusion

October 8-19
International Training Course on Biology and Pathology of the Penaeid Shrimp
CENTEX SHRIMP Faculty of Science, Mahidol University
Email: sbbu@biotec.or.thor
sirintip.dan@biotec.or.thor

October 17-19
Offshore Mariculture 2012
Izmir, Turkey
Web: www.offshoremariculture.com
Email: ktolley@mercatormedia.com

November 5-7
Biotech Malaysia 2012
Kuala Lumpur
Web: www.biomalaysia.com.my
Email: karendass@protempgroup.com

November 6-8
China Fisheries & Seafood Expo
Dalian, China
Email: seafoodchina@seafare.com
Web : www.chinaseafoodexpo.com

November 6 – 8
GLOBALG.A.P. Summit 2012
Madrid, Spain
Web: www.summit2012.org

December 6-8
International Fisheries Symposium- IFS 2012
Can Tho, Viet Nam
Email: ntnlien@ctu.edu.vn or caf@ctu.edu.vn (Nguyen Thi Ngoc Lien)
Web: www.ctu.edu.vn/colleges/aquaculture/ifs2012/

December 7-9
Shanghai International Fisheries & Seafood Expo 2012 (SIFSE 2012)
Web: www.sifse.com/en
Email: kim.yang@gehuaexpo.com (Kim Yang)

2013

February 21-25
World Aquaculture 2013
Nashville, Tennessee USA
Email: worldaqua@aol.com
Web : www.was.orgrg

March 13-15
Aquatic Asia 2013/ VIV Asia 2013
Bangkok, Thailand
Email: : guus.van.ham@vnuexhibitions.com (Guus van Ham)
Web:www.aquatic-asia.net/www.viv.net

April 30-May 4
10th Asian Fisheries & Aquaculture Forum
Yeosu, Korea
Email:10afaf@koference.org
Web: www.koference.org

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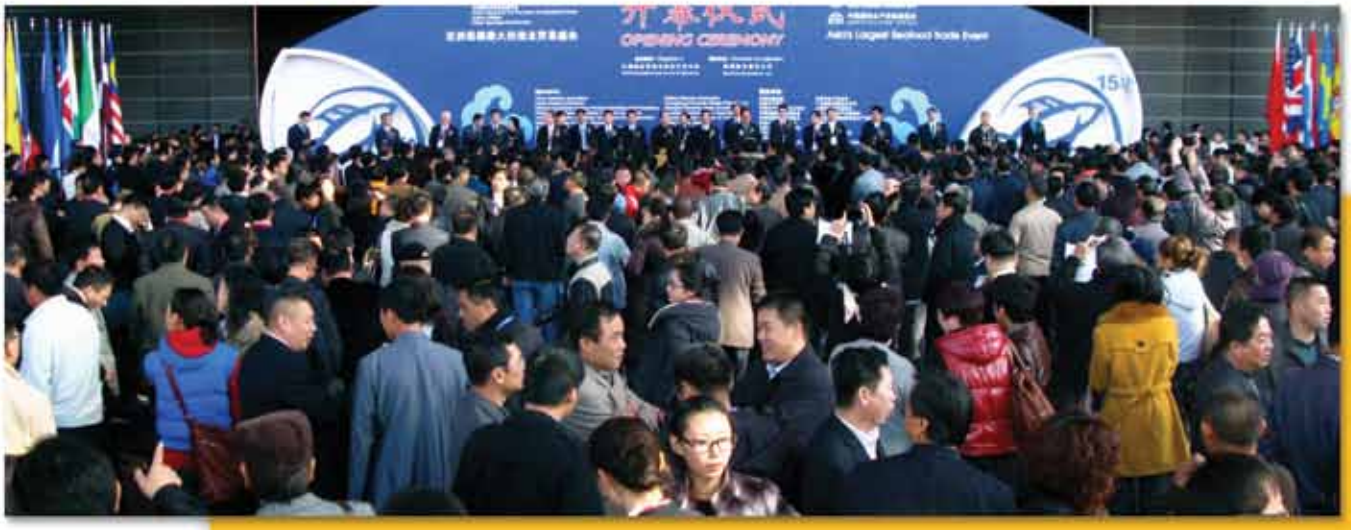

Dalian World Expo Center, Dalian, China
November 6-8, 2012

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